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Constraints faced by farmers in insuring their animals in livestock insurance scheme under national livestock mission

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Abstract

In India, majority of rural are livestock dependant households. In the livestock dependent households, failure of an investment, especially when funded by a loan, can leave a household in an extremely vulnerable position. Insurance is an important risk management tool to safeguard against this unforeseen Loss. Many people are benefited through livestock insurance but it is not reaching to all farmers. Hence, the present study was undertaken to analyse various constraints faced by livestock farmers in joining the livestock insurance scheme under National Livestock Mission. The sample of 30 insured farmers from each district of Tamil Nadu, were selected by simple random sampling procedure, so as to have a total sample of 930 milch cow beneficiaries from thirty one districts of Tamil Nadu. The results indicated that most of the farmers came to know about the NLM scheme through the local veterinarians followed by relatives, friends and media. The results of constraint analysis revealed that the first constraint by the non insurers was that they were not aware there is livestock insurance policy available and their importance. Hence strenuous efforts should be taken to create awareness about the importance of livestock insurance and its usefulness. They were not aware of the subsidy policy available for the NLM scheme. Even if the farmers are aware of the livestock insurance and NLM, they do not know whom to approach and where to apply for the scheme etc. For the farmers to purchase the insurance policy, they have to be convinced that livestock insurance is useful to them, procedures are simple, claims settlement is prompt and quick and the insurance agents has to be available in the villages frequently. Hence, necessary steps may be taken accordingly which would make the scheme more popular and bring more and more farmers under the ambit of the scheme.

Keywords: Constraint, Livestock, Insurance, Farmers', National Livestock Mission

Introduction

In India, majority of rural are livestock dependant households. In the livestock dependent households, failure of an investment, especially when funded by a loan, can leave a household in an extremely vulnerable position. Loss of livestock can have serious consequences for a rural household's livelihood, given the pivotal role played by livestock in the farming systems (World Bank and DFID 1999). Since the farmers cannot predict the probability of occurrence of any of these and cannot bear these risks and uncertainties alone, he is faced with the option of transferring or sharing the risks involved in the day-to-day management of his farm with one or more individuals or firms (Ajieh, 2010). Farmers deciding to use credit to purchase livestock face two risks at once, and both severely endanger

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their livelihood: (1) the risk of losing the livestock asset, and (2) failure of their investment. Because farmers are aware of these risks, they would like to reduce the uncertainty (Buchenrieder *et al.* 2003).

Insurance is an important risk management tool to safeguard against unforeseen loss (Wenner, 2005). Agriculture insurance may broadly be defined as an institutional response to risks faced by the farmers (Mohapatra and Dhaliwal, 2014). Insurance for livestock is more essential because agriculture is main occupation in India and our national income mainly depends on agriculture sector (Skees *et.al.* 2002; Ahmad *et.al.*2019). Many people are benefited through livestock insurance but it is not reaching to all farmers. Hence, the present study was undertaken to analyze various constraints faced by livestock farmers in joining the livestock insurance scheme under National Livestock Mission. Agricultural Insurance is a financial mechanism, which minimizes the uncertainty of loss in production (Mohapatra *et. al.* 2014). It is well known that insuring livestock is the most appropriate strategy to manage the different risks related to livestock farming but there is little attention to address the livestock insurance needs of dairy farmers (Khan, *et al.* 2013). Meuwissen *et al.* (2001) studied about identification of specific risks that are faced by livestock farmers like poor financial performance, human resources availability, pricing, production, regulatory demands and technological changes.

The Livestock Insurance Scheme, a Centrally Sponsored Scheme, was implemented on a pilot basis during 2005-06 and 2006-07 of the 10th Five Year Plan and 2007-08 of the 11th Five Year Plan in 100 selected districts. The scheme was implemented on a regular basis from 2008-09 to 2014-15 in 100 newly selected districts of the country. Implementation of National Livestock Mission (NLM) commenced from 2014-15. The Mission is designed to cover all the activities required to ensure quantitative and qualitative improvement in livestock production systems and capacity building of all stakeholders. The "Risk Management" as a component of sub-mission on Livestock Development of NLM is being implemented in all the districts of the Country which aims towards management of risk and uncertainties by providing protection mechanism to the farmers against any eventual loss of their animals. The benefit of subsidy is being provided to a maximum of 5 cattle units (one cattle unit - one cattle / one buffalo / 10 sheep / 10 goat / 10 pigs) per beneficiary for a policy of one year / three years. Under the scheme, BPL beneficiaries can avail a subsidy of 70 per cent and APL beneficiaries 50 per cent in normal areas and 80% and 60% in Nilgiris district. Milch cattle/buffaloes (in milk/dry, as well as pregnant animals which have calved once), sheep, goats owned by the farmers are covered. Identifying and alleviating the constraints would help in better implementation of the programme.

Sampling design

For this research work, the primary data were collected from seven agro climatic zones of Tamil Nadu i.e. Cauvery, Rainfall, Hill, North east, North west, Southern and Western. Altogether thirty one districts are distributed among seven agro climatic zones of Tamil Nadu. From each district of Tamil Nadu, 30 insured farmers were selected by simple random sampling procedure, so as to have a total sample of 930 milch cow beneficiaries. The data for the study were collected during the period 2019-2020. The primary data was collected on constraints faced by farmers in insuring the animals under National livestock mission.

Analytical tools used

Garret's Ranking Technique

Garret's ranking technique was adopted to assess the constraints faced by field veterinarians. A list of constraints was given to the consumers to rate it (1 to 5). The order of merit given by the respondents was converted into ranks (Garret and Woodworth, 1971).

$$\text{Percent position} = \frac{100\,(R_{ij} - 0.50)}{N_j}$$

Where,

Rij = Rank given for ith factor by jth individual

Nj = Number of factors ranked by jth individual.

The percent position of each rank thus obtained was converted into scores by referring to table given by Garret. For each reason, the scores of the individual respondents were added together and divided by the total number of respondents for whom scores were given and thus based on the mean scores, the ranks were given. These mean scores

for all the reasons were arranged in descending order and the most important reason for the preference of dairy products was ranked first and the least important reason was ranked as the last.

Results and Discussion

Ways through which the farmers know about Livestock Insurance

The farmers were asked to rank the ways through which they come to know about livestock insurance and the results were presented in table 1. Most of the farmers came to know about the NLM scheme through the local veterinarians with a Garett value of 86. Most of the farmers were not aware that there is a central government scheme named NLM under which animals are given subsidy to insure their animals until the veterinarians approach them. Next to veterinarians, relatives and friends played a vital role in disseminating information about NLM scheme. Most of the farmers who had insured their animals also spread the information about NLM to their relatives and friends so that so they can also be benefited. Next to friends and relatives, the information about NLM reached the farmers through radio and television and promotion by the government. Interestingly, the farmers had come to know about the insurance scheme by the insurance companies at the least which indicates that the insurance companies must make some concrete steps to promote their business.

Constraints evinced by non-insured farmers in insuring their animals

Data were also collected from the farmers who had not insured their animals and the results were presented in Table 2. From the table, it could be seen that the first constraint by the non insurers was that they were not aware there is livestock insurance policy available and their importance. Hence strenuous efforts should be taken to create awareness about the importance of livestock insurance and it's usefulness as the farmers were not aware of the scheme itself. They were not aware of the subsidy policy available for the NLM scheme. Even if the farmers are aware of the livestock insurance and NLM, they do not know whom to approach and where to apply for the scheme etc. As discussed earlier, providing insurance cover at the doorsteps/villages would make the scheme more popular and successful. The fourth major constraint felt by the farmers was that people around them do not buy it. The farmers felt that when neighbors' are not purchasing it, why should I buy it. Others are not insuring their animals as they felt it is tedious, claims are difficult and not much of use to the farmers why should I waste my money and energy in it. The farmers also expressed that even if they purchase the policy, they are less likely to gain from it, as it would be very difficult to settle the claims and this makes the livestock insurance more unpopular among the minds of the farmers. Sometimes even if the farmers are willing to insure the animals, they felt that the premium amount is high and they are financially incapable to purchase the policy. The farmers also did not believe the insurance provider as they do not see them frequently. For the farmers to purchase the insurance policy, they have to be convinced that livestock insurance is useful to them, procedures are simple, claims settlement is prompt and quick and the insurance agents has to be available in the villages frequently.

Table 1: Farmer's source of Knowledge on Livestock Insurance

S.No.	Factor	Total score	Garrett score	Rank
1	Radio & television	59883	75	III
2	Relatives & friends	69367	77	II
3	Promotion of government	52450	67	IV
4	Veterinarians	77750	86	I
5	Education	49200	65	V
6	Promotion of Insurance company	42800	60	VI

Conclusion

The present study on analyzing the various constraints faced by farmers in insuring the animals in livestock insurance scheme under National Livestock Mission indicated that most of the farmers came to know about the NLM scheme through the local veterinarians followed by relatives, friends and media. The results of constraint analysis revealed that the first constraint by the non insurers was that they were not aware there is livestock insurance policy available and their importance. Hence

Table 2 : Constraints for non-insured farmers in livestock insurance programme

S.No.	Factor	Sum of scores	Garrett Score	Rank
1	Unaware of the importance of livestock insurance	76083	80	I
2	Unaware about the Subsidy policy of thegovernments	75367	78	II
3	Tedious Insurance procedure and requirements	49933	32	XI
4	Not approached by insurance agents	12650	42	X
5	People around do not buy	70167	74	IV
6	Do not know where to buy	70250	76	III
7	Less likely to gain	69633	72	V
8	Lack of premium paying capacity/High premium	62883	69	VI
9	Not being financially able to purchase insurance	58800	65	VII
10	Livestock insurance has no benefit for smalllivestock farmers	53383	56	VIII
11	Lack of trust on insurance provider	53100	48	IX

strenuous efforts should be taken to create awareness about the importance of livestock insurance and its usefulness. They were not aware of the subsidy policy available for the NLM scheme. Even if the farmers are aware of the livestock insurance and NLM, they do not know whom to approach and where to apply for the scheme etc. For the farmers to purchase the insurance policy, they have to be convinced that livestock insurance is useful to them, procedures are simple, claims settlement is prompt and quick and the insurance agents has to be available in the villages frequently. Hence, necessary steps may be taken accordingly which would make the scheme more popular and bring more and more farmers under the ambit of the scheme.

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Exploring the Indigenous Technical Knowledge (ITK) practices of farmers in Tamil Nadu state: A case study analysis

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Abstract

Indigenous knowledge is the wealth of information, experience, and technique that the local population collected by direct interactions between them and the environment. A study was conducted to record the traditional knowledge utilized by the people in Tamil Nadu. Three methods were employed to obtain the data: practitioner participatory approach (PPA), focused group discussion method, and questionnaire method. This study documents the recently developed and conventionally used effective ITK in Tamil Nadu.

Key words: Practitioner Participatory technique (PPA), Focussed Group Discussion, Birds, Rats, squirrels and Indigenous Technical knowledge

Introduction

A key part of the state economy of Tamil Nadu is agriculture. It brought in 13% of the state revenue. Approximately 56% of the state's population is employed in agriculture. Its net cultivated area is 5.12 million hectares, of which about 56% is irrigated using different irrigation methods. Its seven agroclimatic zones are appropriate for a range of crops. Tamil Nadu leads the nation in groundnut productivity and ranks third in sugarcane productivity. Despite having 5.12 million hectares of net cropped area, agriculture produces just 13% of state income due to monsoon failure, high cultivation costs, increased pest and rodent damage, diseases, and so on. This is due to the loss of traditional wisdom. Indigenous technical knowledge that belongs to a specific community or local group and that the people in that community have developed and continue to develop over time. According to Haverkort and De Zeeuw (1992), Tamil Nadu is a cultural treasure. Tamil Nadu's ancient texts, sage teachings, and many sayings and proverbs include a rich storehouse of ideas, concepts, and practices aimed at addressing the process of establishing harmonious relationships between man, animal, and nature**.** The majority of the literature is based on indigenous technical knowledge (ITK) experiences that have accumulated over centuries and are being developed and standardized via countless experiments and practices. Much of this information is passed down from generation to generation, typically by word of mouth. As a result of significant changes in agriculture, particularly since the end of the Green Revolution, food and fibre production has soared due to new technologies management, the use of chemical inputs, specialization, and government policies that favoured maximizing production level. Although these modifications have had many positive effects and

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alleviated many farming issues, there have also been considerable risks. The astounding increase in the usage of synthetic farm chemicals over the last few decades has not resulted in a reduction in pollution. The enormous increase in the use of synthetic farm chemicals over the last few decades has not resulted in a similar increase in crop yields; instead, it causes significant environmental damage to the country's water and soil resources, threatening national food security, declining farming communities, topsoil depletion, groundwater contamination, precarious working conditions for farm laborers, low productivity, effectiveness, diversity, and a lack of integrative management. ITK is critical to the country's food security, farmer poverty alleviation, and the survival of the current and future populations. The primary goal of this article is to uncover Indigenous Knowledge employed in Tamil Nadu for sustainable agriculture.

Research Methodology

The study region for the identification and documenting of ITK practices is all throughout Tamil Nadu, particularly in the districts of Coimbatore, Salem, Namakkal, Tanjore, and Erode, where our southern heritage still predominates. Participatory approach to documenting and preserving agricultural traditional knowledge

A list of farmers discussion groups (FDG) and important informants from various communities have been compiled. Following that, data were gathered utilizing the focused group discussion method and the practitioner participatory approach (PPA).

Focused Group Discussion

Focused group discussion entails in-depth discussion and interviews of a small group of people on a certain topic or subject. It provides a clear picture of the practices.

Questionnaire technique

Open-ended surveys are used to collect information from individuals.

Practitioner Participatory technique (PPA) PPA is a methodical semi-structured technique that combines a combination of methods to examine and comprehend a community's situation or a specific problem with local people's participation. The information received from different informants and at different times was verified. Only precise and credible information that has been cross-checked has been included.

Results and Discussion

1) Control of rats and squirrels in a coconut plantation

Rats and squirrels destroy nuts and coconut saplings. They develop into nut feed on the kernel and nut water in bearing palms. All phases of development of tender nuts are susceptible to attack; however, the most vulnerable age group is 3-8 months. Unopened inflorescences have also been observed to be attacked when they make frequent visits to palms. Rats and squirrels account for 10 to 23% of yield loss. Rats and squirrels are kept at away by creating snake patterns on coconut trees and scaring them away. The diagram appears to move from upward to below like a real snake. Rats and squirrels are terrified of snakes because they are natural predators. It is the simplest and most cost-effective way.

2) Rat Control in Paddy Fields:

Rattus tanezumi and Rattus argentiventes are present in rice fields all year, wherever food and cover are available; peak reproduction occurs during the rainy season, causing significant yield loss. The ITK was used to manage rats by increasing owl activity by placing stands near rat burrows using either a boot leaf of coconut or a T-shaped wooden owl stand. It allows the owl to sit, observe, and catch the prey.

3. Control of rats in millets and pulses fields:

Use a live trap to capture the live rat. The trapped rats are rendered unconscious or directly coloured with white paint, and different colours are used to keep spots. When they were released into the field, they would seem very different and terrifying. Other rats are afraid and leave the field after seeing this rat. This is an environmentally friendly and cost-effective way of rat control. This is ideal for pulse and millet crops.

4. Rat management for all types of crops on farms

Set up a live trap to catch the rat. The caught rats are either rendered unconscious or have their anus (which regulates excretion removal) sewn shut with thick thread, rendering them incapable of eliminating their waste. The rat becomes insane as a result and attacks the other rats. It lowers the rat population and is the most dependable, cost-effective way to manage rats in all kinds of fields.

Control strategies for birds:

Determining the true extent of bird damage is a challenging task. Widespread damage renders agricultural crops unsold in addition to reducing productivity. Among the common agricultural pest birds are pigeons, green, sparrows, starling black blinds, and crows. Pest birds consume grain crops such as corn, rice, wheat, and rye, whereas the majority of pigeons and doves damage legumes and other plants. Damage by birds results in a sharp reduction in yield. The following discusses the Indigenous Technical Knowledge that is employed to frighten the birds.

1) Plastic Bag:

The plastic coverings are tied with sticks that range in height from 2 to 4 cm. When placed in a field, plastic bags will flatten with the breeze. They keep fresh birds from entering the field in addition to driving away existing birds that feed there.

2) Making Sound with Tins:

Using old tins, beat drums by hand to create sound. The times when there is the most bird damage in the fields are from 4.30 pm to 6 pm and from 6 am to 8 am. The birds are alarmed by the sudden loud noises. It's one of the more successful bird control strategies.

3) Using crackers to make noise:

Burning crackers to frighten birds during high bird activity periods, such as morning and evening. The birds are startled by the sudden loud noise. It's a dependable and reasonably priced means of scaring birds.

4) Using Magnetic Tape to Scare Birds:

Trash Audio cassette tapes are bound and placed in the field. The sound the tapes produce as they flutter in the air and the tape also reflects sunlight and terrifies birds. Only in situations when they reflect sunlight the tapes work.

Scaring Birds with CDs:

Waste CDs are collected and fastened with a rope to 4 to 5 m high sticks. Allowing the CD to freely rotate terrifies the birds because it reflects the sunshine. This works only after sunrise and before nightfall. It is a simple and cost-effective solution.

Scaring Birds with a Doll:

The doll is known as solakaatubommai in the local language. It's composed of paddy stray and mud pot that's been covered in waste clothes. This doll looks like a human person. Birds are inherently afraid of humans. This technique is widely employed in paddy, sorghum, maize, and sunflower flower fields. This is one of the simplest ways to scare the birds.

Peacock control in Drip irrigation method:

Peacock is a new problem in drip irrigation. Because water is available on the open surface in surface irrigation, but not in drip irrigation systems, the peacock begins to damage the laterals for drinking water. This damage results in a financial loss due to the cost of replacing the laterals. The ITK utilized to fix this problem is to put mud pots under the lateral in the ends of ridges and furrows, as well as at field corners. The water was collected in the pot and used by the peacock.

Fruit ripening technique:

Two mud pots are taken. One is huge in size, while the other is small enough to fit in the nozzle of a large pot. Senna auriculata leaves are taken and placed inside the large pot and the banana fruits are placed on top of them. On top of the little pot, a small hole is formed. A dried cow dung cake is placed inside the small pot, and small sticks are placed beneath the small pot to keep the cake from

collapsing. The small pot is tightly attached to the large pot. Now, a little coal is inserted through the whole into the small pot to generate a smokey blaze. When the flame grows larger, the nozzles of the small and large pots are connected together using fresh cow dung. And the little hole on top of the small pot is also filled with fresh cow dung. After 24 hours, the fruits (banana, mango) are removed.

A mango picking tool:

The plucking mechanism is a cup-shaped basket or pouch, usually made from natural materials such as jute or fibres. This basket is designed to gently cradle the mango as it is being harvested. Attached to the cup-shaped basket is a long stick or pole. This stick can vary in length, but it is long enough to reach mangoes high up in the tree. It provides the necessary reach to pluck the mangoes that are out of arm's reach.

The process of using this tool involves placing the cup-shaped basket around the mango, gently twisting or pulling the mango to detach it from the tree, and then allowing it to fall into the basket. The long stick allows the user to access mangoes at varying heights without the need for climbing the tree, making the harvest more efficient and safer.

Control over grazing:

The primary purpose of the muzzle is to prevent the cow from grazing while it's engaged in ploughing. Grazing while working can be counterproductive, as it can distract the animal from its task and reduce its efficiency in ploughing the field.

Preservation of Energy: By restricting the cow's ability to eat while working, the muzzle helps conserve the animal's energy for the ploughing task. This is especially important in areas where manual

labour is a common method for tilling the soil.

Soil Traction: Ploughing with a wooden harrow requires a certain level of traction and control. Allowing the cow to graze freely could result in uneven ploughing and a lack of precision in the field work.

This practice has historical significance and is deeply rooted in traditional agriculture. Before the widespread use of mechanized farming equipment, animals like cows were essential for ploughing fields, and muzzles helped optimize their performance.

The crop guardian

Farmers load their slingshot with small stones. They aim at the monkeys when they approach the crops. The idea is not to hit the monkeys but to create a loud noise and a close encounter that frightens them away. The sound of the slingshot being released and the motion of the projectile are usually enough to frighten the monkeys and deter them from coming back to the crops.

Conclusion

Indigenous Technical Knowledge is unique to a particular community or local group, and it has evolved throughout time and continues to evolve. One approach for attaining sustainable or profitable agriculture is through ITK. As decades pass, these ITK dwindle. These techniques are detailed in this article to conserve ITK and aid in further adoption. The above-mentioned ITK are the most effective, easily adaptable, and economically reliable practices. Farmers will profit from wider use of these strategies.

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Influence of area specific micronutrient supplementation on blood biochemical and plasma mineral profile in Malvi Cows

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Abstract

To discern the effect of area specific micronutrient supplementation (ASMS), on some Blood Biochemical parameters, the intensive study was conducted on 18 Malvi cows in Indore region of Madhya Pradesh. Eighteen healthy multiparous advanced pregnant Malvi cows, identical in body weights, parity, and feeding conditions, were selected for the study. Feed offered and residues left of an individual animal were measured and recorded for 7 consecutive days to accesses the dry matter intake and micronutrients imbalance. A micronutrient supplement was designed to take care of the deficient micronutrients and supplemented in half of the Malvi cows (n = 9) considered to be a treatment, while remaining half (n = 9) is considered to be control, fed as per the existing practice of farmer without additional supplementation. This supplementation study was continued for 4 months during advanced pregnancy and thereafter for 2 months post-calving. Blood samples were collected at 0 and 120 days of the experiments in both the groups and blood parameters were studied. The results of this study revealed that No significant (p>0.05) difference noticed between the groups on blood parameters like Hb (g/dl), Glucose, total protein, Albumin, Globulin, A:G ratio and plasma mineral profile (P, Ca, Zn, Fe, Cu, Se) in peri-parturient Malvi cows. However, numerically higher values were obtained in the area specific micronutrient supplemented animals in comparison to un-supplemented animals. It may be concluded that the supplementation of area specific micronutrient did not affect the blood biochemical and plasma minerals status in Malvi cows .

Keywords: Area Specific Micronutrient, Malvi Cows, Plasma Mineral, Blood Biochemical

Introduction

Minerals have a great impact on animal performance and its imbalance adversely affects growth, fertility, immunity and ultimately affecting production. Health and production of livestock is thus greatly influenced by optimal level of essential and trace mineral in the body (Yengkhom et *al*, 2018).

In Malwa region of Madhya Pradesh, traditional feeding practices are followed by dairy farmers. The majority of farmers offer straw (wheat straw/masoor straw/gram straw) along with cottonseed cake (undecorticated) as sole feed without any mineral and vitamin supplementation to lactating animals, in advanced stage of pregnancy animals feeding solely based on straw without any concentrate. Few farmers offer a little amount of concentrate/green fodder depending upon the availability. Under such feeding conditions, the availability of antioxidants,

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minerals (Zn, Cu, and Se) and vitamins (â-carotene and vitamin E) are not met the requirements of animals for various purposes.

At present, commercial mineral mixtures are prepared and marketed without considering the actual deficiency or excess of minerals in animals of the region. An excess of minerals is taxing to the animal system because of the stress on organs and the extra energy animals spend in their excretion. conversely, supplementation of minerals in deficient diets causes improved performance of animals (Selvaraju *et al.,* 2009). Mineral deficiency in animals is an areaspecific problem. Therefore, recommendation of a mineral mixture of fixed composition across the country is cynical considering its vastness and varied agro-ecological conditions. Keeping the above aspect in mind, the proposed research work was planned to assess the effects of area specific micronutrient supplementation on blood biochemical profile and mineral status in Malvi Cows

Methodology

Geographic coordinates

The experiment was conducted in dairy farms of Malwa region of Madhya Pradesh (India). The city is located between 22°48' N and 75°48' E. Indore district is perched at an average height of 550 meters above the sea level. Indore is a landlocked city, hence the temperatures during the summer time is very high. The temperature during the summer season varies between 35° Celsius to 40° Celsius while in winter the mercury level reaches as low as 6° Celsius. Study was conducted in two phases on indigenous Malvi cows in Indore district of Madhya Pradesh.

First phase

Eighteen multiparous healthy advanced pregnant indigenous Malvi cattle (around last 2 months of gestation), identical in body weights (322±8.57kg) and feeding regime, were selected randomly from a dairy farm in the village Rau and Indore (Madhya Pradesh, India). Bodyweight was determined based on body length and girth by using Schaeffer's formula (Sastry *et al.,* 1982). The average daily feed intake of each animal was calculated by measuring feed offered (morning and evening) and residue left for 7 consecutive days with the help of spring balance for obtaining the baseline data. Feed samples collected at the start of the experiment were analyzed for dry matter (DM) and trace minerals (Ca, P, Mn, Zn, Cu, Co and Se) with the calculation of availability of carotene and vitamin E using reported values. Trace minerals (Manganese, zinc, copper, iron, cobalt and selenium) were estimated in different feedstuffs by atomic absorption spectrophotometer (AAS, Make Motras Scientific, model: AAS Plus). It is observed that the ration of advanced pregnant cows was deficient in copper and zinc by 2.83 % and 63.5 %, respectively. Vitamin A and vitamin E were deficient by 74.6 % and 81.2 %, respectively.

Formulation of area specific micronutrient supplement

Micronutrient availability to the experimental animals was calculated and compared with the requirements given by NRC (2001) to find out the deficiency or excess of micronutrients. For the preparation of micronutrient supplement, copper sulfate (Cu), zinc sulphate (Zn), vitamins A and E (commercial preparations) were used. The measured quantity of trace minerals and vitamin supplements was filled in the plastic packet and supplemented to treatment group daily for the period of 120 days.

Second phase

The selected animals were divided into two groups, control and treatment, including nine indigenous Malvi cows in each group based on their body weights. The control group was fed as per the practice of farmer, while treatment group was supplemented an area specific micronutrient supplement (ASMS) containing Cu, Zn, vitamin E, and vitamin A based on nutrient requirements given by NRC (2001). This supplementation study was conducted for 2 months during advanced pregnancy and continued for 2 months post-calving.

Blood collection and estimation of blood biochemical and mineral profile

Blood samples (10 ml) were collected from all the experimental cows early in the morning before feeding at 0 and 120 d, aseptically by jugular vein puncture in a sterilized plastic tubes containing anticoagulant heparin solution (0.2 mg/ml of blood). Out of 10 ml, 4 ml was added with EDTA for

haematological parameters and the remaining was taken in a well cleaned sterilized centrifuge tubes to collect plasma. Plasma was separated and preserved at –20°C for further analysis. Haemoglobin (Hb) was estimated in whole blood immediately after blood collection by cyanomet haemoglobin method. Glucose concentration was determined calorimetrically. The protein and albumin content were measured as per Vatzidis (1977) and Doumas *et al* (1971), respectively. Serum inorganic P was measured by calorimetric method given by Fiske and Subba Rao (1929). Trace minerals (zinc, iron, copper and selenium) were estimated in plasma by AAS after wet digestion (AAS, Make Motras Scientific, model: AAS Plus). 4 to 5 ml plasma was taken and 8- 10 ml triacid (nitric acid, sulphuric acid and per chloric acid in 5:2:1 ratio) solution was added and digestion carried out under slow heat (70-80ºC) on hot plate. Final volume was made to 10 ml in a volumetric flask with triple glass distilled water.

Statistical Analysis

Data were subjected to statistical analysis using t test (Snedecor and Cochran, 1994). An independent't' test was used to compare differences between groups and period means for different parameters by using SPSS 20.0 software.

Results and Discussion

Effect of area-specific micronutrients supplementation on blood biochemical profile

This study showed that area specific micronutrients supplementation had no significant differences ($p>0.05$) in biochemical blood profiles (glucose, total protein, albumin and globulin between both the groups (Table 1). Likewise, mineral mixture supplementation did not significantly differ with the haemoglobin concentration and plasma mineral parameters in cows. Serum glucose concentrations were 47.17±0.52 and 47.89±1.35 in T_0 and T_1 group, respectively and there were no differences between area specific micronutrients supplementation between the groups. These values are within the normal (50-80 mg/dl) physiological range for cattle (Kaneko, 1989). An increased or decreased level of serum glucose level is an indicator of optimum nutrition to the animals. However, in present study, analogous glucose level indicates normal physiological condition of all the experimental animals throughout the experimental period. Similar findings with (Warken *et al,* 2018) that mineral supplementation on cows diet among 3, 15, 30, 45 and 60 days of treatment did not affect blood glucose. Blood glucose concentration is one of the biochemical indicators of body energy supply (Xuan *et al,* 2018). Furthermore, area specific micronutrients supplementation in this study did not affect the serum total protein, serum albumin and globulin concentration. Serum protein is part of the collection of amino acids in the body and indicates the nutritional status of livestock (Xuan *et al,* 2018). Molefe and Mwanza (2020) showed no difference in total blood protein by giving deficit micronutrients. Khalil *et al* (2019b) mentioned that mineral supplementation on Simmental cows using the different forms (meal and block) did not affect blood protein. Albumin content in the blood could reflect protein status. Its concentration could be affected by liver function, age, intake of protein and energy and protein dropping during specific illnesses. In addition, the level of several constituents in the blood (total protein, globulin, albumin and N-urea) is a representation of nitrogen adequacy or insufficiency in animal diets (Hammond 1983). Mineral mixture supplementation did not generally affect blood hematology in Brahman Crossbred cattle, including haemoglobin, erythrocyte, and leukocyte, MCV, MCH and RDW. The same trend was reported by Khalil *et al* (2019b) that mineral supplementation in Simmental cattle did not affect haemoglobin, haematocrit, MCHC, red blood cells but increased white blood cells. Similarly, Panwar *et al (2022)* observed haematological parameters like haemoglobin, total leukocyte count, differential leukocyte count and total erythrocyte count were found similar and no significant differences were found in between the mineral supplemented groups of Beetal kids.

Effect of area-specific micronutrients supplementation on plasma mineral profile

In the present study, plasma minerals concentration was comparable and varies s within the normal physiological range in both the groups. Similar to present findings, Kalasariya *et al*. (2016) reported that mean plasma inorganic phosphorus

Table 1: Effect of area specific micronutrient supplementation on haemato- biochemical and plasma minerals in Malvi cows

Attributes	Control (T_0)	Treatment(T_1)	Level of significance
At 0 day of experiments			
Hb (gm/dl)	13.35±0.269	13.55±0.381	0.509
Glucose(mg/dl)	46.87±1.06	47.49±1.19	0.922
TP(gm/dl)	6.51±0.07	6.66±0.08	0.786
Albumin(gm/dl)	2.97±0.03	3.05±0.04	0.084
Globulin(gm/dl)	3.75±0.08	3.71±0.07	0.776
P (mg/dl)	5.01±0.10	5.14±0.11	0.452
Ca (g/dl)	8.43±0.05	8.53±0.15	0.125
Zn (ppm)	0.86±0.016	0.92±0.017	0.728
Fe (ppm)	1.97±0.02	1.98±0.03	0.258
Cu (ppm)	0.46±0.019	0.51±0.013	0.469
Se (ppm)	0.064±0.01	0.98 ±0.03	0.192
Co (ppm)	0.17±0.013	0.20±0.02	0.226
Mn (ppm)	0.79±0.08	0.74±0.06	0.94
At 120 days of experiments			
Hb (gm/dl)	13.9±0.014	14.24±0.145	0.322
Glucose(mg/dl)	47.17±0.52	47.89±1.35	0.067
TP (gm/dl)	6.65±0.05	6.69±0.02	0.231
Albumin(gm/dl)	3.02±0.04	3.10±0.06	0.160
Globulin(gm/dl)	3.76±0.08	3.8±0.062	0.460
P (mg/dl)	5.11±0.10	5.61±0.08	0.971
Ca (g/dl)	8.62±0.09	8.69±0.07	0.783
Zn (ppm)	0.88±0.020	0.97±0.022	0.957
Fe (ppm)	2.0±0.022	2.06±0.03	0.338
Cu (ppm)	0.47±0.013	0.54±0.014	0.597
Se (ppm)	0.068±0.01	0.102 ±0.03	0.163
Co (ppm)	0.18±0.01	0.23±0.014	0.513
Mn (ppm)	0.81±0.05	0.76±0.03	0.964

levels fluctuated non-significantly during pre- and postpartum periods and plasma manganese levels were consistently higher in treatment as compared to control group. Ashry *et al.* (2012) also reported that feeding organic Mn, Cu and Zn didn't have any significant effect on serum total protein, albumin and globulin content of animals. Contrary, Sahoo et al. (2017) reported increasing serum mineral in cattle supplemented with the mineral combination in feed. Dutta et al. (2022) and reported that serum Ca, inorganic P, Zn, Cu and Mn levels were increased significantly following mineral supplementation in crossbred cattle. Similarly, Serum mineral level of Ca, P, Cu and Mn increased due to area specific mineral supplementation. In consistent with the present findings, the serum level of Ca, Cu and Mn was reported to be increased from below critical level by two months of dietary supplementation of mineral mixture in dairy cows in hilly areas of Uttarakhand (Meher *et al.*,2017) observed a significant ($P<0.05$) increase in the serum mineral concentration (calcium, phosphorous, zinc, manganese and copper) of the treatment groups than the control.

Conclusion

Based on the results obtained, it may be concluded that the ration of advanced pregnant Malvi cows was deficient (%) in copper, zinc, vitamin A and vitamin E by 2.83, 63.5, 74.6 and 81.2, respectively. The supplementation of area specific micronutrients did not affect the blood biochemical and mineral profiles of Malvi cows.

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Estimation of combining ability for seed yield and its related characters in linseed (*Linum usitatissimum* L.) under late sown condition

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Abstract

The present investigation was carried out to identify superior parent and hybrid combination based on general and specific combining ability for yield and its related characters in linseed. Twenty-eight hybrids were generated by crossing eight diverse parents through diallel mating design (Griffings 1956) Model I Method II excluding reciprocals during Rabi 2018-19. These 36 genotypes were evaluated in randomized block design with three replications during Rabi 2019-20, at Agriculture Research Station, Kota (Rajasthan). The observations were recorded on five equally competitive randomly selected plants for twelve morphologically distinct characters to estimate general combining ability of parents, specific combining ability of crosses for yield and yield contributing traits for subsequent utilization in linseed breeding programme. The highly significant variation was observed through analysis of variance for all the characters indicating presence of a wide spectrum of genetic diversity among genotypes that allows further estimation of inheritance pattern of experimental material. Analysis of variance for combining ability revealed that mean squares due to GCA and SCA were significant for most of the characters indicated the importance of both additive and non-additive gene effects in their inheritance. The low GCA/SCA variance ratios (<1) for all the traits indicated the predominance of non additive gene effects in their inheritance except days to maturity. Parent Meera has been found good general combiner with highest magnitude of GCA effects for seed yield per plant along with number of primary branches per plant, number of capsules per plant and harvest index. In addition to above, KBA 3, KBA 4 and Padmani also showed good GCA effects for oil content, earliness and other component characters. Among the 28 crosses eleven crosses for seed yield and other ten crosses for oil content exhibited positive significant SCA effect along most of its component characters, may be used for developing high yielding varieties by selection transgressive segregants.

Keywords: combining ability, gene action, yield and linseed

Introduction

Linseed (*Linum usitatissimum* L.) is an important oilseed crop grown in rabi season in India. It is cultivated for fibre (Flax) and seed oil (Linseed) or both (dual purpose linseed). Its seed is good for health contains fat (41%), Protein (20%), dietary fibre (28%) and contain oil ranging from 35-45%. Linseed is an important herbal source of omega 3 and omega 6 fatty acid which acts as brain tonic and also which known to cure the diseases like cardiovascular disease diabetes, cancer, major depression (Ekka *et al.* 2017).

Linseed seed oil is used as an industrial ingredient of drying oil due to its high linolenic acid content. However, some linseed genotypes have been developed which contain very low levels of linolenic acid in their oil, making them suitable for use as edible-oil. It is most important crop cultivated by poor farmers, over 172.71 thousand hectares area with production of 99.07 thousand tones. The average seed yield of linseed in India is 574 Kg/ha which is comparably very low in comparison with world average seed yield that is 975 Kg/ ha. (Anonymous 2019-20). The low seed yield is chiefly due to limited resources available to poor farmers along with non availability of high-yielding cultivars. So, the development of high-yielding varieties is needed to compete with other linseed growing countries. Such varieties can easily be developed through suitable hybridization and selection programmes to isolate superior segregants. However, the success of any hybridization programme chiefly depends on combining ability of parents used in crossing programme.

Combining ability analysis is a powerful tool to select elite parents and best specific crosses for yield parameters and also to understand the nature of gene action involved in inheritance of various traits. Thereby it provides the opportunity for the use of these combiners in hybridization programme. Keeping in view above fact this work executed to evaluate eight genotypes and their 28 hybrids.

Materials and Methods

The crosses were generated during Rabi 2018-19 with eight diverse and agronomically adapted parents *VIZ*., PA2, KBA 3, KBA 4, RL 13161, Padmani, RL 15582, RL 15583 and Meera. The 28 crosses were made as per Griffing, 1956, (Model 1 and Method II) in Rabi 2018-19 at Agriculture Research Station, Kota (Rajasthan). These 36 genotypes were sown using a randomized complete block design with three replications, on 05, November, 2019. The seed of each genotype was sown in a single row of 4 m length with a spacing of 30 cm ×10 cm between and within the row respectively. Recommended package of practices was followed to raise a healthy crop. Five competitive plants were randomly selected from each row were used to record the biometric observations for plant height, number of primary branches per plant, number of secondary branches per plant, number of capsules per plant, number of seeds per capsule, biological yield per plant and seed yield per plant. But days to 50% flowering, days to maturity, test weight, oil content, was recorded on whole row basis. The biochemical analysis was done for oil content by Soxhlet procedure as described in AOCS. Combining ability analysis was performed according to procedure suggested by Griffings (1956) Method II Model I (fixed effect).

Results and Discussion

The analysis of variance and estimates of variance components for combining ability using diallel mating design (without reciprocals) are presented in Table 1. exhibited highly significant mean squares due general and specific combining ability both for all the characters except number of secondary branches per plant for general combing ability and days to maturity for specific combining ability. This indicated that both additive and non-additive genetic components were involved in determining the inheritance of character. Similar results were reported by Mahawar *et al.* (2021). There are several instances the importance of both additive and non-additive types of gene action for yield components was reported by Sindhe *et al*. (2022), Shivankar *et al*. (2021), Ahmad *et al.* (2021), Sedhom *et al.* (2016) and Mistry et al. (2016). Non-significant GCA and significant SCA for secondary branches per plant indicates the role of non-additive gene action and Non-significant SCA and significant GCA for days to maturity indicates the role of additive gene action in inheritance of these characters. Earlier reported variance due to gca and sca were significant for the characters under investigation indicating role of both additive and non-additive gene action for the inheritance of characters studied. The relative importance of GCA and sca in determining progeny performance obtained by calculating general predictability ratio on the basis of mean squares. The closer the ratio to unity, the greater the predictability based on a general combining ability alone. Sedhom *et al.* (2016), Mahawar *et al.* (2021) and Sindhe *et al*. (2022) have used relative magnitude of GCA vs SCA as index of relative role of additive and non-additive variation

Table 1: Analysis of variance and estimates of components of variance for combining ability for seed yield and its component characters in linseed

Source of variation	D.F.	Mean sum square											
		DF	DM	PH	PBPP	SBPP	CPP	SPC	TW	OC	BYPP	SY	HI
GCA	7	37.02**	25.71**	89.00**	0.44**	**6.66**	481.35**	0.53**	0.52**	5.17**	8.27**	0.48**	23.78**
SCA	28	5.37**	**2.95**	7.61**	0.37**	18.35**	415.82**	0.43**	0.42**	1.94**	21.27**	1.41**	23.76**
Error	70	0.99	2.60	1.63	0.02	4.59	25.41	0.02	0.04	0.29	0.02	0.10	4.24
Components of variance													
$ó^2_g$		4.20	2.70	10.19	0.05	0.24	53.19	0.06	0.06	0.57	0.73	0.04	2.28
$ó^2_s$		20.44	1.66	27.86	1.61	64.23	1821.53	1.95	1.77	7.70	89.81	6.10	91.09
$ó^2_g / ó^2_s$		0.21	**1.63**	0.37	0.03	0.00	0.03	0.03	0.03	0.00	0.01	0.01	0.03

*, ** significant at 5% and 1% level, respectively.

DF= Days to 50% flowering, DM= Days to maturity, PH= Plant height (cm), PBPP= Number of primary branches per plant, SBPP= Number of secondary branches per plant, CPP= Number of capsules per plant, SPC= Number of seeds per capsule, TW = Test weight (g), OC= oil content (%), BYPP= Biological yield per plant (g), SY= Seed yield per plant (g), HI= harvest index (%).

Table 2: Estimates of general combining ability (GCA) effect for seed yield and its component characters in linseed

Parents	DF	DM	PH	PBPP	SBPP	CPP	SPC	TW	OC	BYPP	SY	HI
PA 2	3.01**	**1.45****	4.41**	0.19**	-1.25	-6.64**	0.02	0.35**	-1.03**	-0.39	0.10	0.88
KBA 3	-0.76*	-0.82	0.79*	-0.05	0.36	-7.44**	0.30**	-0.12	0.49**	0.32	0.10	0.08
KBA 4	0.94**	**0.08**	-2.15**	0.05	0.05	8.79**	-0.26**	0.17**	0.84**	1.47**	0.05	-1.38*
RL13161	0.54	**-0.28**	-0.15	-0.11*	-0.38	-7.62**	-0.12**	-0.15*	0.04	-0.88*	-0.10	0.46
Padmani	**-3.36****	**-2.58****	-3.31**	-0.44**	0.96	-1.35	-0.20**	-0.14*	0.89**	0.80	-0.41**	-2.32**
RL15582	-1.32**	**-1.02***	-3.16**	-0.01	-0.98	0.20	-0.15**	-0.23**	-0.29	0.25	-0.18	-1.16
RL15583	-0.42	**0.48**	-0.49	0.21**	0.33	6.22**	0.37**	0.28**	-0.11	-0.21	0.17	0.94
Meera	1.38**	**2.68****	4.06**	0.15**	0.92	**7.85****	0.06	-0.15*	-0.85**	-1.36**	**0.27****	**2.48****
SE (gi)	0.29	0.48	0.38	0.04	0.63	1.49	0.04	0.06	0.16	0.42	0.09	0.61
SE (gi-gj)	0.45	0.72	0.57	0.07	0.96	2.25	0.06	0.09	0.24	0.64	0.14	0.92

*, ** significant at 5% and 1% level, respectively.

Table 3: Estimates of specific combining ability (SCA) effect for seed yield and its component characters in linseed

Crosses	DF	DM	PH	PBPP	SBPP	CPP	SPC	TW	OC	BYPP	SY	HI
KBA 3 x PA2	-0.69	-0.99	2.21	0.48**	-5.49**	8.61	0.60**	0.40*	1.25*	-2.09	1.09**	7.29**
KBA 4 x PA2	-2.72**	0.11	1.56	0.04	-4.95*	-0.95	0.87**	0.10	-1.90**	2.57*	0.22	-1.64
RL13161x PA2	-3.65**	-1.52	0.66	0.18	-0.19	-4.31	-0.02	0.14	1.53**	1.82	0.44	-0.72
Padmani x PA2	-1.42	1.11	1.44	-0.40**	0.81	1.58	-0.44**	0.57**	0.68	1.98	-0.28	-2.99
RL15582 x PA2	0.88	-0.12	-2.02	-0.24	2.41	11.98*	-0.28*	0.74**	-2.01**	0.60	1.04**	2.69
RL15583 x PA2	0.98	0.05	-4.31**	0.29*	-1.57	-4.71	-0.50**	-0.59**	1.38**	4.01**	-1.52**	-8.99**
Meera x PA2	2.18*	-0.82	-4.35**	0.03	1.82	-2.67	0.13	0.33	0.21	-4.10**	0.45	6.68**
KBA 4 x KBA 3	1.05	-2.29	1.53	0.22	7.11**	-2.69	0.83**	0.31	**1.58****	1.50	-0.08	-1.62
RL13161 x KBA 3	1.78	-0.92	-0.39	0.74**	7.20**	4.05	-0.37**	0.46*	0.28	**9.93****	0.51	-6.05**
Padmani x KBA 3	0.68	0.05	-1.11	-0.43**	7.20**	**21.52****	-0.88**	0.75**	0.18	0.07	1.13**	3.64
RL15582 x KBA 3	0.31	-0.19	-1.45	-0.45**	-2.53	-6.94	0.21	-0.48*	0.77	1.40	-1.10**	-5.04**
RL15583 x KBA 3	-2.25*	2.98*	-5.10**	0.52**	-0.31	**29.96****	-0.83**	-0.07	-0.74	0.85	1.57**	4.07*
Meera x KBA 3	-3.05**	2.11	-0.72	0.03	-3.06	14.80**	-0.25*	0.26	0.40	-2.43	1.58**	8.25**
RL13161 x KBA 4	-0.59	4.85**	-3.43**	-0.45**	1.18	10.68*	-1.10**	0.80**	0.96	2.44	0.66*	-0.09
Padmani x KBA 4	0.65	-1.19	-1.70	0.71**	4.18*	-4.91	-0.43**	-0.13	1.04*	3.53**	-0.07	-2.22
RL15582 x KBA 4	-3.39**	0.91	-1.14	0.17	-1.21	**17.21****	0.40**	0.04	1.19*	3.73**	1.47**	1.85
RL15583 x KBA 4	-0.29	2.41	1.18	0.45**	5.99**	**22.52****	-0.79**	0.60**	-0.32	1.44	1.19**	2.22
Meera x KBA 4	0.58	-2.45	0.00	0.15	-0.01	-6.44	0.17	-0.05	-1.68**	1.81	-0.71*	-4.42*
Padmani x RL13161	-1.62	-0.49	-2.64*	0.19	0.33	11.83*	-0.11	-0.14	-0.39	-1.35	0.21	1.85
RL15582 x RL13161	0.68	-0.39	-2.10	-0.40**	-2.89	**21.95****	-0.24	-0.14	0.22	-3.61**	0.37	5.10**
RL15583 x RL13161	0.45	-1.89	2.57*	0.52**	2.56	18.35**	0.27*	0.38*	-3.29**	-1.33	1.14**	5.22**
Meera x RL13161	-0.69	0.58	-1.43	0.21	0.61	15.30**	0.40**	0.63**	0.45	-3.01*	**0.62***	6.54**
RL15582 x Padmani	0.25	0.58	2.21	1.56**	-2.03	38.45**	-1.29**	0.19	1.00*	4.35**	1.11**	0.63
RL15583 x Padmani	-3.65**	-1.59	2.36*	-0.33*	4.19*	-20.00**	0.87**	0.43*	-0.24	4.40**	-0.32	-4.69*
Meera x Padmani	0.55	-2.12	-2.75*	0.08	-1.02	-3.97	0.11	0.26	-0.04	2.95*	0.30	-2.12
RL15583 x RL15582	4.98**	-0.15	4.15**	0.92**	1.33	-10.86*	0.88**	1.04**	1.58**	3.19*	-0.06	-3.18
Meera x RL15582	-4.15**	-0.02	1.90	-0.70**	2.49	-4.18	-0.00	0.28	1.31**	5.43**	0.53	-3.29
Meera x RL15583	-1.05	0.15	-2.06	0.02	-2.80	11.47*	-0.72**	-0.28	1.70**	2.01	0.02	-2.58
SE (sij)	0.90	1.46	1.16	0.14	1.94	4.57	0.12	0.19	0.49	1.29	0.29	1.87
SE(Sij-ik)	1.34	2.16	1.72	0.20	2.87	6.76	0.18	0.27	0.72	1.91	0.43	2.76

*, ** significant at 5% and 1% level, respectively.

which guides in the choice of breeding plan.

The estimates of variance components ($ó^2$ gca and $ó^2$ sca) were estimated in order to determine the relative magnitude of additive and non-additive gene effects for different characters presented in Table 1 indicated that the ratio of variance of gca and sca ($ó^2$ gca / $ó^2$ sca) was much less than unity for all the characters except days to maturity, which indicated the predominant role of non-additive gene action in the inheritance. (Wadikar et al., 2019).

The ratio of gca and sca variance ($ó^2$gca $ó^2$ sca) was more than unity was observed for days to maturity indicated predominant role of additive gene action in the inheritance of this trait. This suggests that non-additive genetic components are more important than additive genetic components in determining the inheritance of these characters. High gca than sca and preponderance of additive gene action in above characters are in agreement with the previous reports (Wadikar et al., 2019). While characters exhibiting non-additive genetic components in determining inheritance are in accordance with the study of Pali et al. (2014).

The estimates of general combining ability (GCA) effects of parent are presented in Table 2. Based on the general combining ability the parents were categorized in to three classes *VIZ.*, goo average and poor combiners. None of parents was found good general combiner for all the characters. Based on the estimates of GCA effects, the parent Meera was found good general combiner for seed yield along with other contributing characters viz., primary branches per plant and harvest index. KBA 3, KBA4, Padmani were found good general combiner for oil content, beside these, KBA 3 for number of seed per capsule and early maturity; KBA 4 for test weight, short height, and biological yield per plant; Padmani for short height and early maturity were also found good general combiners. These parents showed both additive and non additive type of gene action involving different combinations of high and low general combiners. Similar result was also reported by Singh *et al*. (2008), Shekhar *et al*. (2019), Rastogi *et al.,* (2019) and Mahawar *et al*. (2021).

Analysis of specific combining ability is important parameter for judging the specific cross combination for exploiting it through heterosis breeding program. It is assisted with interaction effects, which may be due to dominance and epistasis components of genetic variation that are non-fixable in nature. The significant and positive SCA effects in desirable direction are presented in Table-3. The Meera x KBA3 (1.58) was best performing cross combination which exhibited positive and significant SCA effects for seed yield per plant followed by RL15583 x KBA3 (1.57), RL 15582 x KBA4 (1.47), RL15583 x KBA4 (1.19), RL15583 x RL13161 (1.14), Padmani x KBA3 (1.13), RL15582 x Padmani (1.11), KBA3 x PA2 (1.09), RL15582 x PA2 (1.04) and Meera x Padmani (0.62). Out of twenty-eight cross eight promising cross having significant SCA effect for days to 50% flowering, six cross for plant height, six cross for primary branches per plant, five cross for number of secondary branches/plant, thirteen cross for number of capsule per plant, eight cross for number of seeds per capsule, eleven cross for test weight, ten cross for seed yield per plant, nine cross for biological yield per plant, seven cross for harvest index and nine cross for oil content. Since sca effect of the cross is an estimated for making selection of best cross combinations, high specific combining ability denotes undoubtedly a high heterotic response, this however, does not mean high performance of the hybrid as well as. The above finding were more or less closely in agreement with the result of earlier reports of Mishra and Rai, (1996), Patel *et al*. (2000), Mukul *et al.* (2000), Chimurka *et al*. (2001), and Singh *et al*. (2008.), Shekhar *et al*, (2019) and Mahawar *et al*. (2021)

Conclusion

Based on the above discussion combining ability analysis revealed that Meera for yield, KBA3, KBA4 and Padmani for oil content and its important contributors were emerged as good general combiners. The cross Meera x KBA3 for seed yield and KBA 4 X KBA 3 and RL15583 x RL 15582 for oil content were identified as most promising cross for yield and components based on SCA effects.

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Assessment of Azolla (*Azolla pinnata*) feeding on milk production of Gir Cow and production performance of Kadaknath chicks

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Abstract

*On Farm Trial were conducted to explore the possibility of using Azolla (*Azolla pinnata*) as feed ingredient in Gir Gir Cow and Kadaknath chicks ration. In 1st study, 40 cross- bred Gir Cows in their 3nd to 5th lactation were randomly divided into 2 groups and feed with or without Azolla supplemented commercial feed (1:1 : Azolla: concentrate). Azolla-fed group showed a significant increase of 11.85% in milk production. In 2nd study, 310 14-day-old Kadaknath chicks were divided into 2 groups and fed with commercial feed supplemented with or without dried Azolla meal [5% feed]. Result showed significant improvement in cumulative feed intake, body weight and FCR in Kadaknath chicks group fed with Azolla. The use of Azolla in cattle and Kadaknath chicks ration improved their production performance; so has a great potential as sustainable efficient feed supplement for Gir Cow and Kadaknath chicks (upto 5%).*

Keywords: Azolla, Kadaknath chickss, Gir Cow, milk production, FCR, weight gain

Introduction

Azolla (*Azolla pinnata*), a floating water fern, is an unconventional feed ingredient as it is not accepted by most of the livestock owners. They consider it a noxious weed (Lumpkin *et al.*, 1980). Adaption of Azolla in India has been slow and sporadic due to poor yield, pest handling and storage difficulties and labour difficulties (Tamizhkumaran and Rao, 2012). It grows naturally in stagnant water of drains, canals, ponds, rivers and marshy lands (Basak *et al.*, 2002). It is most economic and efficient feed substitute for livestock and increases milk and meat production in animal (Pannaerker, 1988). Azolla is rich in protein, essential amino acids, carotinoids, vitamins, growth promoters and minerals (Basak *et al.*, 2002) and contains 20.0-25.5% protein, 3.1% fat, 34.9% carbohydrates, 8.5-11.7% cellulose and essential amino acids (Sithara and Kamalaveni, 2008). Carbohydrates and oil contents are very low in Azolla. High protein and low lignin content contribute for its high digestibility by livestock. Azolla can be mixed with commercial feeds in 1:1 ratio (2 kg each) for feeding livestock (Pillai *et al.*, 2005). Azolla may serve as a valuable protein supplement for many species (Hasan and Chakrabarti, 2009). Besides dairy animals, it may be supplemented in feed for sheep, goat, pig, rabbits and poultry. It increases body weight of Kadaknath chicks chicken (Basak *et al.*, 2002) and egg production of layers (Namara, 2000). In present scenario, the dairy farmers are dependent on commercial feeds, which are not economical for livestock production. Studies on Azolla supplementation in cattle and Kadaknath chickss arescanty; therefore, the present experiments were aimed to assess the effects of Azolla feeding on production performance of cattle and Kadaknath chickss so that the possibility of Azolla as a low cost feed ingredient is explored.

Materials and Methods

A study was conducted in 2019 on crossbred dairy Gir Cows (n = 40) in 3nd to 5th lactation for 12 weeks at Sheopur Block of District Sheopur (M.P.). The culture of Azolla (*Azolla pinnata*) was obtained

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from Central Semen Station, Anjora, Durg and cultivated on large scale on UV stabilized silpauline sheets as described by Pillai *et al*. (2005). It was harvested at weekly interval and used for cattle feeding. After harvest, Azolla was dried and ground to make meal for feeding the Kadaknath chicks chickens. Sun-dried ground Azolla was y analyzed for crude protein, ether extract, crude fiber, nitrogen free extract, ash, calcium and phosphorus on dry matter basis as per the standard methods AOAC, 1990).

A study was conducted on crossbred dairy Gir Cows (n = 40) in 3rd to 5th lactation for 12 weeks at Sheopur Block of District Sheopur, Madhya Pradesh, India in January to March 2019. Animals were divided randomly into two equal groups; one group was fed with fresh Azolla in commercial feed @ 1:1 (1.5 kg Azolla + 1.5 kg concentrate). The other group was feed on commercial feed without Azolla supplementation. All the animals were monitored daily for milk yield during the period of supplementation. The animals were maintained under proper managemental conditions. Animals are kept at village level. Individual Gir Cows were isolated by simple wooden med, Baada . Separate feed mangers were provided. Animals were duly vaccinated and dewormed. Animals were milked twice daily (5 am and 6 pm) by full hand milking. Milk yield was measured by measuring cylinder and measuring flask. Record was maintained on register for individual Gir Cows. In another study, 310 day-old Kadaknath chicks, owned by a self-help group, were divided equally in two. One group (n = 155) was supplemented with dried Azolla meal @ 5.0% commercial feed. The other group fed on feed without Azolla supplementation was taken as control. The Kadaknath chicks birds were reared on deep litter system following the proper manage mental conditions for feeding, watering, vaccination and medication. Individual bird data was recorded. All the birds were monitored weekly for body weight gain against feed consumption upto 42 days. The data was statistically analyzed using independent t-test (Snedecor and Cochran, 1994).

Results and Discussion

The chemical analysis of sun-dried and ground Azolla showed that it contained 24.1% crude protein, 3.75% ether extract, 15.1% crude fiber, 40.25% nitrogen free extract, 16.8% ash, 2.18% calcium and 0.47% phosphorus on dry matter basis. The crude protein content of Azolla estimated in the present study closely agrees with Cherryl *et al*. (2014) and Balaji *et al*. (2009).

The result of On Farm Trial milk yield of dairy Gir Cows feed with or without Azolla, recorded at 15 days interval was shown in Table 1. There was significant ($p<0.01$) increase in milk production of dairy Gir Cows supplemented with fresh Azolla. The milk productivity started to increase after one week of Azolla supplementation, which further increased for next four weeks and thereafter it became constant at increased level. Milk yield increased by 11.85% after Azolla supplementation in dairy Gir Cows. All the treated animals were apparently healthy during the course of supplementation. There was no adverse effect on palatability of Azolla mixed feed for animals. The results of present study agreed with Pillai *et al*. (2005) who reported that fresh Azolla increased 10-15% milk production in dairy cattle and saved 20-25% of commercial regular feeds.

Table 1: Fortnightly milk production performance of Gir Cow feed with or without Azolla for 12 weeks

Milk production/ Gir Cow	Azolla treated group (L)	Control group (L)	Level of significance
0-15 day	118.98 ± 0.70^{a}	115.00 ± 0.06^{b}	**
15-30 day	127.18 ± 0.05^{a}	116.17 ± 0.02^{b}	**
31-45 days	131.21 ± 0.08^{a}	117.87 ± 0.13^{b}	**
46-60 days	131.22 ± 0.08^{a}	117.83 ± 0.09^{b}	**
61-75 day	130.60 ± 0.09^{a}	117.81 ± 0.10^{b}	**
76-90 day	130.50 ± 0.13^{a}	117.14 ± 0.10^{b}	**
Average	128.28 ± 0.08^{a}	116.97 ± 0.12^{b}	**

**$P_{0.01}$; # values shown in table is the average of many cattle (average of how many values)

Increase in milk production might be due to high protein and minerals content of Azolla with low lignin content that contribute for better digestibility and nourishment. Azolla is an efficient livestock feed and is rich in protein, essential amino acids, carotenoids, vitamins, growth promoters and minerals (Basak *et al*., 2002). The observation in the present study is also in accordance with Khare *et al*., (2014) who reported that when Azolla replaced mustard oil cake in lactating Gir Cow, there was significant ($p<0.05$) increase in milk yield. Present finding in the value of milk production is lower than the observation of Gauri *et al*., (2012) who found it to be increased by 15-20%. According to Ambade (2010) there is milk yield increase by 15 to 20% after feeding of azolla in the diet of dairy Gir Cows and 15 to 20% commercial feed can be replaced with azolla. The profitability was comparatively higher in Azolla supplemented dairy Gir Cows due to significant higher milk yield against half replaced commercial feed. On weekly basis, each Gir Cow additionally produced 5.69-lit milk with saving of 10.5 kg commercial feed. In Kadaknath chicks birds result showed that during the entire experimental period Azolla treated group (I), had significant improvement in cumulative feed intake, cumulative body weight and FCR as compared to control except feed intake in first week and body weight in third week (Table 2). The present finding agree with Naghsi *et al*. (2014) who reported significant improved body weight and FCR compared to control when fed azolla @ 5% level. There was no adverse effect on palatability and weight gain in Kadaknath chicks birds supplemented with Azolla meal. These findings agreed with Basak *et al*. (2002) who reported that feeding of dried Azolla up to 5% level does not negatively influence the cumulative body weight gain and feed consumption of Kadaknath chicks chickens. However, Bested and Morento (1985) reported that Azolla affected the palatability of the feed and reduced feed consumption. The survivability of birds was cent percent in Azolla treated group, which indicated that Azolla meal has no deleterious effect on Kadaknath chicks birds. Similar findings are reported by Castillo *et al*. (1981) and Basak *et al*. (2002). The overall performance of Azolla treated

Table 2: Feed consumption body weights and feed conversion ratio of Kadaknath chicks, Chikens feed with or with Azolla upto 42 days of age

Parameters	Days	Group I: Supplemented withAzolla	Group II: Without Azolla supplementation	Level of significance
Feed consumption (g bird^{-1})				
	0-14	179.72 ± 1.93	175.44 ± 1.95	NS
	0-21	561.62 ± 15.89^{b}	611.13 ± 15.63^{a}	*
	0-35	1167.73 ± 44.29^{b}	1275.93 ± 46.76^{a}	**
	0-42	3156.10 ± 25.52^{b}	3232.17 ± 25.28^{a}	**
	0-49	4185.26 ± 46.19^{b}	4316.39 ± 46.80^{a}	*
Body weight (g bird^{-1})				
	0-14	127.44 ± 2.48^{a}	121.83 ± 2.61^{b}	*
	0-21	376.84 ± 1.68^{a}	372.30 ± 1.69^{b}	*
	0-35	758.24 ± 0.90^{a}	757.85 ± 1.01^{b}	ns
	0-42	1725.36 ± 4.57^{a}	1710.43 ± 4.68^{b}	*
	0-49	2157.25 ± 3.62^{a}	2147.37 ± 3.15^{b}	*
Feed conversion ratio unit (g g^{-1})				
	0-14	1.42 ± 0.04	1.45 ± 0.03	NS
	0-21	1.49 ± 0.04^{b}	1.64 ± 0.04^{a}	**
	0-35	1.54 ± 0.06 ^{b}	1.68 ± 0.06^{a}	*
	0-42	1.83 ± 0.01 ^{b}	1.89 ± 0.01^{a}	**
	0-49	1.94 ± 0.02 ^{b}	2.01 ± 0.02^{a}	**

* ($P_{0.05}$); ** $P_{0.01}$); NS stands for non-significant;
# values shown in table is the average of how many birds (average of how many values)

birds was significantly better than control group. It might be due to immunomodulatory effect of dried Azolla supplementation in Kadaknath chicks ration (Prabina and Kumar, 2010).

The average body weight per Kadaknath chicks bird was 1880.0 g against 3184.6 g total feed consumed in Azolla supplemented group compared to 1780.2 g body weight against 3176.5 g feed consumption in control group (Table 2). However, the feed consumption per bird was almost similar but output was higher in Azolla treated group due to 5% commercial feed replacement and cumulative higher body weight gain. For 100 Kadaknath chicks birds, the economic analysis revealed additional gaining of 9.98 kg body weight with saving of 15.92 kg commercial feed. Feeding Azolla to poultry birds improves the weight of the Kadaknath chicken and increases the egg production in layers. The difference in findings might be due to either unbalanced feeding practices followed by the owner or change in local environmental condition. It can be concluded that Azolla as a feed can be used for feeding the Gir Cows and poultry in rural areas to reduce the production cost for attaining higher gain.

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Effect of organic manures and panchagavya solution on growth and yield of taramira (*Eruca sativa* L.) under irrigated conditions

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Abstract

*A research experiment "Effect of organic manures and panchagavya solution on growth and yield of Taramira (*Eruca sativa *L.) under irrigated conditions" was conducted at Campus for Research and Advanced Studies, Dhablan, G.S.S.D.G.S. Khalsa collage, Patiala during the* Rabi *season of 2022-23. The experiment was designed in Split Plot Design with 12 treatments that were replicated thrice. The treatments included three doses of panchagavya solution and four levels of organic manures. Application panchagavya solution and organic manures significantly affected the growth of taramira at various growth stages. The research findings disclosed that among the three doses of panchagavya solution, foliar application of 5% panchagava solution along with combined application of FYM (2 t ha^{-1}) + Poultry manure (3 t ha^{-1}) + Vermicompost (2 t ha^{-1}) recorded significantly higher results of growth parameters such as plant height (cm), number of branches plant^{-1}, fresh weight (g), dry weight (g) and leaf area index at different stages of growth.*

Key words: Taramira, Panchagavya, FYM, Poultry manure, vermicompost

Introduction

Taramira (*Eruca sativa* L.) is one of the important oilseed crops which belong to brassicaceae family. It is commonly known as rocket salad, tara, tirwan, chara, schwan, seoha and sondha. It is a diploid annual herb that has an elongated, upright and rigid branching structure (Singh *et al.* 1958). Taramira is a cool season crop, it requires a cold dry weather with bright sunny days. It can tolerate up to -4^{o}C temperature and drought conditions. It thrives well in light loamy soil whereas alkaline and acidic soils are avoided.

Taramira is rich in vitamins, fibers, minerals, carotenoids, glucosinolates, isothicyanates, flavonoids and phenolic compounds. It is used as salad and for oil extraction. Oil is used for pickling and cooking by mixing it with mustard oil. The oil is also used in many skin and hair care products. Taramira has an oil content of about 27.8% and moisture content of 4.1%.

In agriculture, organic manures are of great importance as they improve the soil heath without harming the environment. Application of organic manures increases nutrient availability and population of microorganisms in the soil. FYM, vermicompost, poultry manure, green manures are some of the sources of organic manures (Ramesh *et al.* 2010). FYM is made up of combination of solid and liquid excretions of farm animals as well as litter and leaf litter from roughages and grain fed to cattle. Vermicompost is prepared using earthworms and contains many macro & micro nutrients. Poultry manure is fermented bird's excreta and it has a high concentration or N and organic matter (Nagavallemma *et al.* 2004).

Panchagavya is highly efficient liquid organic manure. It is made-up of five cow products such as cow dung, cow urine, cow milk, cow curd and cow ghee. It can replace many artificial fertilizers and insecticides. It has been used since ancient times to protect the crop plants and soil microbes in order to get higher production (Amalraj *et al.* 2013).

Materials and Methods

The present research experiment was carried out at Campus for Research and Advanced Studies,

Dhablan, P.G. Department of Agriculture, G.S.S.D.G.S. Khalsa College, Patiala during the *Rabi* season of 2022-2023. The field was situating at approximately 260 m above mean sea level and 30.33° N latitude and 76.28° E longitude. The area has a semi-arid climate with hot and dry summers, hot and humid during monsoon and extremely cold during winters. During the cropping season weekly mean of maximum and minimum temperature were recorded as 32.39 °C and 4.70°C respectively. Weekly mean relative humidity was observed 79.29% and 98.86% as minimum and maximum respectively. A total rainfall of 17.68 mm was received during the whole cropping season. The soil of the experimental field was clayey in texture with a pH 7.56 and organic carbon 0.73%.

The experimental field was laid in Split Plot Design (SPD) with 12 treatment combinations with three replications consisting of three doses of panchagavya solution (LF_1: 3% panchagavya solution, LF_2: 4% panchagavya solution and LF_3: 5% panchagavya solution) and four levels of organic manures (SF_1: FYM 2 t ha^{-1}, SF_2: Poultry manure 3 t ha^{-1}, SF_3: Vermicompost 2 t ha^{-1} and SF_4: FYM 2 t ha^{-1} + Poultry manure 3 t ha^{-1} + Vermicompost 2 t ha^{-1}). Variety TMLC-2 was used with a seed rate of 3 kg ha^{-1} and spacing 30 × 10 cm for sowing.

The growth parameters were recorded at 30 DAS, 60 DAS, 90 DAS and at harvesting from five randomly selected plants from each plot. Plant height was observed from soil level to the tip of shoot. Number of branches plant^{-1} was recorded and mean was calculated. For fresh weight plants were pulled out and weighed immediately and same plants were air dried and then oven dried for dry weight. Leaf area index was observed between 12:00 pm to 2:00 pm from four random places in each plot.

The data collected was analyzed using ANOVA (Analysis of Variance) as described by Gomez and Gomez (1984) using Split Plot Design with 5% level of significance.

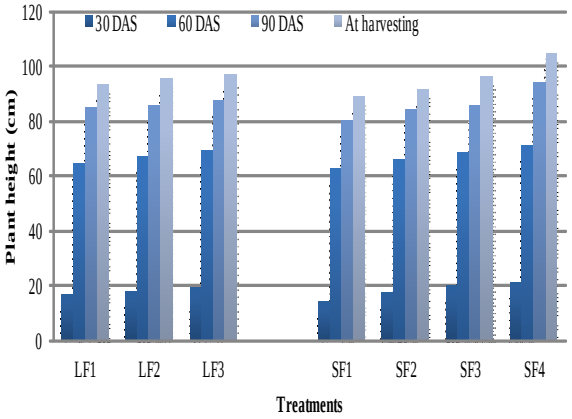
Table 1: Effect of organic manures and panchagavya solution on plant height (cm) of taramira

Treatment	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	At harvest
Panchagavya solution				
LF_1	16.60	64.39	84.71	93.49
LF_2	18.11	67.20	85.55	95.34
LF_3	19.33	69.10	87.05	96.32
SEm±	0.37	0.73	0.58	0.38
CD (P=0.05)	1.02	2.02	1.61	1.06
Organic Manures				
SF_1	14.05	62.26	80.41	88.59
SF_2	17.08	65.48	83.78	91.58
SF_3	19.77	68.58	85.09	95.70
SF_4	21.15	71.26	93.81	104.33
SEm±	0.36	0.71	0.56	0.39
CD (P=0.05)	1.04	2.04	1.63	1.12

Results and Discussion

Plant height (cm)

Plant height is an important growth attribute to be determined. The observations on plant height were recorded 30, 60, 90 DAS and at harvesting and is represented in Table 1 and Fig. 1. Among the foliar application of different doses of panchagavya foliar spraying of 5% panchagavya solution resulted in superior plant height at 30 (19.33 cm), 60 (69.10 cm), 90 DAS (87.05 cm) and at harvesting (96.32 cm) which was statistically at par with foliar application of 4% panchagavya solution. This could be due to the presence of many macro and micro nutrients and growth hormones in panchagavya that helps to increase rate of photosynthesis in plants which leads to taller plant height. Similar results were observed by Tiwari *et al.* (2020). On the other hand, the combined application of FYM (2 t ha^{-1}) + Poultry manure (3 t ha^{-1}) + Vermicompost (2 t ha^{-1}) resulted



. Fig. 1: Effect of organic manures and panchagavya solution on plant height (cm) of taramira

in significantly higher plant height at 30 (21.15 cm), 60 (71.26 cm), 90 DAS (93.81cm) and at harvesting (104.33 cm) whereas the lowest plant height was observed with alone application of FYM (2 t ha^{-1}). This might be due to the increased nutrient availability and higher microorganism population increased by the combined application of organic manures. The results are similar to the results of Murali *et al.* (2018) and Lepcha *et al.* (2016).

Number of branches plant^{-1}

Number of branches were recorded at 30, 60, 90 DAS and at harvesting and are depicted in Table 2 and Fig. 2. The maximum number of branches plant^{-1} were observed with the foliar application of 5% panchagavya solution at 30 (3.60),60 (18.23), 90 DAS (19.57) and at harvesting (20.29) which was statistically at par with the foliar application of 4% panchagavya solution due to the presence of IAA and GA that helps in cell elongation and division and therefore they increase the vegetative growth of plant. The research findings are in accordance with results of Das *et al.* (2023). Among the organic manures the application of FYM (2 t ha^{-1}) + Poultry manure (3 t ha^{-1}) + Vermicompost (2 t ha^{-1}) resulted in maximum number of branches plant^{-1} at 30 (4.42), 60 (22.94), 90 DAS (23.65) and at harvesting (24.15). This could be due to the reason that combined application of all the three manures ensures a continuous supply of nitrogen and poultry

Table 2: Effect of organic manures and panchagavya solution on number of branches plant^{-1} of taramira

Treatment	Number of branches plant^{-1}			
	30 DAS	60 DAS	90 DAS	At harvest
Panchagavya solution				
LF_1	3.17	16.54	17.57	18.42
LF_2	3.40	17.73	18.11	18.90
LF_3	3.60	18.23	19.57	20.29
SEm±	0.09	0.24	0.26	0.26
CD (P=0.05)	0.25	0.68	0.72	0.71
Organic Manures				
SF_1	2.48	12.68	13.82	14.66
SF_2	2.80	14.91	15.73	16.99
SF_3	3.87	19.47	20.46	21.02
SF_4	4.42	22.94	23.65	24.15
SEm±	0.09	0.27	0.25	0.30
CD (P=0.05)	0.26	0.78	0.73	0.86

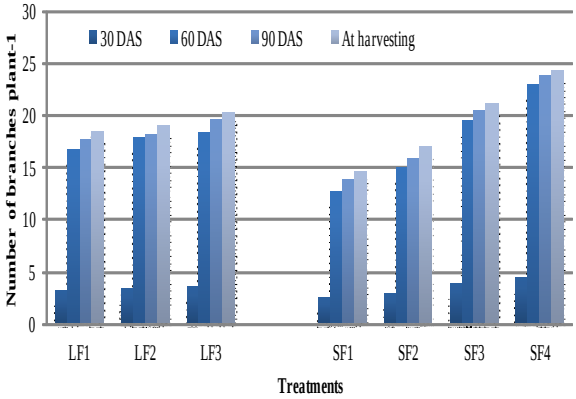


Fig. 2: Effect of organic manures and panchagavya solution on number of branches plant^{-1} of taramira

manures releases half of its nitrogen within 30 days of application and N is the main constitute for the vegetative growth of plant. The research findings are similar to the results of Lepcha *et al.* (2015).

Fresh weight plant^{-1} (g)

Five sample plants were randomly pulled out from each plot and weighed and data collected is represented in Table 3 and Fig. 3. The fresh weight plant^{-1} was significantly higher with the foliar application of 5% panchagavya solution at 30 (10.10 g), 60 (25.04 g), 90 DAS (36.98 g) and at harvesting (49.69 g) which was at par with 4% panchagavya solution at 60, 90 DAS and at harvesting. On the other hand the combined application of FYM (2 t ha^{-1}) + Poultry manure (3 t ha^{-1}) + Vermicompost (2 t ha^{-1}) resulted in superior results of fresh weight plant^{-1} at 30 (11.85 g), 60 (28.48 g), 90 DAS (47.03 g) and at harvesting (64.98 g). Due to the enhancement of nutrition in soil through organic manures the water holding capacity of soil and plant is increased and hence it results in higher fresh weight plant^{-1}. Similar results were observed by Murali *et al.* (2018).

Dry weight plant^{-1} (g)

The plants that were weighed for fresh weight were air dried and oven dried for fresh weight and the data is depicted in Table 4 and Fig.4. 5% foliar spray of panchagavya solution resulted in significantly maximum dry weight at 30 (3.47 g), 60 (6.48 g), 90 DAS (9.11 g) and at harvesting (11.47 g) which was statistically at par with foliar application of 4% panchagavya solution. With 5% panchagavya solution the fresh weight was higher so dry weight

Table 3: Effect of organic manures and panchagavya solution on fresh weight plant^{-1} (g) of taramira

Treatment	Fresh weight plant^{-1} (g)			
	30 DAS	60 DAS	90 DAS	At harvest
Panchagavya solution				
LF_1	8.98	23.22	34.97	48.76
LF_2	9.28	24.39	36.17	49.36
LF_3	10.10	25.04	36.98	49.69
SEm±	0.16	0.18	0.19	0.26
CD (P=0.05)	0.45	0.50	0.53	0.72
Organic Manures				
SF_1	7.28	18.73	30.81	42.58
SF_2	8.37	25.34	32.45	43.96
SF_3	10.32	24.31	33.87	45.56
SF_4	11.85	28.48	47.03	64.98
SEm±	0.16	0.21	0.28	0.29
CD (P=0.05)	0.46	0.61	0.82	0.83

Table 4: Effect of organic manures and panchagavya solution on dry weight plant^{-1} (g) of taramira

Treatment	Dry weight plant^{-1} (g)			
	30 DAS	60 DAS	90 DAS	At harvest
Panchagavya solution				
LF_1	2.98	5.53	7.93	9.69
LF_2	3.13	6.17	8.64	10.77
LF_3	3.47	6.48	9.11	11.47
SEm±	0.16	0.17	0.21	0.24
CD (P=0.05)	0.45	0.48	0.58	0.65
Organic Manures				
SF_1	3.48	4.82	6.16	8.73
SF_2	3.02	5.76	9.73	10.81
SF_3	3.32	5.81	7.21	9.78
SF_4	3.59	7.85	11.15	13.25
SEm±	0.18	0.22	0.24	0.29
CD (P=0.05)	0.53	0.63	0.70	0.84

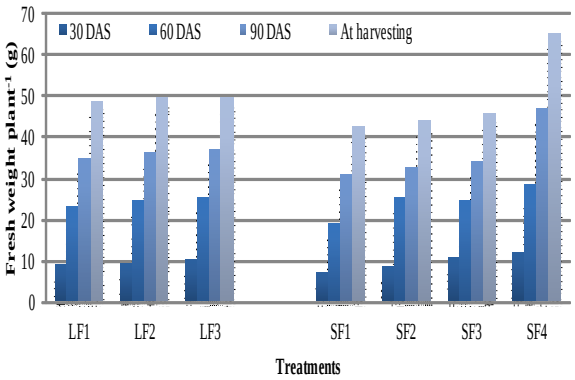


Fig. 3: Effect of organic manures and panchagavya solution on fresh weight plant^{-1} (g) of taramira

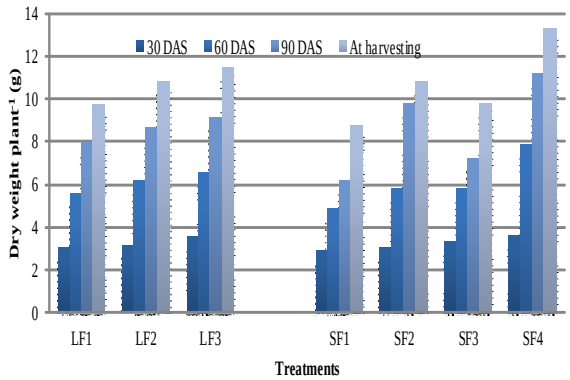


Fig. 4: Effect of organic manures and panchagavya solution on dry weight plant^{-1} (g) of taramira

was also higher and presence of macro and micro nutrients helps to improve the dry matter production in plants. The research findings are closely related to the results of Tiwari *et al.* (2020). Among the organic manures superior results of dry weight at 30 (3.59 g), 60 (7.85 g), 90 DAS (11.15 g) and at harvesting (13.25 g) were reported with the application of FYM (2 t ha^{-1}) + Poultry manure (3 t ha^{-1}) + Vermicompost (2 t ha^{-1}). As the organic manures contains many macro & micro nutrients, vitamins, amino acids and growth regulators which increases the growth parameters and also the dry weight of the plant. Some closely related results were observed by Murali *et al.* (2018).

Leaf area index

Leaf area index was measured at 30, 60, and 90 DAS and is represented in Table 5 and Fig. 5. The results of foliar application of different doses of panchagavya solution were non-significant. Although the higher values of leaf area index were observed with 5% panchagavya solution but they were not significantly different from the other doses of panchagavya solution. On the other hand, among the organic manures leaf area index was recorded superior with the combined application of FYM (2 t ha^{-1}) + Poultry manure (3 t ha^{-1}) + Vermicompost (2 t ha^{-1}) at 30 (0.82), 60 (2.61) and 90 DAS (2.53) which was statistically at par with the application of vermicompost (2 t ha^{-1}). This could be due to increased foliar growth with the combined application

Table 5: Effect of organic manures and panchagavya solution on leaf area index of taramira

Treatment	Leaf Area Index		
	30 DAS	60 DAS	90 DAS
Panchagavya solution			
LF_1	0.64	2.30	2.22
LF_2	0.69	2.37	2.23
LF_3	0.71	2.44	2.35
SEm±	0.01	0.05	0.06
CD (P=0.05)	0.04	0.15	0.16
Organic Manures			
SF_1	0.52	2.05	1.94
SF_2	0.63	2.35	2.24
SF_3	0.75	2.46	2.36
SF_4	0.82	2.61	2.53
SEm±	0.01	0.06	0.07
CD (P=0.05)	0.04	0.18	0.21

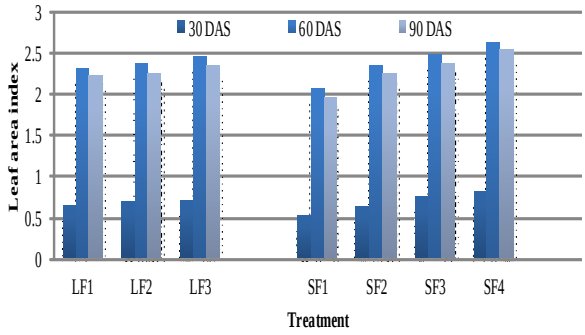


Fig. 5: Effect of organic manures and panchagavya solution on leaf area index of taramira

of organic manures due to the continuous nutrient supply to the plants that improved rate of photosynthesis. Similar results were recorded by Murali *et al.* (2018) and Lepcha *et al.* (2015).

Conclusion

On the basis of current study, it could be concluded that foliar application of 5% panchagavya solution along with the combined application of FYM (2 t ha^{-1}) + Poultry manure (3 t ha^{-1}) + Vermicompost (2 t ha^{-1}) resulted in superior growth parameters such as plant height (cm), number of branches $plant^{-1}$, fresh weight $plant^{-1}$, dry weight $plant^{-1}$ and leaf area index.

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Production potential of field of pea (*Pisum sativum* L.) as influenced by number of irrigation and nutrient management

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Abstract

A field experiment was conducted at Campus for Research and Advanced Studies, Dhablan, P.G. Department of Agriculture, G.S.S.D.G.S. Khalsa College, Patiala during Rabi *season of 2021-2022 with aim to find the "Production potential of field pea (*Pisum sativum *L.) as influenced by number of irrigation and nutrient management'. The experiment was conducted in factorial randomized block design and replicated thrice. Treatments consist of three levels of irrigation (I_1: Two irrigation at 20 and 40 DAS, I_2: Three irrigation at 10, 30 and 60 DAS, I_3: Four irrigation at 10, 30, 50 DAS and pod formation stage) and four levels of nutrient management (F_1: 100% RDF, F_2: 50% RDF +12 t FYM ha^{-1}, F_3: 50% RDF +2.5 t VC ha^{-1}, F_4: 50% RDF +12 t FYM ha^{-1} +2.5 t VC ha^{-1}). A keen observation of data revealed that the treatment I_3 gives significantly higher plant height (cm), number of leaves plant^{-1}, fresh weight plant^{-1} (g), dry weight plant^{-1} and CGR (g day^{-1}). During early stages of growth treatment F_1 gives statistically higher growth attributes but later on at 60 DAS, 90 DAS and at harvest treatment F4 gives significantly higher results in all growth parameters.*

Keywords: *Pisumsativum* L., nutrient, irrigation, growth, yield, quality

Introduction

Pea is one of the leading cool season *Rabi* pulse crops. It is also known as "queen of pulses". There are two types of peas, the garden pea and the field pea. Garden pea is also known as table pea. Field pea (*Pisum sativum* L.) is an annual hearbaceous pulse crop in the world with hypogeal germination. It belongs to the family Leguminosae or Fabaceae and sub family papilionaceae. It is second largest family amongst dicotyledons. Its chromosome number is 2n=14. The optimum time of sowing of field peas in north Indian conditions are second fortnight of October after that it results in extreme yield drop. It is highly sensitive to waterlogging conditions, therefore a well-drained loam soil is considered satisfactorily. Pea has tap root system hence less water requirement and optimum monthly temperature suitable for growth is 13-18^{o}C. The temperature above 30^{o}C is harmful for field pea.

Field peas (*Pisum sativum* L.) are harvested in immature condition and used for cooking as green vegetables or to be canned or frozen for subsequent uses. Pea is cultivated mainly for mature seed or as a forage crop for cattle or as a green manure crop for soil improvement and as a cover crop to reduce soil erosion. The mature seed may additionally be used as whole or split into dal and prepared in a range of approaches for human consumption. It is often used in human being food plan because of high percentage of digestible protein, vitamins, carbohydrates, minerals, fibre and so on. A 100 g of dried edible portion of field pea contain 22.5% protein, 1.8 g fat, 3.2 g minerals, 9.0 mg vitamin C, 62.1 g carbohydrates, 11 g moisture, 64 g calcium (Pandey *et al*. 2017).

The organic amendments influence the soil fertility through its effect on water holding capacity of soil (Gopinath *et al*. 2008). In addition to this, organic amendments feed the soil microbes that

release the nutrients (Bulluck*et al*. 2002) and sustain crop productivity (Jaipaul *et al*. 2011). Thus, a strong relationship exists between the nutrient supply and water availability as they complement each other. To optimize the water use and improve the water use efficiency, integration of irrigation with nutrient management practices hold promise not only for crop and soil productivity sustenance but also for the environment safety under resource scarcity. Hence, an effort was made to study the effect of different irrigation levels and nutrient management on all growth parameters of field pea.

Materials and methods

The field experiment was conducted at Campus for Research and Advanced Studies, Dhablan, P.G. Department of Agriculture, G.S.S.D.G.S. Khalsa college Patiala. It is situated at about 24-26º North Latitude and 76-24º East Longitude at an altitude of about 250 m above the mean sea level. It is in south eastern direction in Punjab state and North West India. The experimental plot was homogenous in fertility having assured irrigation and other required facilities. Patiala is situated in the northern part of Punjab and have sub-tropical zone with extremely hot summer and cold winter. The climatic condition of agronomy research farm at Dhablan is sub-tropical with hot dry summer, hot and humid, rainy and cold winter months. Weekly maximum and minimum temperatures during the Rabi season of year 2021-2022 ranged from 35.9 ^{o}C and 0.34 ^{o}C respectively. Weekly maximum and minimum relative humidity ranges from 94.9 and 35 % during cropping season. Weekly maximum and minimum evaporation ranges from 8.5 to 341 mm during cropping season. The total rainfall of 100.5 mm was received during the entire crop growing season. Soil of experimental field was sandy clay in texture with pH 7.44 (basic), medium in organic carbon (0.72%) Walkley and Black 1934, low in available nitrogen (246.67 kg ha^{-1}), medium in available phosphorous (22.6 kg ha^{-1}) and low in available potassium (129.81 kg ha^{-1}).

Treatment combination consists of three levels of irrigation (I_1: Two irrigation at 20 and 40 DAS, I_2: Three irrigation at 10, 30 and 60 DAS, I_3: Four irrigation at 10, 30, 50 DAS and pod formation stage) and four levels of nutrient management (F_1: 100% RDF, F_2: 50% RDF +12 t FYM ha^{-1}, F_3: 50% RDF +2.5 t VC ha^{-1}, F_4: 50% RDF +12 t FYM ha^{-1} +2.5 t VC ha^{-1}). Punjab 89 variety of field pea was sown at a spacing of 30 cm x 10 cm. A recommended dose of 20:60:30 kg ha^{-1} NPK was applied through urea, SSP and MOP. All inorganic nutrients as per treatment were applied at the time of sowing, while all organic manures were applied 20 days before sowing. Irrigation is given as per the schedule. Total 12 treatment combinations were laid out in Factorial Randomized Block Design with three replications. Growth and growth contributing characters were recorded.

All growth parameters were recorded at 30, 60, 90 DAS and at harvest. The plant height was measured in cm from the soil surface to the main apical bud up to last foliate. The total numbers of leaves plant^{-1} were counted from randomly selected five tagged plants and the mean was calculated and then recorded. Fresh weight was taken as soon as the plants are pooled out of plot to avoid loss of water. For dry weight, same five plants were air dried and then dried in hot air oven at 60 ± 5 °C till a constant weight was obtained and again weighed to record the average dry weight of the plant. The crop growth rate can be calculated by using the following formula:

$$\text{CGR (g day}^{-1}) = \frac{W_2 - W_1}{t_2 - t_1}$$

All the data recorded during course of investigation were subjected to Analysis of variance as described by Gomez and Gomez (1984) for using Factorial Randomized Block Design at 5 % level of significance.

Results and discussion

Plant height (cm)

Plant height is an important parameter of plant during the growth and development of the crop. The data on plant height as influenced by number of irrigation and nutrient management is depicted in Table1 with Fig. 1(a) and 1(b) respectively. Treatment I_3 (four irrigation at 10, 30, 50 DAS and at pod formation stage) gives significantly superior results (17.56, 53.95, 85.37 and 92.56 cm) at all growth stages which was at par with treatment I_2 (Three irrigation at 10, 30 and 60 DAS) at 30 and

Table 1: Influence of number of irrigation and nutrient management on plant height(cm) of field pea

Treatments	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	At harvest
No. of irrigation				
I_1	15.52	48.69	77.06	84.48
I_2	17.51	52.68	84.10	90.74
I_3	17.56	53.95	85.37	92.56
SEm±	0.43	0.53	0.49	0.46
CD 5%	0.89	1.10	1.01	0.95
Nutrient management				
F_1	17.64	50.01	77.67	85.97
F_2	16.15	50.89	79.38	86.46
F_3	16.72	53.07	83.98	90.73
F_4	16.95	53.12	87.67	93.89
SEm±	0.50	0.61	0.56	0.53
CD 5%	1.03	1.26	1.17	1.10

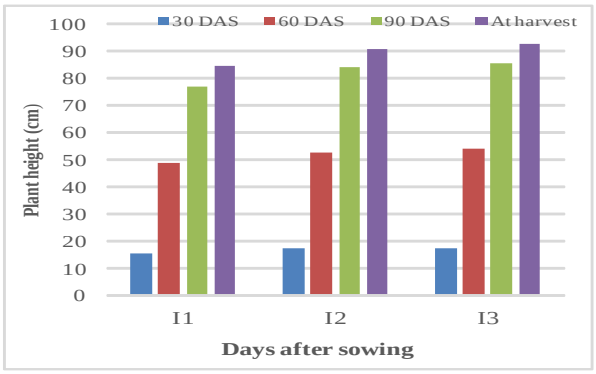

Fig. 1(a): Influence of number of irrigation on plant height of field pea

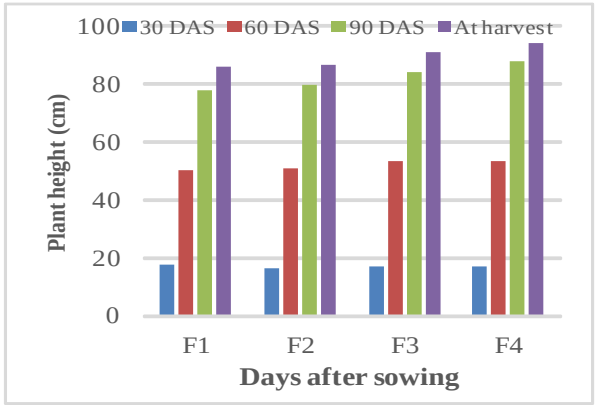

Fig. 1(b): Influence of nutrient management on plant height of field pea

60 DAS. Irrigation provides moisture at the right time and in sufficient quantities, which leads to better availability and translocation of nutrients that cause significant increase in vegetative growth. Treatment I_1 (Two irrigation at 20 and 40 DAS) resulted in significantly inferior values at all growth stages. Among nutrient management practiceshighest plant height (53.12,87.67 and 93.89 cm) was recorded at 60, 90 DAS and at harvest respectively with the application of F_4 (50% RDF + 12 t FYM ha^{-1} + 2.5 t VC ha^{-1}) might be due to rapid mineralization of chemical fertilizer which supplied the nitrogen in early stages of the crop and presence of relatively readily available nutrient, growth promoting substances and other beneficial micro-organisms in vermi compost, which are involved in nitrogen fixation, glucose decomposition and other beneficial activities for nutrient availability in later stages of the crop. But at 30 DAS higher plant height (17.64 cm) was recorded with the treatment F_1 (100 % RDF) which was at par with treatment F_3 (50% RDF + 12 t FYM ha^{-1}) and F_4 (50% RDF + 2.5 t VC ha^{-1}). Similar results had been also given by Srivastava *et al.* (2020).

Number of leaves plant^{-1}

Number of leaves are the outcomes of growth attribute characters. Higher number of leaves are the result of proper vegetative growth of plant. The data pertaining to number of leaves plant^{-1} as influenced by number of irrigation and nutrient management was statistically analysed and outlined in Table 2 and Fig. 2 (a) and Graph 2 (b) respectively. A perusal of data showed that treatment I_3 (four irrigations at 10, 30, 50 DAS and pod formation stage) recorded significantly higher no. of leaves plant^{-1} (21.28, 51.94, 103.49 and 99.13) at 30, 60, 90 DAS and at harvest respectively. This could be due to more and better availability of moisture and translocation of nutrients which significantly increases vegetative growth of the crop. Treatment I_1 (Two irrigation at 20 and 40 DAS) resulted in significantly inferior values at all growth stages. Similar results were obtained by Lende *et al.* (2017). Among nutrient management practices highest number of leaves plant^{-1} (53.89, 107.77 and 102.44) was recorded at 60, 90 DAS and at harvest

Table 2: Influence of number of irrigation and nutrient management on number of leaves plant^{-1} of field pea

Treatments	Number of leaves plant^{-1}			
	30 DAS	60 DAS	90 DAS	At harvest
No. of irrigation				
I_1	19.87	46.33	90.79	85.49
I_2	21.23	49.81	101.45	97.06
I_3	21.28	51.94	103.49	99.13
SEm±	0.40	0.61	0.57	0.46
CD 5%	0.83	1.28	1.19	0.95
Nutrient management				
F_1	21.70	46.88	92.83	88.14
F_2	19.84	47.23	93.13	88.42
F_3	20.78	49.44	100.58	96.57
F_4	20.87	53.89	107.77	102.44
SEm±	0.46	0.71	0.66	0.53
CD 5%	0.95	1.47	1.37	1.10

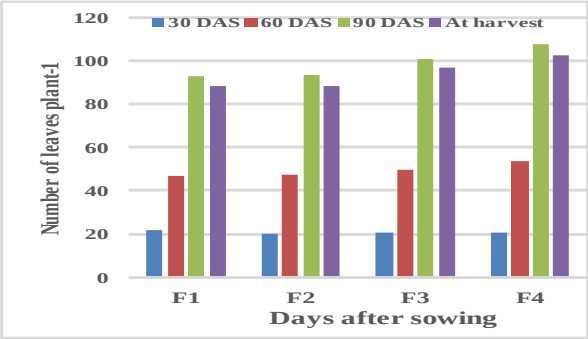

Fig. 2(a): Influence of number of irrigation on number of leaves plant^{-1} of field pea

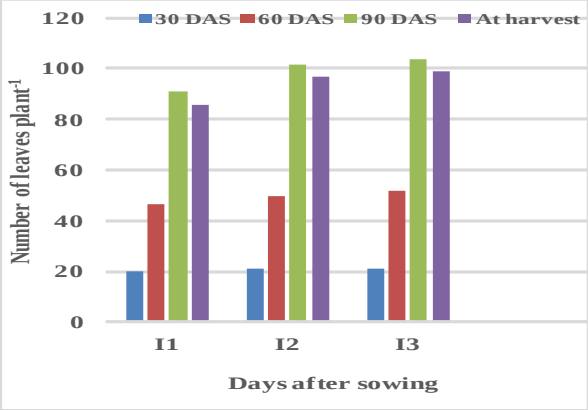

Fig. 2(b): Influence of nutrient management on number of leaves plant^{-1} of field pea

respectively with the application of F_4 (50% RDF + 12 t FYM ha^{-1} + 2.5 t VC ha^{-1}). Vermicompost and FYM provides more macro and micronutrients, growth hormones and enzymes to plants which promote the cell division, cell elongation and rises immunity and growth rate of plant. At harvesting, number of leaves plant^{-1} declines due to defoliation and senescence of leaves. But at 30 DAS higher number of leaves plant^{-1} (21.70) was recorded with the treatment F_1(100 % RDF) which was at par with treatment F_3 (50% RDF + 12 t FYM ha^{-1}) and F_4 (50% RDF + 2.5 t VC ha^{-1}). The study approved the earlier findings of Srivastava *et al*. (2020).

Fresh weight plant^{-1} (g)

Fresh weight is the important parameter of crop growth. Table 3 and Graph 3(a) and Graph 3(b) depicts the data stating to fresh weightplant^{-1} (g) of crop. An inspection of data given in table revealed that treatment I_3 (four irrigations at 10, 30, 50 DAS and pod formation stage) recorded significantly higher fresh weightplant^{-1} (5.53, 17.21, 29.47 and 43.03 g) at 30, 60, 90 DAS and at harvest respectively which was at par with the treatment I_2 at 30 DAS. This might be due to the reason that irrigation provide better nourishment to plant. Similar results were obtained by Lende *et al*. (2017). Among nutrient management results designates that highest fresh weight plant^{-1} (16.77, 30.64 and 43.73 g) was recorded at 60, 90 DAS and at harvest respectively with the application of treatment F_4 (50 % RDF + 12 t FYM ha^{-1} + 2.5 t VC ha^{-1}). As would be expected, the increase in fresh weight might be attained to increase in plant height and number of leaves plant^{-1} which have accompanied with more photosynthesis rate and accumulation of food material that fallouts in higher fresh weight of plant. Also, vermi compost and FYM through slow and continuous release of macro and micronutrients increases the biomass of plant. But at 30 DAS maximum fresh weight plant^{-1} (5.70 g) was recorded with the application of treatment F_1 (100 % RDF) which was at par with F_3 and F_4. The results are in agreement with the previous findings of Srivastava *et al*. (2020).

Dry weight plant^{-1} (g)

It is clear from the data in the Table 4 and Fig. 4(a) and 4 (b) that dry matter content was

Table 3: Influence of number of irrigation and nutrient management on fresh weight plant^{-1} (g) of field pea

Treatments	Fresh weight plant^{-1} (g)			
	30 DAS	60 DAS	90 DAS	At harvest
No. of irrigation				
I_1	4.62	13.38	18.65	29.65
I_2	5.52	16.02	25.04	36.61
I_3	5.53	17.21	29.47	43.03
SEm±	0.42	0.45	0.57	0.58
CD 5%	0.86	0.92	1.19	1.20
Nutrient management				
F_1	5.70	14.69	18.92	30.32
F_2	4.46	14.93	20.88	32.86
F_3	5.19	15.77	27.08	38.81
F_4	5.54	16.77	30.64	43.73
SEm±	0.48	0.51	0.66	0.67
CD 5%	0.99	1.07	1.38	1.39

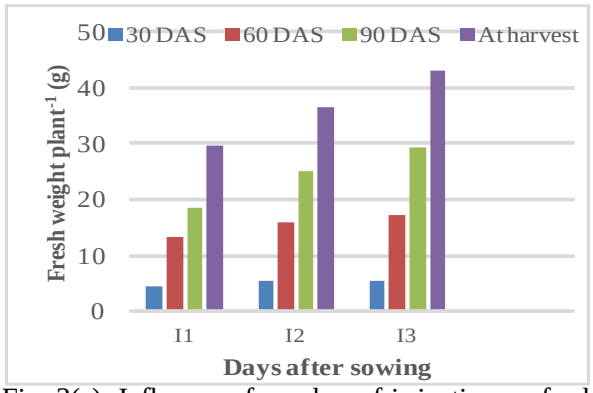

Fig. 3(a): Influence of number of irrigation on fresh weight plant^{-1} (g) of field pea

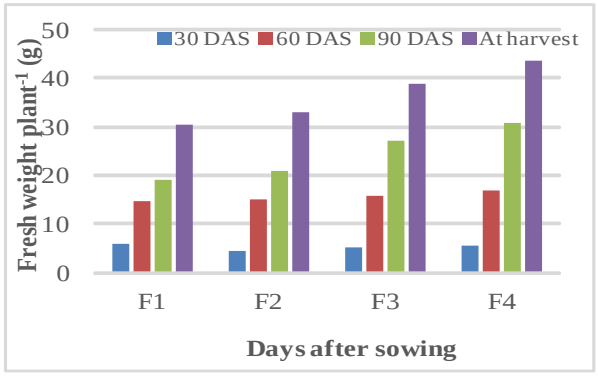

Fig. 3(b): Influence of nutrient management on fresh weight plant^{-1} (g) of field pea

significantly influenced by different irrigation levels and nutrient management practices. Amongst the irrigation levels the treatment I_3 (four irrigations at 10, 30, 50 DAS and pod formation stage) recorded significantly higher dry weightplant^{-1} (1.84, 5.74, 9.82 and 14.34 g) at 30, 60, 90 DAS and at harvest respectively which was at par with treatment I_2 (three irrigations at 10, 30 and 60 DAS) at 30 DAS. This may be owed to accumulative effect of increasing plant height, number of leaves plant^{-1} and fresh weight plant^{-1} result in higher dry weigh plant^{-1}. Similar results were obtained by Lende *et al.* (2017) and Dutt *et al.* (2003).

Among nutrient management practices, an inspection of data discovered that highest dry weight plant^{-1} (5.59, 10.21 and 14.58 g) was recorded at 60, 90 DAS and at harvest respectively with the application of F_4 (50 % RDF + 12 t FYM ha^{-1} + 2.5 t VC ha^{-1}). It is directly proportional to vegetative growth of plant. As would be expected, the increase in dry weight might be attained to increase in plant height, number of leaves plant^{-1} and fresh weight plant^{-1} that might have accompanied with more photosynthesis rate and accumulation of food material which result in higher dry weight of the plant. But at 30 DAS higher dry weight plant^{-1} (1.99 g) was recorded with the application of treatment F_1 (100 % RDF) which was at par with treatment F_3 and F_4. The present study approved the previous findings of Srivastava *et al.* (2020) and Lalito *et al.* (2018).

Crop growth rate (g day^{-1})

The crop growth rate is a most important component of crop. The data pertaining to crop growth rate (g day^{-1}) at 30, 60, 90 DAS and at harvest as influenced by nutrient management has been presented in Table 5 and Fig. 5 (a) and 5(b). Among different irrigation levels highest CGR (0.06, 0.13, 0.14 and 0.09 g day^{-1}) was observed at 30, 60, 90 DAS and at harvest respectively which was produced by treatment I_3 (four irrigations at 10, 30, 50 DAS and pod formation stage). The highest CGR increases photosynthesis and dry matter conversion efficiency of plant. The study approved the previous finding of Lende*et al.* (2017) and (Singh *et al.* 2017). A close examination of data revealed that highest crop growth rate (0.13, 0.15 and 0.09 g day^{-}

Table 4: Influence of number of irrigation and nutrient management on dry weight plant^{-1} (g) of field pea

Treatments	Dry weight plant^{-1} (g)			
	30 DAS	60 DAS	90 DAS	At harvest
No. of irrigation				
I_1	1.58	4.46	6.22	9.88
I_2	1.84	5.34	8.35	12.20
I_3	1.85	5.74	9.82	14.34
SEm±	0.12	0.15	0.19	0.19
CD 5%	0.25	0.31	0.40	0.40
Nutrient management				
F_1	1.99	4.90	6.31	10.11
F_2	1.48	4.98	6.96	10.95
F_3	1.73	5.26	9.03	12.94
F_4	1.84	5.59	10.21	14.58
SEm±	0.14	0.17	0.22	0.22
CD 5%	0.29	0.36	0.46	0.46

Table 5: Influence of number of irrigation and nutrient management on CGR (g day^{-1}) of field pea

Treatments	CGR (g day^{-1})			
	30 DAS	60 DAS	90 DAS	At harvest
No. of irrigation				
I_1	0.05	0.10	0.06	0.07
I_2	0.06	0.12	0.10	0.08
I_3	0.06	0.13	0.14	0.09
SEm±	0.00	0.01	0.01	0.01
CD 5%	0.01	0.01	0.02	0.01
Nutrient management				
F_1	0.07	0.10	0.05	0.08
F_2	0.05	0.12	0.07	0.08
F_3	0.06	0.12	0.13	0.08
F_4	0.06	0.13	0.15	0.09
SEm±	0.00	0.01	0.01	0.01
CD 5%	0.01	0.02	0.02	0.01

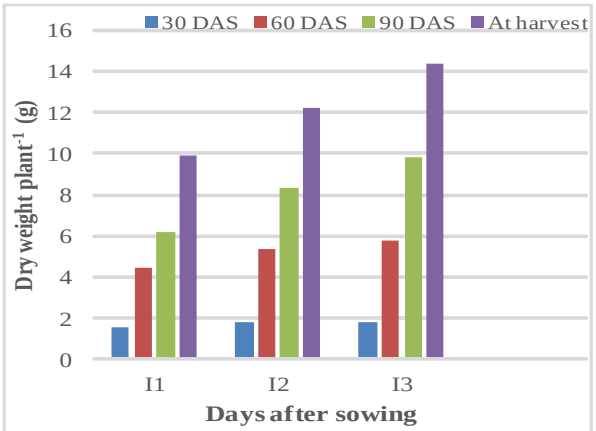

Fig. 4(a): Influence of number of irrigation on dry weight plant^{-1} (g) of field pea

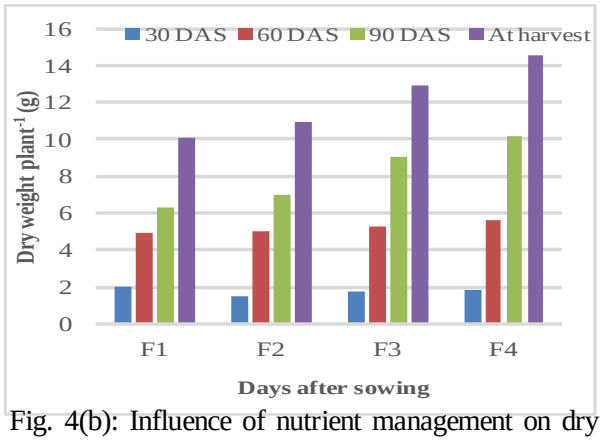

Fig. 4(b): Influence of nutrient management on dry weight plant^{-1} (g) of field pea

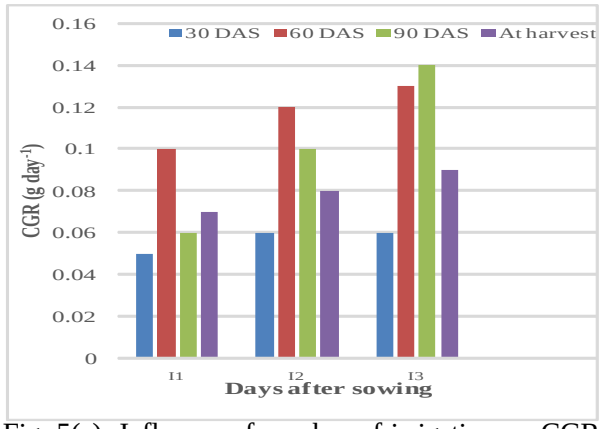

Fig. 5(a): Influence of number of irrigation on CGR *(g day^{-1}) of field* pea

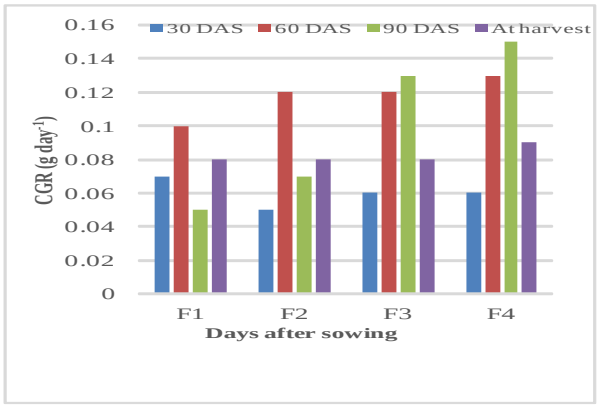

Fig. 5(b): Influence of nutrient management on CGR (g day^{-1}) of field pea

^{1}) was recorded at 60, 90 DAS and at harvest respectively with the application of treatment F_4 (50 % RDF + 12 t FYMha^{-1} + 2.5 t vermi compost ha^{-1}). It is directly proportional to dry weight of plant. As would be expected, the increase in dry weight might be result in higher CGR of plant. But at 30 DAS maximum crop growth rate (0.07 g day^{-1}) was recorded with the application of 100 % RDF because application of NPK increases vegetative growth and biomass production of crop and dry weight plant^{-1} (g) effectively. The present study approved the previous findings of Srivastava *et al*. (2020).

Conclusion

In field pea, application of treatment I_3 (four irrigations at 10, 30, 50 DAS and pod formation stage) gave significantly superior results in all growth parameters over I_1 and I_2. This might be due to positive and optimum effect of irrigation. Irrigation provides sufficient moisture, improve nutrient uptake, translocate assimilates from source to sink and so on.

On the other hand, among nutrient management practices application of treatment F_4 (50 % RDF +12 t FYM ha^{-1} +2.5 t VC ha^{-1}) shows significantly higher results at all growth parameters over all other treatments. This might be due to higher supply of macro-micro nutrients, release of various enzymes, growth hormones through vermi compost.

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Economic Empowerment of Rural Community through Mushroom Cultivation: Special Reference to District Pauri Garhwal, Uttarakhand

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Abstract

*The primary share of mushroom production of Indian comes from white button mushroom (*Agaricusbisporus*) accounting for approximately 90-92%, remaining portion of production comes from paddy straw mushroom (*Volvarieua spp.*) and oyster mushroom (*Pleuroteus Spp.*). Throughout history, people across the world have been using wild mushrooms for food, medicine and cosmetics uses as well as for various cultural purposes. The present investigation was carried out to assess the socio-economic empowerment through mushroom cultivation in the Khirsu Block of District Pauri Garhwal, Uttarakhand.The sample comprised of 65 randomly selected mushroom growers from 10 villages. The analysis revealed that 63.6 percent change feel in the economically empowered of the mushroom growers. While 57.3 percent change found in enhanced income from mushroom production has helped them in purchasing expensive items and enhance the standard of living of the family.The study also revealed that out of 65 respondent majority (68%) were women respondents.The rusults shows that the main problems in mushroom cultivation to collect the major raw material (Wheat straw, rice straw and mushroom spawn) not easily available for the mushroom growers.*

Keywords: Empowerment Mushroom Cultivation, Khirsu, Socio-economics, *Constraints*

Introduction

Mushrooms are fruit-bearing bodies produced by certain fungi. Not all fruit bodies real mushrooms, Paffballs and Morels are edible fruit bodies sometimes called “Mushrooms”. Mushroom cultivation today is practiced in more than 100 countries and production grows at an annual rate of 6-7 percent. Mushrooms are a delicious, protein-rich food. Its farming method is simple and straightforward and adapts to most climates.

Mushrooms are considered as modern-day health friendly food, offering a combination of low in carbohydrates and fats content, while providing high in protein content (ranging from 20 to 40% on dry weight basis and 4% on a fresh weight basis), which is comparable to that found in milk and are rich in compared to majority of vegetables. Remarkably, mushroom is the only source available of Vitamin-D among all the vegetable for human diet (Sheu et al., 2007; Mariga et al., 2014 and Kalac, 2009).

Mushrooms are favorable option for patients of diabetes because they have a low calorific value, no starch contain, low fat contain, sugar and carbohydrate. The reduced protein available in mushrooms helps to reducing cholesterol level in the body. Therefore, it is a preferred choice for those people who are struggling to lose weight as died. In India mushroom are extensively cultivated in regions such as Uttarakhand, Himachal Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka and the North East region. Mushroom

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cultivation holds potential as an agri-business and is an ideal income generating opportunity enterprise for housewives (Samrath, *et al.,* 2020; Karwa and Rai 2005).

Engaging in Mushroom production, Bee-keeping, Goat rearing, Dairy,Seed production, cultivation of fruits,vegetables and flower can enhance the income of rural farmers by upto 70-80%(Singh, *et al.,* 2018).Consequently, thereis avital need to make empower rural community both economically and socially. In this context, an attempt have beenmade to introduce the mushroom cultivation as an income generating and employment generating opportunity (Bashir, *et al.,* 2018; Chiroro, 2004 and Rawat et al, 2020). Mushroom cultivationhas the potential ability to enhancing the economic as well as socio-economic condition of rural community. Keeping in view to assess the impact of mushroom cultivation grower on socio and economic empowerment in the Khirsu Block of District PauriGarhwal, Uttarkhand

Materials and Methods

The present study is conducted in Khirsu block of Pauri Garhwal district in Uttarakhand state of India, during 2021-22. The data regarding scocioeconomic, economic empowerment and constraints face, was collected from 10 villages of total 65 mushroom growers in the study area. Data was collected using a questionnaire from all the respondents for overall information in terms of age, education, category, land holdings, economic empowerment of mushroom growers about different vriable and contraints faced during the mushroom production. The data was collected through a brief interview schedule and personal discussion, after that data was tabulated and using descriptive statistically.

Results and Discussion

Socio economic status

Age is one of the major socio-economic status of people as it decides the decisions making capacity among people. The data revealed that maximum respondent belonged to above 55 age groups which is shown in the Table-1Gender ratio of respondent farmers shown that mostlywomen were involved in mushroom production.Data has shown that 80% respondent is literate on the other hand only 20% are illiterate. All illiterate respondents were above 60 years age group.Most of the villagers in the study area are general caste based. According to study, 70% respondent's houses were Semi pacca type. Result shows that 68 mushroom growers were living in nuclear family. According to research study, out of total 65 respondents most of them were unemployed.

Economic Empowerment

Mushroom cultivation offers an opportunity to enhancement of household income at low cost investment. Mushroom cultivation can be the imperative and good livelihood options for unemployed youths, landless farmers and rural community. It is a labour intensive but high

Table 1: Scio-economic Conditions of the Mushroom Growers

Particulars	Frequency	Percentage
Age Group		
25-35	19	29.23
35-45	9	13.85
45-55	15	23.08
above 55	22	33.85
Gender		
Male	21	32.0
Female	44	68.0
Literacy		
YES	52	80
NO	13	20
Caste		
GEN	54	86.25
SC/ST	11	13.75
House type		
Kachcha	4	3.8
Paccaa	16	26.3
semi pacca	45	70.0
Family type		
Joint	25	31.3
Nuclear	40	68.8
Job Type of Respondents		
Govt.	10	15.38
Private	6	9.23
Business	14	21.54
Unemployed	35	53.85
Land Type		
Irrigated	0	0
Non-irrigated	65	100

Table 2: Economic Empowerment through Mushroom Cultivation Practice

Particulars	Joining Before Mushroom Cultivation		Joining After Mushroom Cultivation		Economic Empowerment Change (%)
	Frequency	Percentage	Frequency	Percentage	
Helped in savings and investment	17	26.15	32	53.33	27.2
Support the family due to increased income	22	33.85	44	73.33	39.5
Feel economically empowered	15	23.08	52	86.67	63.6
Nutritious food and education to children due to increased income	23	35.38	53	88.33	52.9
Increase the income helped to purchase expensive items and enhance the living standard of the family	18	27.70	51	85.00	57.3

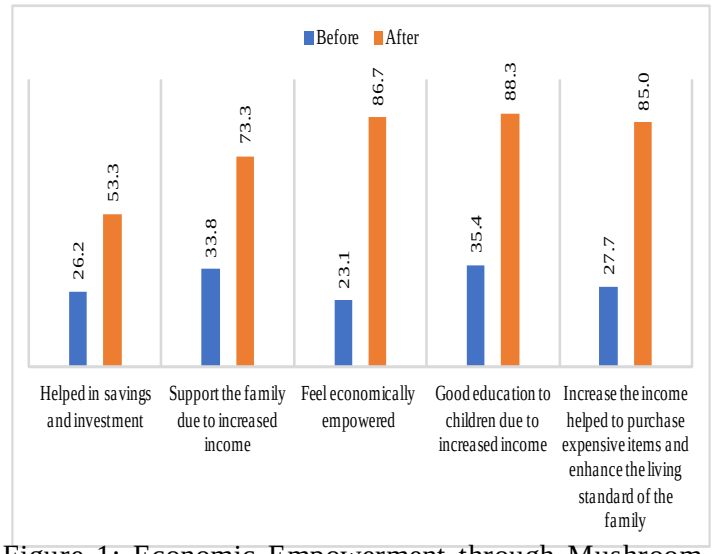

Figure 1: Economic Empowerment through Mushroom Cultivation

Table 3: Constraints faced by the beneficiaries

Constraints	Frequency		Percentage	
	Yes	No	Yes	No
Seed	46	19	70.77	29.23
Straw	31	34	47.69	42.31
Transportation	37	28	56.92	53.08
Marketing	34	31	52.31	47.69

profitableentrepreneurthat can provide gainful employment of the poor people. The result show table 2 revealed that mushroom cultivation helped them in increasing their savings and investments 26.15 to 53.33 percent.Further, it was noticed that to Support the family due to increased income (33.85 to 73.33), Feel economically empowered (23.08 to 86.67 percent), provide good education, nutritious food to their children, increased standards of living due to increased income (35.38 to 88.33 percent) and Increase the income helped to purchase expensive items and enhance the living standard of the family (27.70 to 85.0 percent) through mushroom cultivation.

Constraints Faced by Mushroom Growers

In the study area of Khirsu block, maximum farmers faced seed availability is the major constraint than other constraints like Straw availability, Transportation and Marketing during oyster mushroom cultivation. The similar result found in the study of Gautam *et al.* (2014) and Singh *et al.* (2008) has also found similar results.

Conclusion

India's economy is predominately rural with over 67% of the population living in rural areas and are agriculture oriented, it is very necessary to aware the rural population so that they can use their own land for a large scale of agricultural crop production. As the Indian government is now focusing on self-employment, the government has started several plans to support rural people so that they can start their own business where mushroom cultivation is very good option for hilly areas or rural areas farmers.The study found that most of the mushroom growers were belonged to nuclear family, as hiring labours cost more while working with the family member is a good option of self- employment.As study revealed that most of the respondents were unemployed, by this way they can generate more income for their family households. It is important to commercially utilize the spent mushroom substrate left after cultivation for making manure or vermicompost for additional income and total recycling of agricultural wastes.The main problems in mushroom cultivation to raw material (Wheat straw, rice straw and mushroom spawn),because this raw material for mushroom cultivation not easily available in the local market and the mushroom grower have to go 150-200 km far away to buy this raw material. The result indicates that women are more active in Mushroom Cultivation is a very good sign of women empowerment. Result also shows that after the joining of Mushroom cultivation practice, improve the economic empowerment of mushroom growers Thus, mushroom cultivation reduces poverty and improves the life style of many poor farmers.

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Field evaluation of novel insecticides against fruit & shoot borer, *leucinodes orbonalis* (guenee) in brinjal

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Abstract

A field experiment was conducted to determine the comparative efficacy of insecticides i.e. *Flubendiamide 39.35 EC @ 75 ml/ha, Carbosulfan 25 EC @ 1000 ml/ha, Emamaectin benzoate 5 SG @ 250 g/ha, Spinosad 45 SC @ 500 ml/ha, Indoxacarb 14.5 SC @ 500 ml/ ha, Chlorantraniliprole 18.5 SC @ 80 ml/ha & Lambda cyhalothrin 5 EC @ 500 ml/ha and biopesticide* viz., B t *@ 1.5 kg/ha which were sprayed on brinjal variety Pusa purple round against shoot & fruit borer,* Leucinodes orbonalis *(Guenee) during* kharif *2020-21 and 2021-22. The effect of these applications was also recorded on the yield attributes. All the treatments had the comparable lower percentage of shoot as well as fruit infestation than un-treated control. Chlorantraniliprole was best with lowest shoot and fruit infestation of 6.67 and 10.33 per cent, respectively and 293.26 q/ha yield followed by Flubendiamide, Emamaectin benzoate, Carbosulfan, Spinosad, Indoxacarb, Lambda cyhalothrin and* Bt, *which gave 283.26, 275.73, 269.79, 265.96, 257.86, 238.50, and 169.30 q/ha yield respectively.*

Keywords: Efficacy, Novel insecticides, *Leucinodes orbonalis*, Chlorantraniliprole, Flubendiamide, Brinjal

Introduction

Brinjal (*Solanum melongena* L.) is an important vegetable crop of India, grown throughout the year. The crop is highly sensitive and a potential host for several insect pests. Among them, attack of shoot and fruit borer (*Leucinodes orbonalis* Guenee) is important one. The larvae of this insect bore into tender shoots causing shoot wilt and feeds on young fruits rendering them unfit for consumption. The yield loss due to the pest is to the extent of 70 to 92 per cent (Eswara Reddy and Srinivas, 2004). Pesticides continue to be one of the most powerful tools available for the control of insect- pests and increasing crop yields. Presently, chemical control is the only practical method for a farmer to respond to an increasing shoot & fruit borers' infestation. A number of chemical insecticides have been reported to be effective against this pest (Singh and Nath, 2007; Gautam *et al*., 2008 and Tiwari *et al*., 2011) but the control is not satisfactory because of the development of resistance for these chemicals. Among the several avenues to overcome the insecticidal resistance problem, replacement with new insecticide is one of the important considerations. Evaluation of newer molecules for their efficacy against *L. orbonalis* is a continuous process as newer molecules having novel mode of action are being added every year. The use of conventional insecticides also causes sudden decrease in the number of natural enemies. Keeping in view the importance of brinjal crop, the present

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study was undertaken to test the relative efficacy of some novel insecticides and biopesticide with conventional insecticide against shoot & fruit borer, *Leucinodes orbonalis* in brinjal crop.

Materials and Methods

The experiment was conducted at Research Block, Krishi Vigyan Kendra, Pilibhit of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut-250110 (U.P.) for two consecutive years During *Kharif* 2020-21 and 2021-22. The experiment was laid in Randomized Block design (RBD), having 9 treatments (Flubendiamide 39.35 EC @ 75 ml/ha, Carbosulfan 25 EC @ 1000 ml/ha, Emamaectin benzoate 5 SG @ 250 g/ha, Spinosad 45 SC @ 500 ml/ha, Indoxacarb 14.5 SC @ 500 ml/ha, Chlorantraniliprole 18.5 SC @ 80 ml/ha & Lambda cyhalothrin 5 EC @ 500 ml/ha and biopesticide *viz.*, *B t* @ 1.5 kg/ha and untreated (control) which were replicated thrice. The plot size was 5 × 4 m with a spacing of 60 × 60 cm. Normal fertilizers doses and recommended agronomical practices were adopted. All these insecticides and bio-pesticides were sprayed with knapsack sprayer twice. For the control of shoot damage, first spray was given at 30 days after transplanting, while for the fruit damage control, first spray was applied at 45 days after transplanting. The subsequent second spray was applied at an interval of 15 days. Observations on shoot and fruit damage were recorded on five randomly selected plants one day before and 3, 7 and 14 days after each application of treatments. Fruits were harvested from each plot separately and yield (kg) per plant at each picking was recorded. The total yield was worked out by adding the yield of all the pickings. The plot yield was converted to quintals per ha. Finally, the cost economics of each chemical treatment was computed. To eliminate the influence of sucking pests and mites, spraying of Imidacloprid 17.8 SL @ 100 ml + dicofol 18.5 EC @ 250 ml/ ha was given two times as blanket sprays (Need based). The percentage of shoot and fruit damage was worked out by the following formula:-

$$\text{Shoot/Fruit damage (\%)} = \frac{\text{No. of damaged shoots/Fruits}}{\text{Total number shoots/Fruits}} \times 100$$

Results and Discussion

Shoot damage

The effect of different treatments on the damage of shoots was significant during both the years as compared to the control (Table 1). In treated plots, the shoot infestation ranged from 6.67 to 18.33 as against 28.34 per ten plants in control, fourteen days after second spray, Chlorantraniliprole 18.5 SC @ 80 ml/ha was found most effective against shoot & fruit borer in minimizing the infestation and was followed by Flubendiamide 39.35 SC @ 75 ml/ha > Emamaectin benzoate 5 SG @ 250 g/ha > Carbosulfan 25 EC @ 1000 ml / ha. > Spinosad 45 SC @ 500 ml/ha > Indoxacarb 14.5 SC @ 500 ml/ha > Lambda-cyhalothrin 5 EC @ 500 ml/ha in the decreasing order, fourteen days after second spray. The bio-pesticidal treatments of *B. thuringiensis* recorded 18.33 per cent shoot infestation. The highest shoot infestation of 28.34 per cent was recorded with untreated control. It was evident that chemical insecticides including bio-pesticides suppressed the shoot infestation by shoot & fruit borer. The insecticide Chlorantraniliprole has been observed to be very effective against fruit & shoot borer. The present findings are in confirmation with Naik *et al.* (2011), who opined that, Chlorantraniliprole resulted in lowest shoot (1.80%), fruit damage (8.20%) and highest marketable fruit yield (159.25 q/ha) followed by Flubendiamide (2.30% shoot damage, 8.50% fruit damage and 158.00 q/ha fruit yield) and Spinosad (2.30% shoot damage, 8.30% fruit damage and 158.00q/ha). The findings of Tayde and Sobita (2010) revealed that Spinosad 45 SC @ 0.01% recorded lower shoot infestation (9.84%), fruit infestation (6.87% on number basis and 07.35% on weight basis) and increased fruit yield (239.30 q/ha). Similarly, Mishra (2008) recorded significantly lowest shoot damage in Chlorantraniliprole 20 EC @ 40 and 50 g a.i./ha in winter (0.08-0.18%) and summer (0.14-0.27).

Fruits damage

The observations of data recorded on the fruit damage on 14th day after first application showed that Chlorantraniliprole 18.5 SC and Flubendiamide 39.35 SC proved most effective insecticides showing minimum (6.67 per cent) fruit damage (Table -2).

Table 1: Effect of different treatments on shoot infestation by L. *orbonalis* on Brinjal (Pooled data of two years).

Treatments	Dose/ ha	Percent shoot damage						
			First Spray			Second Spray		
		1 DBS	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1 Flubendiamide 39.35 EC	75 ml	18.33(25.18)	6.67(14.75)	3.33(8.61)	5.00(12.92)	5.00(12.92)	5.00(12.92)	8.33(16.59)
T_2 Carbosulfan 25 EC	1000 ml	16.67(23.85)	8.33(13.74)	6.67(14.75)	6.67(14.75)	10.00(18.04)	8.33(16.59)	11.67(19.30)
T_3 Emamaectin benzoate 5 SG	250 g	20.00(26.25)	8.33(16.59)	5.00(12.92)	5.00(12.92)	8.33(16.59)	6.67(14.75)	10.00(18.04)
T_4 Spinosad 45 SC	500 ml	17.67(24.81)	10.00(18.04)	10.00(18.04)	8.33(16.59)	10.00(18.04)	10.00(18.04)	11.67(19.30)
T_5 Indoxacarb 14.5 SC	500 ml	22.00(27.53)	13.33(20.75)	8.33(16.59)	10.00(18.04)	13.33(20.75)	11.67(19.30)	13.33(20.75)
T_6 Chlorantraniliprole 18.5 SC	80 ml	17.33(24.34)	3.33(8.61)	1.67(4.31)	1.67(4.31)	3.33(8.61)	3.33(8.61)	6.67(10.45)
T_7 Lambda cyhalothrin 5 EC	500 ml	18.00(25.03)	11.67(19.30)	11.67(19.30)	11.67(19.30)	13.33(20.75)	13.33(20.75)	16.67(23.85)
T_8 *Bacillus thuringiensis*	1500 g	20.00(26.25)	13.33(21.13)	13.33(20.75)	13.33(20.75)	15.00(22.59)	15.00(22.59)	18.33(21.89)
T_9 Untreated Control	-	21.67(27.27)	28.33(29.67)	23.33(28.84)	25.00(29.91)	23.33(28.84)	26.67(31.06)	28.34(30.48)
SEm±		3.709	5.984	3.867	4.825	4.219	4.255	6.967
CD (0.05)		N.S	12.794	8.269	10.316	9.022	9.099	9.221

Data in parentheses are angular transformed values DBS= Day before spray, DAS = Day after spraying

Table 2: Effect of different treatments on fruit infestation by L. *orbonalis* on Brinjal (Pooled data of two years)

Treatments	Dose/ ha	Mean percent fruit damage						
			First Spray			Second Spray		
		1 DBS	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1 Flubendiamide 39.35 EC	75 ml	16.67(23.73)	6.67(14.75)	6.33(14.29)	6.67(14.75)	8.33(16.59)	10.67(18.85)	11.67(19.30)
T_2 Carbosulfan 25 EC	1000 ml	16.00(23.18)	11.67(19.30)	8.33(16.59)	10.00(17.46)	11.67(19.30)	13.33(20.75)	14.00(21.56)
T_3 Emamaectin benzoate 5 SG	250 g	18.33(25.18)	8.33(16.59)	6.67(14.75)	8.33(16.59)	10.00(17.46)	11.67(19.30)	13.33(20.75)
T_4 Spinosad 45 SC	500 ml	15.00(22.58)	13.33(20.75)	10.00(17.46)	11.67(19.30)	13.33(20.75)	15.00(22.59)	15.33(22.85)
T_5 Indoxacarb 14.5 SC	500 ml	15.67(23.19)	15.00(22.59)	11.67(19.30)	13.33(20.75)	14.33(21.92)	16.67(23.73)	16.67(23.73)
T_6 Chlorantraniliprole 18.5 SC	80 ml	18.00(24.91)	5.00(12.92)	3.33(8.61)	6.67(14.75)	8.33(16.59)	10.00(17.46)	10.33(18.46)
T_7 Lambda cyhalothrin 5 EC	500 ml	20.33(26.51)	15.33(22.90)	13.33(20.75)	15.00(22.59)	16.67(23.73)	18.33(25.18)	20.33(26.70)
T_8 *Bacillus thuringiensis*	1500 g	20.67(26.77)	16.67(23.73)	15.00(22.59)	16.67(23.73)	18.33(25.18)	20.33(26.70)	21.67(27.27)
T_9 Untreated Control	-	21.67(27.27)	28.33(32.13)	23.33(28.84)	27.00(31.28)	30.00(33.15)	31.67(34.21)	36.33(36.99)
SEm±		2.649	2.735	3.315	3.100	3.084	3.104	3.397
CD (0.05)		N.S.	1.271	10.025	9.375	9.325	9.386	10.272

Data in parentheses are angular transformed values DBS= Day before spray, DAS = Day after spraying

The next effective treatments were Emamaectin benzoate 5 SG (8.33 per cent) followed by Carbosulfan 25 EC, Spinosad 45 SC, Indoxacarb 14.5 SC, Lambda-cyhalothrin 5 EC and *B. thuringiensis* where in fruit damage ranged from 10.00 to 16.67 per cent. The highest fruit damage (27.00 per cent) was recorded in control. Similar trend was recorded on 3rd day after second application i.e. Chlorantraniliprole 18.5 SC proved to be the best treatment (8.33 per cent). The next treatments were Flubendiamide 39.35 SC, Emamaectin benzoate 5 SG, Carbosulfan 25 EC, Spinosad 45 SC, Indoxacarb 14.5 SC, Lambda-cyhalothrin 5 EC and *B. thuringiensis* in which fruit borer infestation ranged from 8.33 to 18.33 per cent fruit damage. Maximum fruit borer infestation (30.00 per cent) was recorded in control plot. In observations recorded on 14th day after the second application, Chlorantraniliprole 18.5 SC maintained its effectiveness in reducing the fruit borer infestation (10.33 per cent fruit damage). Flubendiamide 39.35 SC with 11.67 per cent infestation was the next effective treatment followed by Emamaectin benzoate 5 SG, Carbosulfan 25 EC, Spinosad 45 SC, Indoxacarb 14.5 SC, Lambda-cyhalothrin 5 EC and *B. thuringiensis* with 13.33, 14.00, 15.33, 16.67, 20.33 and 21.67 per cent fruit damage, respectively. The highest infestation (36.33 per cent fruit damage) was recorded in control plot. The results are in confirmation with Niranjana *et al*. (2017) who reported the supremacy of Chlorantraniliprole 18.5 SC in controlling brinjal shoot and fruit borer. The results are in line with Dattatray *et al.* (2012) who also recorded the lowest fruit damage of 8.8 per cent (number basis) and 8.4 per cent (weight basis) with high yield (293.26 q/ha) by Chlorantraniliprole 18.5 SC, Rajavel *et al.* (2011) also reported that Chlorantraniliprole @ 60 g a.i./ha was effective which record the lowest fruit damage (4.99 %) with yield of 13.22 t/ha followed by its lower doses *i.e.,* 50 and 40 g a.i./ha., which corroborates present finding.

Yield and economics of treatments

All the treated plots resulted higher fruits yield ranging between 169.30 to 293.26 q/ha and were proved significantly superior over the control (155.03 q/ha) (Table 3). The highest fruits yield of 293.26 q/ha was obtained from the Chlorantraniliprole 18.5 SC treated plot. The Flubendiamide 39.35 SC was the second most effective treatment with fruit yield of 283.26q/ha followed by Emamaectin benzoate 5 SG, Carbosulfan 25 EC, Spinosad 45 SC, Indoxacarb 14.5 SC, Lambda-cyhalothrin 5 EC and *B. thuringiensis* with the yield of 275.73, 269.79, 265.96, 257.86, 238.50 and 169.30 q/ha., respectively. The lowest yield (155.03 q/ha) was obtained in control plot. The cost benefit clearly showed that Chlorantraniliprole 18.5 SC ranked first

Table 3. Economics of different treatments against shoot & fruit borer, *L. orbonalis* in Brinjal on pooled yield.

Treatments	Dose/ha	Yield q/ha	Increase in yield over control qt/ha	Value of increase yield (Rs./ha)	Cost of treatment per ha	Net profit (Rs./ha)	Cost benefit ratio
T_1 Flubendiamide 39.35 EC	75 ml	283.26	128.23	23961.00	2600.00	21363.00	1:9.2
T_2 Carbosulfan 25 EC	1000 ml	269.79	120.70	20090.00	2800.00	17290.00	1:7.1
T_3 Emamaectin benzoate 5 SG	250 g	275.73	114.76	22232.00	2600.00	19632.00	1:8.5
T_4 Spinosad 45 SC	500 ml	265.96	110.93	18151.00	2500.00	15651.00	1:7.2
T_5 Indoxacarb 14.5 SC	500 ml	257.86	102.83	16681.00	2450.00	14231.00	1:6.8
T_6 Chlorantraniliprole 18.5 SC	80 ml	293.26	138.23	26761.00	2700.00	24061.00	1:9.9
T_7 Lambda cyhalothrin 5 EC	500 ml	238.50	83.47	12929.00	2500.00	10429.00	1:5.1
T_8 *Bacillus thuringiensis*	1500 g	169.30	14.27	9989.00	2300.00	7689.00	1:4.3
T_9 Untreated Control	-	155.03		-	-	-	-

* Labour charges - @ Rs. 300.00/day/labour.
* Rental value of sprayer - @ Rs. 55.00/day.
* Market price of Brinjal fruits - @ Rs. 900.00/qt.

indicating the maximum return of Rs. 9.9 per rupee invested followed by Flubendiamide 39.35 SC, Emamaectin benzoate 5 SG, Carbosulfan 25 EC, Spinosad 45 SC, Indoxacarb 14.5 SC and Lambda-cyhalothrin 5 EC with 1:9.2, 1:8.5, 1:7.2, 1:7.1, 1:6.8 and 1:5.1 C:B ratio, respectively. *B. thuringiensis* @ 1.5 kg/ha was also found to be effective in reducing the infestation of shoot and fruit borer in brinjal. However, this treatment had low cost benefit ratio (1:4.3). The present findings are supported by the finding of Joshi *et al*. (2010) and Nayak *et al*. (2013) who reported the efficacy of entomopathogen *Bacillus thuringiensis* @ 500gm/ha in reducing the infestation of shoot and fruit borer. The present observations on the effectiveness of Emamectin benzoate are in conformity with those of Anil and Sharma (2010). These results also coincide with Kalawate and Dethe (2012) who stated that Emamectin benzoate and Spinosad are efficient in reducing the population and the subsequent damage caused by brinjal fruit borer.

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Effect of phosphorus and zinc application on the yield and uptake of nutrients by wheat (*Triticum aestivum*) in alluvial soil

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Abstract

A field experiment was conducted at R. B. S. College Research farm Bichpuri, Agra (U.P.) during Rabi season of 2019-2020 to study the response of wheat to phosphorus (0,30,60 and 90 kg ha^{-1}) and zinc (0,2.5,5.0 and 7.5 kg ha^{-1}) on growth and yield attributes and yields of wheat. The experiment was laid out in randomized block design with three replications. Results revealed that application of phosphorus and zinc improved the grain and straw yield of wheat. The per cent increase in grain and straw yield due to 30, 60 and 90 kg P_2O_5 ha^{-1} was to the tune of 8.1, 17.6, 21.5 and 7.8, 17.0 and 20.8 per cent over control, respectively. Application of P @ 90 kg ha^{-1} recorded maximum significantly higher nitrogen, phosphorus, potassium, sulphur and zinc uptake by wheat grain and straw yield followed by P applied @ 60 kg ha^{-1} and P @ 30 kg ha^{-1} compared to control respectively. Application of zinc @ 7.5 kg ha^{-1} recorded significantly higher nutrients uptake by wheat crop compared to no application of zinc

Keywords: Phosphorus, zinc, yield, nutrients, uptake, wheat

Introduction

Wheat is one of the oldest and most important of the cereal crops. Of the thousands of varieties known, the most important are common wheat (*Triticum aestivum*), used to make bread; durum wheat (*T. durum*), used in making pasta (alimentary pastes) such as spaghetti and macaroni; and club wheat (*T. compactum*), a softer type, used for cake, crackers, cookies, pastries, and flours. Additionally, some wheat is used by industry for the production of starch, paste, malt, dextrose, gluten, alcohol, and other products. In India it is the second most important crop after rice and ranks as second largest wheat producing nation at global level contributing approximately 13.88 per cent to the world's wheat production from 14.35 per cent of global area. Wheat contributes about 35 per cent to total food grain basket of our country from about 31.36 million hectares with a production of 107.25 million tonnes and productivity of 3.42 tonnes ha^{-1}**.** The major area under wheat falls in the Indo-Gangetic Plains (IGP) which accounts for roughly 20 million hectares covering the states of Punjab, Haryana, Uttar Pradesh, Bihar and West Bengal. The states of Punjab and Haryana provide maximum contribution to the wheat buffer stock, an essential component of food security in our country.

Phosphorus is a vital component of ATP, the "energy unit" of plants. ATP forms during photosynthesis, has phosphorus in its structure, and

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processes from the beginning of seedling growth through to the formation of grain and maturity. Thus, phosphorus is essential for the general health and vigor of all plants. Phosphorus plays an important role in energy transformation and metabolic process in plants. The most essential function of P in plants is in storage and transfer. Phosphorus is also an important structural component of nucleic acids, coenzymes, nucleotides, phosphoproteins, phospholipids and sugar phosphates. A good supply of P is associated with increased root growth. Ample P nutrition reduces the time required for grain ripening. It is known to be associated with nucleus formation, cell division and nitrogen fixation, fat and albumen formation of the heredity.

Zinc is essential for promoting certain metabolic reactions. It is necessary for the production of chlorophyll and carbohydrates. Zinc is directly o r indirectly required by several enzyme systems, auxin and protein synthesis, seed production and rate of maturity. Zinc is believed to promote RNA synthesis, which, in turn, is needed for protein production. Zinc disposal and uptake by the plant is adversely affected by increasing the phosphorus fertilizer (Salimpour, *et al.* 2010). Both the elements are important for obtaining more yields although they have antagonistic in nature to each other i.e. increasing dose of P adversely effects the Zn nutrient the translocation and accumulation of Zn from roots toward shoots of the plant is in slow rate and that might be the reason (Stukenholts, *et al.* 1996). This antagonism is known to cause yield reduction in many crops. The yield reduction is mainly caused by either P or Zn deficiencies.

Materials and Methods

The field experiment was conducted at the Agriculture Research farm of R.B.S. College Bichpuri, Agra (located in semi arid or gray steppe arid region of South-Western Uttar Pradesh. the intersect of 27.2 0 N attitude and 77.9 0E longitude), during rabi season of 2019-2020 on sandy loam soil. The soil of the experimental field was sandy loam in texture, having pH 8.1, organic carbon 3.7 g kg^{-1} and available N, P, K, and Zn 183.0, 28.0, 290.0 kg ha^{-1}, and 0.58 mg kg^{-1}, respectively. The experiment was laid out in randomized block design with three replications. The treatments included four levels of phosphorus (0, 30, 60 and 90 kg P_2O_5 ha^{-1}) and four levels of zinc (0, 2.5, 5.0 and 7.5 kg Zn ha^{-1}). Recommended doses of nitrogen (120 kg N ha^{-1}) and potash (40 kg K_2O ha^{-1}) along with phosphorus as per treatment were applied through urea, MOP and SSP at the time of sowing as basal dressing. Zinc was applied as per treatment through zinc oxide at the same time. The wheat variety (Raj-3765) which is well suited for Agra region was sown in furrows 5 cm deep at the distance of 20 cm. with seed rate of 100 kg ha^{-1}. The yield and yield attributes were recorded at harvest and analyzed statistically. The mean of each parameter was compared statistically using analysis of variance. For various parameters the critical difference (CD) among the treatments was worked out.

Results and Discussion

Yields

Application of phosphorus up to 60 kg ha^{-1} significantly improved the grain and straw yield over the control (Table1). However, when the level of phosphorus increased from 60 to 90 kg P_2O_5 ha^{-1}, the increase in grain and straw yield was marginal and could not reached the level of significance. The yield of wheat grain increased by 8.1, 17.6 and 21.5 per cent over control due to 30, 60 and 90 kg P_2O_5 ha^{-1}, respectively. The corresponding increase in straw yield was 7.8, 17.0 and 20.8 per cent. The higher yield with increasing levels of phosphorus was mainly due to adequate supply of phosphorus to plants which is turn contributed to better growth and yield attributes, thus led to higher yield. Responses to P application in wheat crop have also been reported by Sepat and Rai (2013), Singh *et al*. (2017) and Mishra *et al.* (2017). The soil in this study was deficient in available phosphorus therefore significant response of wheat to applied phosphorus is quite understandable. The magnitude of response to wheat yield was more in case of phosphorus compared to zinc. (Singh et al. 2016) Application of Zn also increased the green foliage and dry matter yield significantly up to 4 kg Zn ha^{-1}. The magnitude of increase was 15.5 and 27.3 per cent in green foliage and dry matter yield, respectively over control.

Table 1: Grain and straw yield (q ha^{-1}) of wheat as affected by different levels of Phosphorus and Zinc application

Treatments	Grain yield (qha^{-1})	% response	Straw yield (qha^{-1})	% response
Phosphorus (kg P_2O_5 ha^{-1})				
0	42.64	-	50.55	-
30	46.09	8.1	54.47	7.8
60	50.13	17.6	59.16	17.0
90	51.83	21.5	61.06	20.8
SEm±	0.82		1.3	
CD at 5%	2.38		3.79	
Zinc (kg ha^{-1})				
0	44.92	-	52.85	
2.5	47.32	5.3	56.07	6.1
5.0	50.07	11.5	59.35	12.3
7.5	48.25	7.4	57.15	8.1
SEm±	0.82		1.3	
CD at 5%	2.38		3.79	

Nutrients uptake in wheat grain

Application of P @ 90 kg ha^{-1} recorded significantly higher nitrogen (102.1 kg ha^{-1}), phosphorus (12.8 kg ha^{-1}), potassium (27.2 kg ha^{-1}), sulphur (11.8 kg ha^{-1}) and zinc (135.0 mg kg^{-1}) by wheat grain followed by P applied @ 60 kg ha^{-1} nitrogen (98.2 kg ha^{-1}), phosphorus (10.9 kg ha^{-1}), potassium (25.3 kg ha^{-1}), sulphur (10.9 kg ha^{-1}) and zinc (131.5 mg kg^{-1}) and P @ 30 kg ha^{-1} nitrogen (89.4 kg ha^{-1}), phosphorus (9.1 kg ha^{-1}), potassium (22.4 kg ha^{-1}), sulphur (9.1 kg ha^{-1}) and zinc (124.1 mg kg^{-1}) compared to control nitrogen (81.4 kg ha^{-1}), phosphorus (7.6 kg ha^{-1}), potassium (19.8 kg ha^{-1}), sulphur (8.0 kg ha^{-1}) and zinc (114.0 mg kg^{-1}) respectively. Application of zinc @ 7.5 kg ha^{-1} recorded significantly higher nitrogen (98.0 kg ha^{-1}), phosphorus (11.4 kg ha^{-1}), potassium (25.3 kg ha^{-1}), sulphur (11.3 kg ha^{-1}) and zinc (143.3 mg kg^{-1}) by wheat grain followed by zinc applied @ 5.0 kg ha^{-1} nitrogen (95.1 kg ha^{-1}), phosphorus (10.9 kg ha^{-1}), potassium (24.6 kg ha^{-1}), sulphur (10.5 kg ha^{-1}) and zinc (134.9 mg kg^{-1}) and zinc @ 2.5 kg ha^{-1} nitrogen (91.3 kg ha^{-1}), phosphorus (9.6 kg ha^{-1}), potassium (23.4 kg ha^{-1}), sulphur (9.8 kg ha^{-1}) and zinc (120.4 mg kg^{-1}) compared to control nitrogen (86.2 kg ha^{-1}), phosphorus (8.9 kg ha^{-1}), potassium (21.8 kg ha^{-1}), sulphur (8.9 kg ha^{-1}) and zinc (107.2 mg kg^{-1}) respectively. (Munna et al. 2016) Application of @ 90 kg P_2O_5 ha^{-1} significantly increased the nitrogen, phosphorus, potassium and molybdenum uptake by faba bean over control.

Table 2: Effect of phosphorus and zinc levels on nitrogen and phosphorus uptake by barley crop

Treatment	Nitrogen		Phosphorus	
	Grain	Straw	Grain	Straw
Phosphorus (kg ha^{-1})				
0	81.4	25.8	7.6	4.6
30	89.4	28.2	9.1	5.5
60	98.2	32.0	10.9	6.4
90	102.1	34.2	12.8	7.3
SEm±	1.59	0.59	0.35	0.19
CD (P=0.05)	4.61	1.72	1.01	0.55
Zinc (kg ha^{-1})				
0 86.2	27.4	8.9	4.8	
2.5	91.3	29.7	9.6	5.6
5.0	95.1	32	10.3	7.1
7.5	98.0	31.4	11.4	6.3
SEm±	1.59	0.59	0.35	0.19
CD (P=0.05)	4.61	1.71	1.01	0.55

Nutrients uptake in wheat straw

Application of P @ 90 kg ha^{-1} recorded significantly higher nitrogen (34.2 kg ha^{-1}), phosphorus (7.3 kg ha^{-1}), potassium (112.3 kg ha^{-1}), sulphur (7.3 kg ha^{-1}) and zinc (121.3 mg kg^{-1}) by wheat grain followed by P applied @ 60 kg ha^{-1} nitrogen (32.0 kg ha^{-1}), phosphorus (6.4 kg ha^{-1}),

Table 3: Effect of phosphorus and zinc levels on potassium sulphur and zinc uptake by barley crop

Treatments	Potassium		Sulphur		Zinc	
	Grain	Straw	Grain	Straw	Grain	Straw
Phosphorus (kg ha^{-1})						
0	19.8	90.4	8.0	4.1	114.0	99.6
30	22.4	98.5	9.1	5.5	124.l	108.3
60	25.3	108.0	10.9	6.5	131.5	116.0
90	27.2	112.3	11.8	7.3	135.0	121.3
SEm±	0.44	1.01	0.59	0.44	1.92	2.11
CD (P=0.05)	1.27	2.89	1.71	1.28	5.57	6.12
Zinc (kg ha^{-1})						
0	21.8	95.l	8.9	4.8	107.2	89.8
2.5	23.4	102.0	9.8	5.6	120.4	102.0
5.0	23.9	108.6	10.0	7.1	134.9	123.4
7.5	25.3	104.0	10.9	5.8	143.3	128.0
SEm±	0.44	1.01	0.59	0.44	1.92	2.11
CD (P=0.05)	1.27	2.89	1.71	1.28	5.57	6.12

potassium (108.0 kg ha^{-1}), sulphur (6.5 kg ha^{-1}) and zinc (116.0 mg kg^{-1}) and P @ 30 kg ha^{-1} nitrogen (28.2 kg ha^{-1}), phosphorus (5.5 kg ha^{-1}), potassium (98.5 kg ha^{-1}), sulphur (5.5 kg ha^{-1}) and zinc (108.3 mg kg^{-1}) compared to control nitrogen (25.8 kg ha^{-1}), phosphorus (4.6 kg ha^{-1}), potassium (90.4 kg ha^{-1}), sulphur (4.1 kg ha^{-1}) and zinc (99.6 mg kg^{-1}) respectively. Application of zinc @ 7.5 kg ha^{-1} recorded significantly higher nitrogen (32.0 kg ha^{-1}), phosphorus (7.1 kg ha^{-1}), potassium (108.6 kg ha^{-1}), sulphur (7.1 kg ha^{-1}) and zinc (128.0 mg kg^{-1}) by wheat grain followed by zinc applied @ 5.0 kg ha^{-1} nitrogen (31.4 kg ha^{-1}), phosphorus (6.3 kg ha^{-1}), potassium (104.0 kg ha^{-1}), sulphur (6.4 kg ha^{-1}) and zinc (123.4 mg kg^{-1}) and zinc @ 2.5 kg ha^{-1} nitrogen (29.7 kg ha^{-1}), phosphorus (5.6 kg ha^{-1}), potassium (102.0 kg ha^{-1}), sulphur (5.6 kg ha^{-1}) and zinc (102.0 mg kg^{-1}) compared to control nitrogen (27.4 kg ha^{-1}), phosphorus (4.8 kg ha^{-1}), potassium (95.1 kg ha^{-1}), sulphur (4.8 kg ha^{-1}) and zinc (89.8 mg kg^{-1}) respectively. (Pal et al. 2016) A phenomenal increase in uptake of nutrients was recorded in onion bulbs due to increasing levels of Zn up to 5 kg ha^{-1} thereafter a reduction was noted at 10 kg Zn ha^{-1}.

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Influence of Integrated Nutrient Management on growth and yield of Oat (*Avena sativa* L.) under irrigated conditions

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Abstract

*An experiment is conducted at the Campus of Research and Advanced Studies, Dhablan, P.G. Department of Agriculture, G.S.S.D.G.S. Khalsa college, Patiala during 2019-20 to study the "Influence of integrated nutrient management on the growth and yield of the oat (*Avena sativa *L.) under the irrigated conditions". Experiment comprises of the eleven treatments. The experiment was based upon the Completely Randomized Block design with the three replications. The texture of the field soil was clayey with the pH range between 7.2 to 7.4 (saline). The aim of the experiment was to check which combination of organic and inorganic manures is effective to obtain the highest growth and yield. It had been observed that all the treatments had given the effective responses. During the whole crop life cycle the growth attributes, yield attributes and quality parameters were higher with the application of 15 t FYM* ha^{-1} *+ 2 t Groundnut cake* ha^{-1} *+ 2 t vermicompost* ha^{-1} *+ 5 kg* Azotobacter ha^{-1}*. The minimum readings were recorded in the control treatment. The application of 100 % RDF* ha^{-1} *gave the higher cost benefit ratio whereas, higher net return and gross return was obtained by the treatment* T_{10}*. The higher values of quality parameter were also obtained from* T_{10}*.*

Keywords: FYM, Groundnut cake, Vermicompost, RDF, *Azotobacter,* Oats

Introduction

Oat is the both cereal as well as fodder crop. The family of oat is Poaceae. There are over 26 *Avena* species. Only four *Avena* species are widely cultivated all over the world i.e., (*Avena sativa, Avena byzantine, Avena strigose,* and *Avena abyssinica*). The oat (*Avena sativa* L.) is typically known as normal oat and it is major developed and cultivated species.

Nitrogen plays out an ultimate role in improving the efficiency. However, the better utility of inorganic manures will diminish the usefulness because of the deficiency of at least one micronutrient. A higher dose of fertilizers additionally impacts the dearth of one or more micronutrients. Additionally, the cost of fertilizers is also high.

In addition to fertilizer application, the natural increments can also be made. Natural excrement (application of organic manures) works on the physical, chemical and biological properties of the soil. In any case, the whole healthful nutritional requirement of oat can't be satisfied with only organic manure. While with the increase in the use of organic manures, there is increase in the soil acidity which consequently decrease the usefulness.

Biofertilizers are also an excellent opportunity for improving the forage productivity. Biofertilizers increases the range of micro-organisms and increase the microbial processes to transform the supply of nutrients in the form which can be assimilated by the plants. For the fast release of nutrients, the biofertilizer -*Trichoderma* can be used which decomposes the organic matter at faster rates. Like *Trichoderma*, PSB (Potassium Solubilizing Bacteria) is likewise used for seed treatment. PSB changes the unavailable form of soil phosphorous to an available form, in order that it can be easily taken by the plants (Amit Kumar, 2016).

Materials and Methods

This experiment was conducted at the Campus of Research and Advanced Studies, Dhablan, P.G. Department of Agriculture of G.S.S.D.G.S. Khalsa College, Patiala during the rabi season of the year 2019-2020. This area lies at $30^0 33'$ North latitude and $76^0 28'$ East longitude. It lies about 10 km away in the west of Patiala. The climatic condition of this area is quite favourable for the cultivation of the oat crop. The experimental sight is located at 250 m above the sea level. The soil the experimental side is clayey and arid brown in colour. The soil pH ranges between 7.2 to 7.4. The water holding capacity of the soil is high. Soil is deficient in the NPK content.

There was total 11 treatments. The treatments include application of organic, inorganic and biofertilizers. The treatments were T_0 (Control), T_1 (100% RDF ha^{-1}), T_2 (75 % RDF ha^{-1}), T_3 (10t FYM ha^{-1}), T_4 (10 t FYM ha^{-1}+ 3 t Poultry manure ha^{-1}), T_5 (10 t FYM ha^{-1}+ 0.5 t Neem cake ha^{-1}+ 2 t vermicompost ha^{-1}), T_6 (10 t FYM ha^{-1}+ 1 t Groundnut cake ha^{-1}+ 2 t vermicompost ha^{-1}+ *Azotobacter* 5 kg ha^{-1}), T_7 (15 t FYM ha^{-1}), T_8 (15 t FYM ha^{-1}+ 3 t Poultry manure ha^{-1}), T_9 (15 t FYM ha^{-1}+ 1 t Neem cake ha^{-1}+ 2 t vermicompost ha^{-1}), T_{10} (15 t FYM ha^{-1}+ 2 t Groundnut cake ha^{-1}+ 2 t vermicompost ha^{-1}+ *Azotobacter* 5 kg ha^{-1}).

The growth, yield, quality parameters and economics was observed under research work. The readings were taken at 30, 60, 90 DAS and at harvest. The observing the plant parameters the three plants were selected randomly. The fresh weight was observed in (g plant^{-1}). For the dry weight the plants were dried in the oven for 24 hours. Under the plant growth parameters, the plant growth indices such as leaf area index, NAR, crop growth rate were also studied by recording the leaf foliage and dry weight^{-1} at 30, 60, 90 DAS and at harvest. For the yield parameters the crop was harvested and kept under the sun dry for a week. After sun drying the crop was threshed with the thresher. The biological and grain yield was observed in each plot and expressed in the form of q ha^{-1}.

Results and discussion

Under the field experiment the integrated nutrient management had shown the significant role the growth parameters. The values of plant height were best with the application of high amount of integrated organic bulky and concentrated manures (Table 1). The maximum height, fresh weight, dry weight and number of leaves per plant were obtained by the treatment T_{10} followed by the treatment T_9 were there is application of 15 t FYM ha^{-1}+ 1 t Neem cake ha^{-1}+ 2 t vermicompost ha^{-1}. The superiority of treatment T_{10} was due to combined application of bulky and concentrated manures which provides the macro as well as micro plant nutrients in huge amount. As well as the N-fixing bacteria *Azotobacter* was also applied by the soil inoculation for the quick nitrogen response of the manures by fixing into the nitrate form. The growth indices such as leaf area index, NAR and CGR were also higher by the treatment T_{10} (15 t FYM ha^{-1}+ 2 t Groundnut cake ha^{-1}+ 2 t vermicompost ha^{-1}+ *Azotobacter* 5 kg ha^{-1}) followed by T_6 (10 t FYM ha^{-1}+ 1 t Groundnut cake ha^{-1}+ 2 t vermicompost ha^{-1}+ *Azotobacter* 5 kg ha^{-1}) and T_9 (10 t FYM ha^{-1}+ 0.5 t Neem cake ha^{-1}+ 2 t vermicompost ha^{-1}). The growth indices are directly proportional to foliage and dry matter accumulation. In the treatment T_{10} the foliage of the plants was higher due to which their photosynthesis rate was also higher (Table 2). Therefore, formation of photosynthates were also in higher amount as compared to other treatments which increases the dry matter accumulation of the crop plants. With the higher dry matter accumulation, the values of growth indices were higher in the treatment T_{10} (15 t FYM ha^{-1} + 2 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1}). Moreover, in this treatment bulky and concentrated manures improve the physical and biological properties of the soil which effect the soil productivity and increase the production potential (Table 3).

Yield parameters consists of biological and grain yield. Influence of INM on yield attributes were recorded significant. The values of harvest index were recorded higher with the application of treatment T_{10} (15 t FYM ha^{-1} + 2 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1}) i.e., 22.01. The second highest reading was obtained by the treatment T_6 (10 t FYM ha^{-1} + 1 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} +

Table 1: Influence of integrated nutrient management on plant height (cm) at 30, 60, 90 DAS and at harvest

Treatments	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	At harvest
T_0 -Control	18.1	43.1	81.7	99.6
T_1 -100% RDF ha^{-1}	29.3	51.3	92.6	109.1
T_2- -75 % RDF ha^{-1}	25.9	49.7	91.0	107.9
T_3 -10 t FYM ha^{-1}	23.5	47.4	87.3	104.8
T_4 –10 t FYM ha^{-1} + 3 t Poultry manure ha^{-1}	25.4	50.2	90.4	107.9
T_5 -10 t FYM ha^{-1} + 0.5 t Neem cake ha^{-1} + 2t vermicompost ha^{-1}	26.6	50.5	92.2	109.7
T_6 -10 t FYM ha^{-1} + 1 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1}	28.4	52.6	99.2	118.1
T_7 -15 t FYM ha^{-1}	24.4	49.3	89.3	106.8
T_8 -15 t FYM ha^{-1} + 3 t Poultry manure ha^{-1}	26.2	51.4	91.5	109.0
T_9 -15 t FYM ha^{-1} + 1 t Neem cake ha^{-1} + 2 t vermicompost ha^{-1}	27.2	51.7	92.8	110.3
T_{10} -15 t FYM ha^{-1} + 2 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1}	30.3	55.3	103.2	121.4
SE (d) ±	1.1	0.6	1.4	1.7
CD (5%)	2.3	1.2	3.0	3.5
CD (5%)	0.15	0.12	0.52	0.54

Table 2: Influence of integrated nutrient management on NAR at 30, 60, 90 DAS and at harvest

Treatments	NAR (g m^{-2} day^{-1})			
	30 DAS	60 DAS	90 DAS	At harvest
T_0 -Control	0.19	1.37	3.18	2.86
T_1 -100% RDF ha^{-1}	0.77	1.56	3.23	3.05
T_2- -75 % RDF ha^{-1}	0.54	1.74	3.44	3.26
T_3 -10 t FYM ha^{-1}	0.35	1.59	3.23	3.05
T_4 –10 t FYM ha^{-1} + 3 t Poultry manure ha^{-1}	0.64	1.57	3.44	3.26
T_5 -10 t FYM ha^{-1} + 0.5 t Neem cake ha^{-1} + 2t vermicompost ha^{-1}	0.86	1.71	3.57	3.39
T_6 -10 t FYM ha^{-1} + 1 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1}	1.24	1.78	3.75	3.56
T_7 -15 t FYM ha^{-1}	0.46	1.53	3.34	3.15
T_8 -15 t FYM ha^{-1} + 3 t Poultry manure ha^{-1}	0.96	1.68	3.54	3.36
T_9 -15 t FYM ha^{-1} + 1 t Neem cake ha^{-1} + 2 t vermicompost ha^{-1}	1.13	1.72	3.65	3.47
T_{10} -15 t FYM ha^{-1} + 2 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1}	1.38	1.87	4.13	3.98
SE (d)±	0.02	0.09	0.25	0.26
CD (5%)	0.15	0.12	0.52	0.54

Azotobacter 5 kg ha^{-1}). Similarly, highest grain yield (37.66 q ha^{-1}) and biological yield (173.74 q ha^{-1}) was also recorded by the application of treatment T_{10} (15 t FYM ha^{-1} + 2 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1}), followed by the treatment T_6 (15 t FYM ha^{-1} + 2 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1}). The lowest yield parametric readings harvest index (12.32), grain yield (12.14 q ha^{-1}), biological yield (130.84 q ha^{-1}) was obtained by the treatment T_0 (Control).

The biological yield was significantly affected by the rate of dry matter accumulation in the crop plant which was higher by the application of treatment T_{10} due to high light interception because of high leaf area (Table 4). Whereas, the grain yield

Table 3: Influence of integrated nutrient management on leaf area index at 30, 60, 90 DAS and at harvest

Treatments	Leaf area index			
	30 DAS	60 DAS	90 DAS	At harvest
T_0 -Control	0.85	2.27	3.39	4.17
T_1 -100% RDF ha^{-1}	1.33	3.12	5.96	6.74
T_2- -75 % RDF ha^{-1}	1.60	3.53	6.06	6.84
T_3 -10 t FYM ha^{-1}	1.04	2.56	4.87	5.66
T_4 –10 t FYM ha^{-1} + 3 t Poultry manure ha^{-1}	1.53	3.32	4.99	5.78
T_5 -10 t FYM ha^{-1} + 0.5 t Neem cake ha^{-1} + 2t vermicompost ha^{-1}	1.52	3.29	4.49	5.28
T_6 -10 t FYM ha^{-1} + 1 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1}	1.93	3.58	6.11	6.90
T_7 -15 t FYM ha^{-1}	1.14	3.24	5.25	6.03
T_8 -15 t FYM ha^{-1} + 3 t Poultry manure ha^{-1}	1.67	3.36	5.61	6.39
T_9 -15 t FYM ha^{-1} + 1 t Neem cake ha^{-1} + 2 t vermicompost ha^{-1}	1.87	3.55	5.72	6.51
T_{10} -15 t FYM ha^{-1} + 2 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1}	2.02	3.70	6.31	7.09
SE (d)±	0.24	0.29	0.50	0.88
CD (5%)	0.30	0.21	0.64	0.93

Table 4: Influence of integrated nutrient management on grain yield (q ha^{-1})

Treatments	Grain yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
T_0 -Control	12.14	130.84	12.32
T_1 -100% RDF ha^{-1}	24.57	153.51	16.01
T_2- -75 % RDF ha^{-1}	22.16	135.69	16.33
T_3 -10 t FYM ha^{-1}	19.21	134.07	13.33
T_4 –10 t FYM ha^{-1} + 3 t Poultry manure ha^{-1}	23.54	141.25	16.67
T_5 -10 t FYM ha^{-1} + 0.5 t Neem cake ha^{-1} + 2t vermicompost ha^{-1}	26.27	161.60	16.25
T_6 -10 t FYM ha^{-1} + 1 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1}	35.28	170.27	20.73
T_7 -15 t FYM ha^{-1}	22.28	135.56	14.96
T_8 -15 t FYM ha^{-1} + 3 t Poultry manure ha^{-1}	28.98	162.44	17.84
T_9 -15 t FYM ha^{-1} + 1 t Neem cake ha^{-1} + 2 t vermicompost ha^{-1}	33.23	166.26	19.98
T_{10} -15 t FYM ha^{-1} + 2 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1}	37.66	173.74	22.01
SE (d)±	1.51	1.21	1.03
CD (5%)	3.15	3.52	2.15

was higher because of the application of the micronutrients with macronutrients which affect the productivity of the crop.

The parameters studied under the quality were crude protein, crude fibre and TDN. The highest readings of the quality parameters crude protein (206.47 kg ha^{-1}), TDN (16.43 %), crude fibre (37.64 %) was obtained by the application of the treatments T_{10} (15 t FYM ha^{-1} + 2 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1}) and T_6 (10 t FYM ha^{-1} + 1 t Groundnut cake ha^{-1} + 2 t vermicompost ha^{-1} + *Azotobacter* 5 kg ha^{-1})

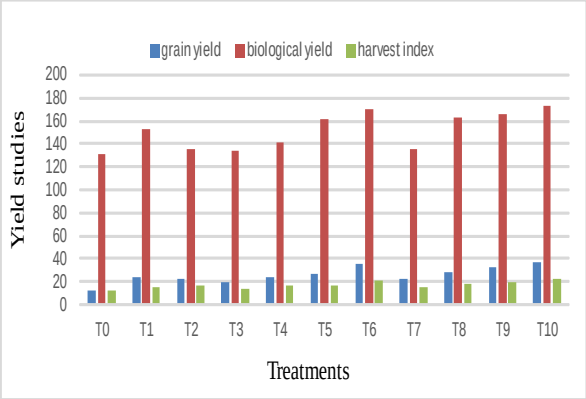

Fig. 1: Influence of integrated nutrient management on yield studies of oat

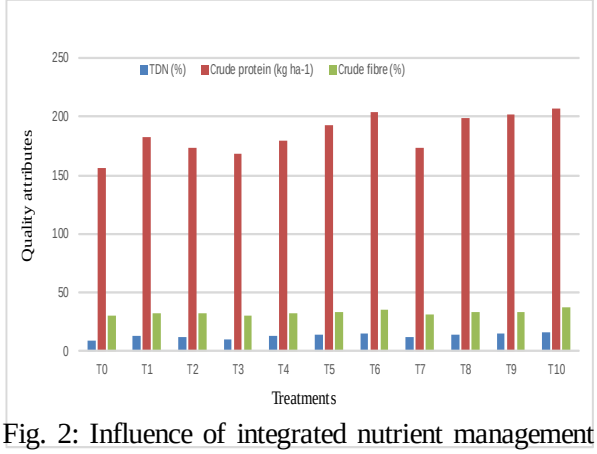

Fig. 2: Influence of integrated nutrient management on quality attributes of oat

was statistically at par to T_{10}. The lowest quality parameters were obtained by the control treatment. The crude protein was made up of amino acids whose primary constituent is nitrogen. So, the availability of nitrogen too higher in treatment T_{10}, that's why crude protein content was higher in this treatment. The crude fibre was higher because of higher vegetative growth increases the lignin percentage which is indigestible

Based upon the biological yield, grain yield and cost of cultivation, the highest B:C ratio was given by the treatment T_1 (100 % RDF), followed by the treatment T_2 (75% RDF).

From the above research finding it could be concluded that the higher grain and forage yield can be achieved by the application of 100 % RDF. However, the higher quality parametric reading such as crude protein, crude fibre and TDN etc are achieved with the application of 100 % RDF with the combination of FYM and vermicompost.

So, the application of 100 % RDF with the bulky organic manures are recommended for higher productivity and quality of oat. INM is essential for the enhancement of quantity, quality and yield parameters. INM not only affect the crop parameters, it also enhances the soil physio-chemical properties of the soil such as application of organic manure prevents the nutrient leaching.

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Optimization of NPK fertilization in conjunction with Plant Growth Regulators (PGRs) affecting productivity and profitability of wheat (*Triticum aestivum* L.)

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Abstract

A field experiment was conducted during Rabi *season of 2018-19 at Agricultural Research Farm, Department of Agronomy, R.B.S. College, Bichpuri, Agra (U.P.) the investigation entitled* "Optimization of NPK fertilization in conjunction with Plant Growth Regulators (PGRs) affecting productivity and profitability of wheat *(*Triticum aestivum *L.)". The experiment was conducted in RBD with 9 treatments, viz. control (T_1), 50% recommended dose of NPK (T_2), 75% recommended dose of NPK (T_3), 100% recommended dose of NPK (T_4), 125% recommended dose of NPK (T_5), 150% recommended dose of NPK (T_6), 100% recommended dose of NPK with plant growth regulator spray at first node and boot leaf stage (T_7), 125% recommended dose of NPK with plant growth regulator spray at first node and boot leaf stage (T_8) and 150% recommended dose of NPK with plant growth regulator spray at first node and boot leaf stage (T_9). Application of higher doses of NPK (225:90:60) with growth regulator spray at first node and boot leaf stage had significant positive effect on all morphological characters of wheat plant. Among all the treatments, application of 150% recommended dose of NPK with plant growth regulator spray at first node and boot leaf stage showed significantly better plant growth and yield.*

Keywords: *Plant Growth Regulators, productivity, profitability,* regulator

Introduction

Wheat is staple food of approximately 23 per cent population of the world. Twenty per cent energy is achieved through wheat at global level. Among food grains wheat is the richest source of protein and it stands at second place after pulses. In general wheat contains carbohydrate (70%), protein (12%), lipid (2%), vitamins & minerals (2% each) and crude fibre (2%). Besides staple food for human beings, wheat straw is a good source of feed for a large population of cattle in our country. Ralcewicz and Knapowski (2004). In addition to house hold uses wheat is consumed in industrial uses in different forms *viz.*, starch, gluten, bran, vitamins, binders and filters, food thickeners, card board etc.

In cereals, lodging is considered to be a serious malady for long time. Development of semi dwarf varieties of crops reduced the problem to some extent, but not completely. Use of higher level of fertilizers, irrigation and sometimes reverting to older cultivars for specific needs and increase in the mechanized harvesting may lead to further losses due to lodging. Presently, development of new varieties for higher yields has reached a plateau and no further increase is achieved unless biotechnological interventions are made. Lodging is the state of permanent displacement of the stems from their upright position. It is induced by external forces like wind, rain or hail. Lodging is often not

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distributed uniformly throughout an affected field but may be scattered over certain sections or spots. Berry *et. al.* (2004) described the types of lodging as stem lodging and root lodging. In cereals, lodging tends to be more when crop is near harvest. Lodging may begin as early as the emergence of the ear or panicle. Winter wheat has been observed to lodge at any time from the emergence of its ear until its grains have matured (Easson *et. al.*, 2003).

In cereals, PGR's are used to reduce lodging. This is mainly achieved by reducing cell elongation, but also by decreasing the rate of cell division. The most commonly used are *Chlormequat chloride* and *Mepiquat Chloride,* contain a positively charged ammonium group in its structure. This group enables the blocking of *ent*-Kaurene synthesis from geranylgeranyl pyrophosphate, which is the precursors of gibberellin. The whole biosynthesis of gibberellin is thereby blocked, inhibiting cell elongation, resulting in shorter stems (Rademacher, 2015). PGR's applied before the emergence of the ear reduced lodging. Most growth regulators are only active for a few days after application and can therefore shorten internodes most effectively when applied during their extension. It was found that applying Chlormequat to winter wheat at the beginning of stem extension could reduce the percentage area lodged from about 73% to less than 8% (Herbert, 2012).

Materials and Methods

The field experiment was carried out during *Rabi* season of 2020-21 at Agricultural Research Farm, Department of Agronomy, R.B.S. College, Bichpuri, Agra (27^0 2' N and longitude of $77^0$9' E with an elevation of 163.4 m above the mean sea-level), Uttar Pradesh. The soil of experimental field was sandy loam in texture with a pH 8.12. The soil was low in available nitrogen (183.00 kg ha^{-1}), medium in available phosphorus (28.30 kg P_2O_5 ha^{-1}) and available potassium (290.00 kg K_2O ha^{-1}). During *Rabi* season of 2020-21, only 9.00 mm rains were received. The Variables involved in this study were nine different treatments of NPK doses and plant growth regulators *viz.* Absolute control (T_1), 50% recommended dose of NPK (T_2), 75% recommended dose of NPK (T_3), 100% recommended dose of NPK (T_4), 125% recommended dose of NPK (T_5), 150% recommended dose of NPK (T_6), 100% recommended dose of NPK with plant growth regulator spray at first node and boot leaf stage (T_7), 125% recommended dose of NPK with plant growth regulator spray at first node and boot leaf stage (T_8) and 150% recommended dose of NPK with plant growth regulator spray at first node and boot leaf stage (T_9). Thus, in all 9 treatments were compared in a randomized block design (RBD) with three replications.

Results and Discussion

Yield attributes

Stand count/m^2

The data set out in Table 1 reveal that stand count/m^2 was significantly influenced due to various treatments over absolute control and the variation was 19.85 to 30.24 per cent. Maximum stand count/ m^2 was noted with the application of 150% recommended dose of NPK with growth regulator spray at first node and boot leaf stage (T_9) which was significantly higher over all other treatments except T_8 (125% Recommended dose of NPK with growth regulator spray at first node and boot leaf stage) and T_7 (100% Recommended dose of NPK with growth regulator spray at first node and boot leaf stage).

Number of ear head/metre^2

Treatment T_9 (150% recommended dose of NPK with growth regulator spray at first node and boot leaf stage) differ marginally with T_8 (125% recommended dose of NPK with growth regulator spray at first node and boot leaf stage) and T_7 (100% recommended dose of NPK with growth regulator spray at first node and boot leaf stage), produced significantly higher number of ear head/m by 4.56 to 32.87per cent over rest of the treatments.

Length of spike (cm)

The data enumerated in Table 1 indicate that length of spike increased significantly due to all treatments of various levels of NPK and PGR application over control. Length of spike appreciably increased with the application of 150% recommended dose of NPK with plant growth regulator spray at first node and boot leaf stage (T_9) over all other treatments except T_8 (125% recommended dose of NPK with plant growth regulator spray at first node

Table 1: Yield contributory characters of wheat as influenced by various treatments

Treatments	Stand count/ m^2	No. of Ear head /m^2	Length of spike (cm)	No. of spikelets spike^{-1}	No. of fertile spikelets	No. of unfertile spikelets	No. of grains spike^{-1}	Grain weight spike^{-1} (g)	1000-grain weight(g)
T_1-control	206.64	188.91	7.36	35.81	30.10	5.71	35.38	1.42	40.14
T_2-50%RDF	247.66	230.64	9.06	45.82	41.42	4.40	45.46	2.06	41.37
T_3-75%RDF	251.76	233.93	9.67	48.71	45.08	3.63	47.68	2.12	41.69
T_4-100%RDF	254.13	236.19	9.72	51.11	48.13	2.98	49.38	2.16	42.23
T_5-125%RDF	257.27	239.21	9.93	54.86	52.84	2.02	52.76	2.30	42.40
T_6-150%RDF	258.91	240.07	10.02	56.86	54.98	1.88	57.78	2.44	43.59
T_7-100%RDF+PGR	263.04	244.89	10.36	64.24	62.34	1.90	59.24	2.47	43.74
T_8-125%RDF+PGR	265.15	247.27	10.41	64.38	62.83	1.55	61.39	2.54	44.46
T_9-150%RDF+PGR	269.13	251.01	10.75	65.89	64.49	1.40	64.38	2.73	45.31
SEm±	0.18	0.21	0.15	0.94	0.47	0.11	1.68	0.08	0.40
CD (p=0.05)	0.58	0.65	0.46	2.82	1.40	0.34	5.05	0.24	1.20

* RDF = (150:60:40kgha^{-1}N.P.K.) * PGR =Plant Growth Regulator

and boot leaf stage) and T_7 (recommended dose of NPK with plant growth regulator spray at first node and boot leaf stage) which were statistically at par with T_9.

No. of Spikelets spike^{-1}

The data summarized in Table 1 reveal that all the treatments had significant effect on number of spikelets spike^{-1}. Application of 150 % recommended dose of NPK with growth regulator spray at first node and boot leaf stage (T_9) did not differ much with 125% recommended dose of NPK with growth regulator spray at first node and boot leaf stage (T_8) and 100% recommended dose of NPK with growth regulator spray at first node and boot leaf stage(T_7), resulted in significantly higher number of spikelets spike^{-1} by 15.88 to 84.00per cent, over rest of the treatments. Treatment T_6 (150% recommended dose of NPK) and T_5 (125% recommended dose of NPK) were at par among themselves but increased number of spikelets spike^{-1} significantly over T_4, T_3, T_2 and T_1.

No. of Fertile spikelet's spike^{-1}

Maximum number of fertile spikelet's spike^{-1} was observed with the application of 150% recommended dose of NPK with growth regulator spray at first node and boot leaf stage (T_9) which was significantly higher over all other treatments by 2.64 to 114.25per cent.

Treatment T_8 (125% recommended dose of NPK with growth regulator spray at first node and boot leaf stage) did not differ with T_7(100% recommended dose of NPK with growth regulator spray at first node and boot leaf stage) but these treatments had significantly higher number of fertile spikelet's spike^{-1} as compared to rest of the treatments.

Unfertile spikelet's spike^{-1}

Table 1 clearly indicates that different levels of recommended doses of NPK and PGR application exert significant effect on number of unfertile spikelet's spike^{-1}. Maximum number of unfertile spikelet's spike^{-1} (5.71) was noted with absolute control (T_1) which was significantly higher by 22.94 to 75.48 per cent over all other treatments tested in the experiment. Although the application of 150% recommended dose of NPK with growth regulator spray at first node and boot leaf stage (T_9)

was statistically at par with T_8(125% recommended dose of NPK with growth regulator spray at first node and boot leaf stage) but produced a smaller number of unfertile spikelets spike^{-1} significantly than that of rest of the treatments and the magnitude was 26.32 to 75.48 per cent.

No. of grains spike^{-1}

Table 1 clearly indicates that number of grains spike^{-1} significantly influenced due to application of doses of NPK and PGR. Treatment T_9 (150% recommended dose of NPK with growth regulator spray at first node and boot leaf stage) recorded significantly higher number of grains spike^{-1}over all other treatments except T_8 (125% recommended dose of NPK with growth regulator spray at first node and boot leaf stage).

Grain weight spike^{-1}

From the data presented in Table 1, it is observed that different doses of NPK and PGR application exert significant effect on grains weight spike^{-1}. Maximum grains weight spike^{-1} (2.73 g) was observed with the application of 150% recommended dose of NPK with growth regulator spray at first node and boot leaf stage (T_9) which was statistically at par with T_8 (125% recommended dose of NPK with growth regulator spray at first node and boot leaf stage) produced significantly higher grain weight spike^{-1}over rest of the treatments by 11.90 to 98.59 per cent. Minimum grain weight spike^{-1} was noted with absolute control (T_1).

1000-Grain weight (g)

Treatment T_9 (150% recommended dose of NPK with growth regulator spray at first node and boot leaf stage) differed marginally with treatment T_8 (125% recommended dose of NPK with growth regulator spray at first node and boot leaf stage), resulted in significantly higher 1000-grain weight by 2.96 to 9.12 per cent over all other treatments. Absolute control (T_1) proved its significant inferiority over all other treatments with 1000-grain weight of 40.14 g.

Yield (qha^{-1})

Biological yield (q ha^{-1})

The data pertaining to biological yield of wheat as affected by various treatments were subjected to statistical analysis. The observations recorded showed that biological yield was significantly higher (134.95 q ha^{-1}) with the application of 150% recommended dose of NPK with growth regulator spray at first node and boot leaf stage (T_9) which produced significantly higher biological yield over all the treatments except treatment T_8 (125% recommended dose of NPK with growth regulator spray at first node and boot leaf stage).

Minimum biological yield (55.11q ha^{-1}) was observed in case of absolute control (T_1) which was significantly less by 81.20 to 144.87 per cent than all other treatments under test.

Table 2: Biological, grain and straw yield and harvest index of wheat as influenced by various treatments

Treatments	Biological yield(q/ha)	GrainYield (q/ha)	StrawYield(q/ha)	Harvest index(%)
T_1-control	55.11	23.21	31.90	42.12
T_2-50%RDF	99.86	41.34	58.52	41.40
T_3-75%RDF	108.34	45.11	63.23	41.64
T_4-100%RDF	112.72	47.08	65.64	41.77
T_5-125%RDF	119.33	49.97	69.36	41.88
T_6-150%RDF	121.75	51.15	70.60	42.01
T_7-100%RDF+PGR	125.38	53.00	72.38	42.27
T_8-125%RDF+PGR	128.77	54.27	74.50	42.14
T_9-150%RDF+PGR	134.95	55.28	79.67	40.96
SEm±	2.04	0.74	1.71	0.47
CD (p=0.05)	6.12	2.22	5.13	NS

*RDF-(150:60:40kgha^{-1}N.P.k.)

Grain Yield (qha^{-1})

The data computed in Table 2 clearly indicate that the grain yield differed significantly due to levels of NPK and PGR. A perusal of data reveals that treatment T_9 (150% recommended dose of NPK with growth regulator spray at first node and boot leaf stage) did not differ much with T_8 (125% recommended dose of NPK with growth regulator spray at first node and boot leaf stage).

Straw Yield (qha^{-1})

A perusal of the data reveals that various levels of recommended doses of NPK as well as application of PGR exhibited significant variation in straw yield. Significantly higher straw yield was obtained with treatment T_9 (150% recommended dose of NPK with growth regulator spray at first node and boot leaf stage) over all other treatments and the magnitude of increase was to the tune of 6.94 to 149.75 per cent.

Harvest Index (%)

Different levels of NPK and PGR did not exert significant effect on harvest index. However, maximum (42.27) and minimum (40.96) harvest index was noted with T_7 (100% recommended dose of NPK with growth regulator spray at first node and boot leaf stage) and T_9(150% Recommended dose of NPK with growth regulator spray at first node and boot leaf stage), respectively.

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Impact of mineral mixture feeding on milk yield of buffalo in Sheopur district of Madhya Pradesh

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Abstract

A field experiment was conducted in Vijaypur block of Sheopur district to observe the Impact of mineral mixture feeding on milk yield in Sheopur district Buffalos of Madhya Pradesh. Animals were selected randomly from 4 villages of Vijaypur block of Sheopur (Doulatpura, Dimarchha, Kishanpura and Sikheda). 30 Buffaloes were selected in their 1nd and 2rd stage of lactation and divided into two groups of 15 animals each. First group (A) was feed with 70 g mineral mixture daily till 90 days of lactation, which are experimental practices. Other groups (B) of 15 animals were not feed additional mineral mixture, which is farmers practice in that particular area. The farmers were not feed scientific method of feeding. They could not added proper quantity of mineral mixture in balance ration. To keeping in mind a trial was conducted in Vijaypur block of Sheopur district since 2017-18 & 2018-19. Milk yield of these animals was recorded by their owners and these values were averaged for fortnightly interval. Milk production parameters like average daily milk yield, peak yield and total milk yield (Lit.) were compared between treatment and control groups. It was observed that average daily milk yield, peak yield and total milk yield (Lit.) were found significantly (P < 0.05) higher by 12.50, 14.85 and 11.55 per cent in mineral mixture feed group than control group. On the basis of this, it is recommended that continuous feeding of mineral mixture bettered performance of milk yield in Vijaypur block in Sheopur district buffaloes.

Key words: Mineral mixture, feeding on milk yield, Buffalo

Introduction

India is the first in milk producing country in the world accounting for 18.5 per cent of world milk production and achieving an annual output of 146.3 million tons during 2014-15, with a growth of 6.26 per cent. However, in other aspect present level of buffaloes milk in Sheopur district of Madhya Pradesh is very low, under production is mainly result of involuntary culling due to poor body condition, low fertility and some health issue, eventually it affects profitability from the animals. The balanced nutrition is very essential for keeping animal body in good condition and renders them to maintain their optimum production out of all nutrients minerals and vitamin play a crucial role in metabolism, location, reproduction and even for microbial fermentation in rumen (Bhannderi *et al.,* 2016).

Most of the animals in developing countries including India are feed on agriculture by products and low quality crop residues, which have got low in herent, low nutritive value and digestibility. High producing buffaloes in early lactation do not consume sufficient dry matter to support maximum production of milk (Goff and Horst, 1998). Demand for energy is very high during early stage of lactation but supply is not commensurate with demand due physiological stage or limited intake may affects production

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potential of animal in the whole lactation length

Problem of mineral deficiency and metabolic disease in all categories of dairy livestock have been reported by many Scientist due to lower content and low bioavailability of some essential macro and micro mineral in different feed stuffs. Regular feeding of mineral mixture supplement have reportedly improved milk yield in some parts of India (Tiwari *et al.*, 2013). The present study was conducted to observe the effect of mineral mixture feeding on milk yield of buffalo over a period of 90 days.

Materials and Methods

Thirty buffaloes (15 in treatment group, 15 in control group) were selected randomly from 4 villages of Vijaypur block of Sheopur (Doulatpura, Dimarchha, Kishanpura and Sikheda). during the study period (October 2017 to December 2019).

All the animals were selected at a comparable stage of lactation *i.e.* within first month of lactation and were maintained under similar management conditions throughout the trial. Animals from treatment group were feed mineral mixture (Table 1) at the rate of 70 g/animal/ day for a period of 3 months, whereas animals from control group were not fed supplemented, milk yield of these animal was recorded by their dairy farmer and these value were averaged daily milk yield, peak yield, total milk yield, milk fat percentage, SNF percentage, total milk solid and 90 days milk production (lit) was noted regularly in whole experiment period of 3 months. Fortnightly analysis of milk sample was done to find out composition of the milk. The data recorded on various parameters were analyzed for statistical difference by analysis of variance (Snedecor and Cochran, 1989) and Duncan's multiple range test (Duncan, 1995).

Table 1: Composition of mineral mixture (per 100 kg)

Source	Weight (in kg)
Diacalcium phosphate	55 kg
Calcium corbonate	30 kg
Ferrous sulphate 2 kg	
Mangnesium sulphate	10 kg
Copper sulphate 0.5 kg	
Manganese sulphate	0.5 kg
Zinc sulphate	0.5 kg

On the basis of this, it is recommended that continuous feeding of mineral mixture bettered performance of milk yield in buffaloes.

Results and Discussion

The results of the present study as well as relevant discussions have been presented under following sub heads: Milk yield parameter: The observation was recorded for milk yield and their composition and data presented in Table 2.

It was observed that average daily milk yield was found significant ($P < 0.05$) higher in treatment group than the control group. Beside this, treated animals were produced significantly ($P < 0.05$) higher total milk yield for 90 days than the control group. Noeek *et al.* (2006) has also found higher milk yield in mineral supplementation group of buffaloes. Average daily milk yield and total milk yield was found higher in treatment group over control group by 11.55 per cent and 14.85 per cent, respectively.

Singh *et al.* (2016) also reported same result of improved milk production in mineral fed buffaloes. The recorded peak milk production in treatment group was also found significantly ($p < 0.05$) higher in treatment group. However, a time lap to achieve peak production was found non-significant higher in treatment group. It means buffalo fed with mineral mixture was getting more time in her peak production but these buffaloes were found more persist in nature. The treatment group buffaloes were able to hold per peak yield for longer duration than the control group. Result indicating that feeding of mineral mixture could improve milk production potential of buffaloes due to having impact on the milk production cells in the udder. Their micro and macro element contribute in the working of memory cell to enhance their production. These finding is in full agreement with Rohilla and Bohra (2007) observation.

Average percentage of milk fat was found non- significantly higher in treatment group (7.95%) than the control group (7.13%). The percentage SNF and total solid of milk (TS) was followed the same trend as the parameters were found non-significantly

Table 2: Effect of mineral mixture on milk yield parameter in buffaloes (Mean ± SE)

Milk yield parameter	Treatment (T)	Control (C)
Average daily milk yield (lit)	10.80 ± 1.62	9.6 ± 1.42
Peak milk yield (lit)	12.37 ± 0.17	10.77 ± 0.30
Time laps to reach peak yield (day)	31.2 ± 1.12	23.5 ± 1.25
Total milk yield for 90 day (lit)	985 ± 0.92	883 ± 1.25
Average milk fat %	7.95 ± 0.37	7.13 ± 0.34
Average milk SNF %	9.59 ± 0.10	9.24 ± 0.78
Total solid in milk	18.02 ± 0.17	17.57 ± 0.18

higher in mineral fed group than the control group. These finding was comparable with result obtained by Verma *et al.* (2009).

Conclusion

It could be recommended that supplementation of mineral mixture in milking buffaloes improve their health and production potential, so with its supplementation farmer can earn more profit from their buffaloes.

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Existing Management Practices Followed by Goat keepers in Jhunjhunu District of Rajasthan

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Abstract

The present study was carried out in Jhunjhunu district of Rajasthan to identify the various existing management practices followed by the goat keepers. It was observed that majority (57.08%) of the respondents grazed their flock in field, more than two-third (69.17%) of the goat keepers fed concentrate mixture to lactating doe and 80.00 percent of the respondents fed special concentrate mixture after kidding. Regarding breeding practices, all the respondents resorted to natural service, more than half (57.50%) of the goat keepers yet use non-descript buck for breeding and about three-fourth (71.25%) change breeding buck in 1.5-2.25 years age. Majority (84.58%) of the goat keepers conceived their female kids in the age of 12-15 months. Mixed type shed (47.50%), kutcha floor (89.17%), thatched material roof (40.00%), shed near dwelling (40.83%), barbed wire boundary fencing (52.92%) and weekly cleaning of shed (49.17%) were more prevalent in the study area. It was observed that majority (85.00%) of the respondents fed colostrum to newly born kids within two hours, ligation and disinfection of naval cord (70.42%), weaning of kids after two months (82.92%), castration of male kids (89.58%) and selling of kids in three months age (68.75%). physical appearances (89.68%) of kids were the main base of market cost and marketing at their own village/ home were more preferred by the goat keepers. Regarding healthcare management practices, it was concluded that only 13.33 % goat keepers done three times deworming in a year, 27.50 % did regular vaccination and 11.25 % take proper treatment from veterinary doctor. Majority (74.17%) of the respondents leave as such dead body of animals for decay/ vulture and 57.92 percent of the goat keepers not satisfied with the available veterinary facilities.

Key words: Goat. Goat keepers, Existing management practices

Introduction

Goat rearing plays a vital role in rural areas by providing milk, meat, manure and employment. Goat can consume a variety of vegetation, which are not useful for other livestock species. Goat is very popular among small, medium and land less farmers, it requires less capital investment, labour, space, care, feed and fodder for rearing, so it is more beneficial in comparison to rear large dairy animals for weaker section. Goat milk is very useful and nutritious for baby and old age people due to their easy digestion character. Goat rearing is well suited to weaker sections of the society with small land holding (Rohilla and Chand, 2004). Among the small ruminants, goats are widely distributed (Rath, 1992) and contribute a significant source of supplementary income and family nutrition to resource poor rural people (Kumar and Deoghare,

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2003). According to 20th livestock census, goat population contributes 27.79 percent of the total livestock population in India and out of total goat (56.80 million) 20.84 million goats were reared in Rajasthan which is nearly 36.69 percent of the nation (Livestock census, 2019). In the past six decades, the rate of increase in goat population was highest among all ruminants, where on an average 30 % goat were slaughtered per year in our country. Jhunjhunu district has 442134 goat populations which are highest in ruminants and it is 74.30 % of total small ruminants. Establishment of organized goat farming unit increases day by day in rural area because it provides regular income as well as employment to the rural unemployed youth. Hence, it is an ATM, mobile freeze and *Kamdhenu* for farmers in rural areas. Keeping the importance of goat husbandry in district, a comprehensive study was carried out to find out the existing management practices followed by goat keepers in the aspects of feeding, breeding, housing, kids and healthcare management.

Methodology

The present study was carried out in Khetri, Udaipurwati, Mandawa and Alsisar blocks of Jhunjhunu district of Rajasthan. Out of eleven blocks of Jhunjhunu district four were selected purposively on the basis of goat population. Three village from each block and 20 goat keepers from each village were selected on the basis of maximum goat population with the help of Patwari and Gram Panchayat livestock population data. Thus the entire sample consisted of 240 respondents from selected twelve villages in the four block of the district. The data were collected by personal interview techniques through a well structured interview schedule. The survey was conducted in the field from April to November, 2022. The existing management practices related to feeding, breeding, housing, kids and healthcare management were separately enlisted. The frequencies were obtained for individual practices of feeding, breeding, housing, kids and healthcare management included in the study. The score of individual practice was converted into percentage to draw a meaningful inference of the study.

Results and Discussion

The existing management practices of feeding, breeding, housing, kids and healthcare followed by all the respondents were studied and individual practice has been described in the following sub-sections.

I. Existing Feeding Management Practices:

The results regarding various feeding management practices followed by the goat keepers are presented in Table-1. Majority (57.08%) of the respondents grazed their flock in the harvested/ fellow land, while 29.58 percent practiced semi stall feeding. More than two-third (69.17%) of the respondents fed concentrate mixture to lactating doe, 56.25 percent fed concentrate mixture to advance pregnant females (after135 days of pregnancy) and 80.00 percent respondents fed special concentrate mixture after kidding for 5-7 days. These data were encouraging than reported by Sakthivel *et al*. (2012), who reported that only 12.86 percent respondents fed concentrate mixture in Namakkal district of Tamil Nadu and same findings were reported by Yadav (2019) for Bhilwara district of Rajasthan. Regarding flushing up of breedable females, more than half (52.92%) of the respondents practiced before onset of breeding season. About three-fourth (74.58%) of the goat keepers fed concentrate mixture to kids and none of the respondents fed concentrate mixture to breeding buck regularly. Incorporation of mineral mixture in goat ration was very low (9.17%) and none of the respondents fed hay to the flock. About two-third (69.17%) of the respondents fed green fodder/ tree lopping occasionally and 30.83 percent fed green fodder regularly in the study area. Similar findings were also reported by Sakthivel *et al*. (2012). These data clearly indicated that majority of the goat keepers were aware about the feed & fodder importance and fed concentrate mixture and green fodder.

II. Existing Breeding Management Practices:

It was concluded from the Table 2 that all the respondents resorted to natural breeding and none of the respondents followed the artificial insemination breeding method. Similar observations were reported by the Sakthivel *et al*. (2012), Rashmi *et al*. (2014) and Meena *et al*. (2022) in their study

Table 1: Existing feeding management practices n-240

S.No.	Feeding practices	Existing practices	Frequency	Percentage
I	Feeding	Grazing	137	57.08
		Stall feeding	32	13.33
		Semi stall feeding	71	29.58
II	Concentrate feeding to lactating does	Yes	166	69.17
		No	74	30.83
III	Concentrate feeding to advance pregnant doe	Yes	135	56.25
		No	105	43.75
IV	Special feeding after kidding	Yes	192	80.00
		No	48	20.00
V	Flushing up of breedable female	Yes	127	52.92
		No	113	47.08
VI	Concentrate feeding to kids	Yes	179	74.58
		No	61	25.42
VII	Concentrate feeding to breeding buck	Regular	00	00
		Breeding season	240	100.00
VIII	Mineral mixture feeding	Yes	22	09.17
		No	218	90.83
IX	Green fodder/tree lopping feeding round the year	Regular	74	30.83
		Occasionally	166	69.17
X	Hay feeding	Yes	00	00
		No	240	100.00

areas. More than half (57.50%) of the goat keepers used non-descript breeding buck with two service (86.25%) per oestrus period. These findings were supported by Randhave *et al*. (2022). Majority (85.42%) of the respondents take first service of breeding buck in the age of 12-18 months. These findings are in line with Rashmi *et al*. (2014). About three-fourth (71.25%) of the respondents change breeding buck at 1.5-2.25 years interval and few number (2.92%) had maintain proper breeding record. These findings are encouraging than Yadav (2019) who reported that 76.00 percent goat keepers had not changed breeding buck. Frequent urination, wagging of tail, bleating and mounting were the major sign of heat detection and all the respondents diagnosed pregnant does by absence of oestrus signs and physical appearance of female goat. Although majority of the breedable female conceived in both spring and autumn season and only 14.58 percent respondents kept breeding buck separate from the flock. Majority (84.58%) of the goat keepers bred their female kid first time in the age of 12-15 months and 86.25 percent respondents bred 2-3 months after kidding. These findings are encouraging than Kumar and Vasanthakumar (2017), who reported less adoption of these practices in Tamil Nadu and Rawat *et al*. (2017) also, who reported more age at first kidding and kidding interval in Bundelkhandi goat.

III. Existing Housing Management Practices:

It was observed that majority (57.08%) of the respondents had mix type housing followed by closed (26.67%) and open type house (16.25%). *Kutcha* Floor (89.17%) was more prevalent in the study area. Similar observations were reported by Tanwar *et al*. (2008), Yadav and Khada (2009), Yadav and Tailor (2010) and Tanwar & Rohilla (2012) from different region of Rajasthan. More than (77.50%) three-fourth of the goat keepers had no slope in goat shed. It was observed that 40.00, 35.42 and 24.58 percent of the respondents used thatched material, tin and open goat shed roof, respectively. Similar findings were reported by Ekambaram *et al*. (2011) in Andhra Pradesh and

Table 2: Existing breeding management practices n-240

S.No.	Breeding Practices	Existing practices	Frequency	Percentage
I	Breeding method	Natural service	240	100.00
		Artificial insemination	00	00
II	Breed of breeding buck	Sirohi	47	19.58
		Jakhrana	55	22.92
		Non descript	138	57.50
III	No. of service/ oestrus	One	33	13.75
		Two	207	86.25
IV	Service take at breeding buck age	10-12 months	14	05.83
		12-18 months	205	85.42
		18-24 months	21	08.75
V	Change of breeding buck	1.0-1.5 year	69	28.75
		1.5-2.25 year	171	71.25
VI	Maintenance of proper breeding record	Yes	07	02.92
		No	233	97.08
VII	Sign of heat detection	Frequent urination & wagging of tail	109	45.42
		Bleating, mounting	82	34.17
		Discharge from vulva	49	20.42
VIII	Pregnancy diagnosis	By Veterinary staff	00	00
		By symptoms	240	100.00
IX	Breeding season	Spring	197	82.08
		Autumn	202	84.17
X	Breeding buck kept	Separate	35	14.58
		Together with flock	205	85.42
XI	Breeding after 2-3 months of kidding	Yes	207	86.25
		No	43	13.75
XII	Age at first breeding of female	10-12 months	37	15.42
		12-15 months	203	84.58

Singh *et al*. (2017) in Uttar Pradesh. Regarding location of shed, 40.83 percent of the respondents kept near dwelling house, 37.92 percent in side dwelling house and 21.25 percent separate from dwelling house (Table 3). Similar findings were reported by Singh *et al*. (2017) in Uttar Pradesh. More than half (52.92%) of the respondents constructed boundary wall by barbed wire/bushes and 49.17 percent goat keepers did weekly cleaning of shed. Majority (82.08%) of the respondent kept male & female together in flock and kids separate. More than half (55.00%) of the goat keepers constructed water trough in goat shed and majority (84.58%) of the goat keepers had no drainage channel or pit in the shed.

IV. Existing Kids Management Practices:

Perusal of the data revealed that majority (85.00%) of the respondents fed colostrum within two hours (Table 4) and twice in a day (90.42%) to newly born kids. More than two-third (70.42%) of the respondents did ligation and disinfection of naval cord and 82.92 percent goat keepers weaning of kids up to two months of age. Majority (89.58%) of the respondents castrated male kids. The present findings are contrary to Yadav (2019), who reported less adoption of male kids' castration in his studied area. It was observed that 79.58 percent of the respondents did deworming of kids. About two-third (68.75%) of the respondents sold kids in three month of age. Majority (89.58%) of the respondents decide selling cost on the basis of physical appearance of kids/ culled animals. These findings are contrary to Senthikumar *et al*. (2012), who reported that more than three-fourth of the respondents trading was

Table 3: Existing housing management practices n-240

S.No.	Housing Management Practices	Existing practices	Frequency	Percentage
I	Type of shed	Open	39	16.25
		Close	64	26.67
		Mixed	137	57.08
II	Floor of shed	*Kutcha*	214	89.17
		Pucca	26	10.83
III	Slope in floor	Yes	54	22.50
		No	186	77.50
IV	Type of roof	Open	59	24.58
		Thatched material	96	40.00
		Tin shed	85	35.42
V	Location of shed	Inside dwelling house	91	37.92
		Near dwelling house	98	40.83
		Separate from dwelling house	51	21.25
VI	Type of boundary wall	Stone	78	32.50
		Pucca	35	14.58
		Barbed wire/ bushes	127	52.92
VII	Cleaning of shed	Daily	44	18.33
		Weekly	118	49.17
		Fortnightly	78	32.50
VIII	Housing pattern	Male & female together but kids separate	197	82.08
		Female & kids together but male separate	43	17.92
IX	Provision of water trough in shed	Yes	132	55.00
		No	108	45.00
X	Drainage channel/ pit	Yes	37	15.42
		No	203	84.58

based on muscle thickness at loin and thigh region. The traders assess the probable meat yield on the muscle thickness and fixed price for animals in southern Tamil Nadu and only 12.73 percent decided the selling price on the basis of physical appearance. Majority (80.00%) of the goat keepers preferred to sell kids and surplus stock at home itself. It might be due to small number of animals available for sale with respondents and better bargaining strength when sold at their own home/ village. These observations were similar to earlier findings of Deoghare and Kumar (2003), Tanwar *et al*. (2008), Gurjar *et al*. (2008) and Tanwar and Rohilla (2012). Almost three-fourth (71.67%) of the respondents sold kids and culled animals about 30 percent of their total stock per year, which is the main source of goat keepers' income.

V. Existing Healthcare Management Practices:

It can be concluded from the Table 5 that all the respondents done deworming in which 52.92, 33.75 and 13.33 percent goat keepers did one time, two time and three times in a year, respectively. The present results are encouraging than Gurjar *et al*. (2008), Tanwar & Rohilla (2012) and Singh et al. (2023) who were reported less deworming practices in other parts of the country. Only 27.50 percent of the respondents did regular vaccination, while majority (72.50%) of the goat keepers done vaccination only when diseases were spread. Similar findings were reported by Gokhale *et al*. (2002), Tanwar & Rohilla (2012) and Yadav (2019). It was observed that 68.75 percent of the respondents did not isolate their sick animals from healthy ones and more than half (54.58%) of the respondents take proper treatment of sick animals from veterinary doctor (11.25%) and LSA (43.33%). The results were supported by Yadav (2019). More than (36.25%) one-third of the goat keepers smoke of

Table 4: Existing kids management practices n-240

S.No.	Kids management Practices	Existing practices	Frequency	Percentage
I	Colostrum feeding to newly born kids	Within two hours	204	85.00
		After placenta drop	36	15.00
II	Colostrum feeding to newly born kids	Twice in a day	217	90.42
		Thrice in a day	23	09.58
III	Ligation & disinfection of naval cord	Yes	169	70.42
		No	71	29.58
IV	Weaning of kids	Up to two months	199	82.92
		Up to three months	41	17.08
V	Castration of male kids	Yes	215	89.58
		No	25	10.42
VI	Deworming of kids	Yes	191	79.58
		No	49	20.42
VII	Selling of kids at the age	Three months	165	68.75
		Six months	22	09.17
		One year	53	22.08
VIII	Criteria for selling of male kids/ culled goat	Body weight	25	10.42
		Physical appearance	215	89.58
IX	Marketing place	At home/ village	192	80.00
		Nearby city	48	20.00
X	Selling of male kids + culled animals per year	About 20% of total flock	26	10.83
		About 30% of total flock	172	71.67
		About 40% of total flock	42	17.50

waste grass/fodder to control flies during rainy season and 44.58 percent of the respondents use insecticide dust for control of lice/ticks. Majority (74.17%) of the respondents leave as such animals' dead body for decay/ vulture in pasture land. The present results are to contrary to Meena *et al*. (2022), who reported that 76.67 percent goat keepers disposed off dead animals by contractor of dead animals. Regarding availability of veterinary facilities, only 15.42 and 26.67 percent goat keepers accepted good and satisfactory facilities, while more than half (57.92%) of the respondents were not satisfied with the veterinary facilities. Similar findings were observed by Mohan *et al*. (2009) and Sharma *et al*. (2018) in their study.

Conclusion

It can be concluded from the corresponding data that feeding management practices were satisfactory but a large number of respondents had not fed mineral mixture and hay, which is essential for nutritious and economic feeding. Majority of the respondents bred doe with non-descript buck and none of the goat keepers followed artificial insemination. Good breed is the backbone of a flock, which can be upgraded by pure and proven breeding buck. A small number of respondents change breeding buck at appropriate time, maintain breeding record and keep breeding buck separate. Majority of the respondents not followed proper cleaning and housing pattern of flock. Overall kids' management practices were satisfactory due to its market value and income source. Regarding health care management, it was noticed that deworming and vaccination practices were not satisfactory due to non availability of veterinary facilities at village level. Majority of the respondents did not isolate their sick animals from healthy ones, which may be the major reason of disease spread in the flock. The results indicate that there is a great urgency to create awareness among the goat keepers for increase the production and productivity of goat by adoption of scientific management practices.

Table 5: Existing healthcare management practices n-240

S.No.	Healthcare management Practices	Existing practices	Frequency	Percentage
I	Deworming	Once in a year	127	52.92
		Twice in a year	81	33.75
		Thrice in a year	32	13.33
II	Vaccination	Regular vaccination	66	27.50
		When disease spread	174	72.50
III	Isolation of sick animals	Yes	75	31.25
		No	165	68.75
IV	Proper treatment of sick goat	By veterinary doctor	27	11.25
		By livestock assistant	104	43.33
		By quacks	109	45.42
V	Measures adopted to control flies	Smoke of waste grass/ fodder	87	36.25
		Electric fan	00	00
VI	Measures adopted to control lice/ ticks	Manual	55	22.92
		Dusting of insecticides	107	44.58
VII	Disposal of dead animals	Deep burial	62	25.83
		Leave as such for decay/ vultures	178	74.17
VIII	Veterinary aid available in the surveyed village	Veterinary hospital	00	-
		Stockman centre	04	-
IX	Availability of veterinary facilities	Good	37	15.42
		Satisfactory	64	26.67
		Poor	139	57.92

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Effect of levels of Sulphur and Zinc as well as growth regulators on growth, yield and quality of onion (*Allium cepa* L.)

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Abstract

A field study was conducted to determine the effect of sulphur, zinc and gibberellin application on Onion growth, yield and quality during 2021 and 2022 at Main Research Farm, RBS College, Bichpuri, Agra, India. Eighteen treatments combination viz. T_1- S_0+Z_0+G_1, T_2 -S_0+Z0+G_2, T_3 -S_0+Z_1+G_1, T_4 -S_0+Z_1+G_2, T_5 -S_0+Z_2+ G_1, T_6 -S_0+ Z_2+ G_2, T_7 -S_1+Z_0+ G_1, T_8 -S_1+Z_0+ G_2, T_9 -S_1+ Z_1+ G_1, T_{10} -S_1+ Z_1+ G_2, T_{11} -S_1+ Z_2+ G_1, T_{12} -S_1+ Z_2+ G_2, T_{13} -S_2+ Z_0+ G_1, T_{14} -S_2+ Z_0+ G_2, T_{15} -S_2+ Z_1+ G_1, T_{16} -S_2+ Z_1+ G_2, T_{17} -S_2+ Z_2+ G_1 *and* T_{18} -S_2+ Z_2+ G_2. *The tallest plant was recorded under plant height was highest recorded under* S_2+ Z_2+ G_2 *(30kg/ ha Sulphur + 20kg/ha zinc + gibberellin @200ppm as a foliar spray at 30 DAT) followed by* S_2+ Z_2+ G_1 *(30kg/ha Sulphur + 20kg/ha zinc + gibberellin @100ppm as a foliar spray at 30 DAT)>* S_2+ Z_1+ G_1 *(30kg/ha Sulphur + 10kg/ha zinc + gibberellin @100ppm as a foliar spray at 30 DAT) >* S_2+ Z_0+ G_2 *(30kg/ha Sulphur + No zinc + gibberellin @200ppm as a foliar spray at 30 DAT) which was at par with* S_2+ Z_1+G_1*(30kg/ha Sulphur + 10kg/ha zinc + gibberellin @200ppm as a foliar spray at 30 DAT). Highest TSS content was obtain by the combine application of 30kg/ha Sulphur + 20kg/ha zinc + gibberellin @200ppm as a foliar spray.*

Keywords: Growth, yield, fertilizer, Gibberellin, zinc, sulphur

Introduction

Onion (*Allium cepa* L.) is one of the most important commercial bulbous vegetable spices grown all over the world in more than hundred countries. It belongs to the family "Amaryllidiaceae" (Alliaceae). Today the onion has become the atom of precious important. The skyrocketing price of onion has brought tears to the eyes of housewives of every walk, since it is an important vegetable for both vegetarian and non-vegetarian society in our country. Onion is the most essential vegetable and cash crop (because of its high export potential) not only amongst the bulbs crops but in vegetable crops, too. Onion is found in most of the markets of the worlds at all seasons of the year. Onion is largest vegetable produced and consumed not only in India but also in the world. It is grown in western northern as well as in southern part on our country. Maharashtra, Uttar Pradesh, Karnataka, Gujarat, Orissa, Tamil Nadu, Andhra Pradesh, Madhya Pradesh and Bihar are major onion growing states in India. However, the per capita consumption of vegetable in the country is still very low which in view of existing population, works out to be 130 g against a minimum of 280 g, recommended by the National Institute of nutrition Hyderabad.

It is an important and indispensable item in every kitchen as condiment and vegetable. Be it in curry, chutney, pickles or stuffed parathas, be it white, red, green, dry, chive or any member of its family, the onion improves every food except

desserts. Due to above properties it is called "Queen of the kitchen" by Germans (Gulshanlal, 1976) onion has medicinal uses like used as diuretic, in bruises, boils and wound.

The growth regulators have successfully been utilized in controlling the various physiological functions of the plant. They have been used in encouraging the development of root, breaking the dormancy, encouraging defoliation, metabolic processes and growth phenomenon. The use of plant growth regulators for increasing the growth, yield and quality of vegetables had assumed great importance in some advanced countries of the world. These chemicals respond differently to different crops, according to their method of application, concentration, time and purpose for which they are used in different crop (Wagh & Deore, 1995). Their use on vegetable crops was also widely tried by various workers of our country. The common methods used are spray, seed treatment and seedling dip. Dipping of the seedling in the solution of growth regulators has been found effective among most vegetable crop including bulb crops. Growth regulators have dipp-seated effects on fundamental growth processes of an organism and involve both beneficial as well as detrimental effects. "Growth regulators give double benefit. First the roots, when they are not established to absorb rich nutrients for plant growth. Secondly, these plants get good supply in the new place and take better start resulting better root and shoot growth. The findings of the various workers and experiments on practical use of growth regulators on vegetable production indicate that seed treatment is suitable convenient and chemical method for increasing the yield and quality of vegetable production. (Singh *et al.,* 1995 Hore *et al.,* 1988, Nirmal *et al.,* 1994).

The requirement of sulphur for optimum crop growth varies from 0.1 to 0.5% by weight of dry matter. However, the requirement of sulphur varies with nature and type of crop. The requirement decrease in the order of Cruciferae >Leguminosae> Gramineae. On an average, 41 per cent sulphur deficiency has been noticed in Indian soils (Shukla *et al.,* 2016). While in Uttar Pradesh sulphur deficiency recorded to the extent of > 61per cent (Shukla *et al.,* 2021). Survey of Indian soils revealed that about 49 per cent of 2.52 lakh soil samples analyzed were found deficient in available Zn distributed over 20 states (Shukla *et al*., 2016). Zinc deficiency is wide spread in all agro-ecological zones (AEZ). Zinc deficiency (49%) in soil is a worldwide nutritional problem in crop production. The extent of deficiency of Zinc was to the tune of 86% in Maharashtra, 72.8% in Karnataka, 60.5% in Haryana, 58.4% in Tamil Nadu, 57% in Meghalaya, 54% in Bihar and Orissa, 49.4% in Andhra Pradesh, and 48.1% in Punjab (Singh *et al.,* 2009). Zinc Deficiency in Uttar Pradesh is about 50 percent (Shukla *et al.,* 2021).

Research Methodology

Site description

The present study was carried out at Main Research Farm, RBS College, Bichpuri, Agra, Dr. B. R. Ambedkar University, Agra over two consecutive years (2021 and 2022) to evaluate the effect of different level of sulphur, zinc and growth regulators on onion quality, growth and yield. The initial soil properties of the experimental site were silty loam soil with a pH of 8.2 and EC 0.35 dS/m (Table 1). Organic carbon content was measured at 4.5 g/kg and the available nitrogen, phosphorus and potassium levels were recorded at 170.8, 9.4 and 215.6 kg/ha, respectively. Onion sowing take place during *kharif* season (June–November), followed by onion sowing in subsequent next same (*kharif*) season (June–November).

Fertilizer treatments and experimental design:

This study comprised eighteen treatments arranged in randomized block design. Three replications were maintained under all the treatments. Nitrogen, phosphorus, potassium and sulfur were applied, in the form of urea, single super phosphate, murate of potash and sulphur granules respectively according to treatments. Full quantity of FYM, phosphorus, potassium and sulphur fertilizer along with one third of nitrogen was applied before transplanting the seedlings as per treatment plot. While the rest of the nitrogen was applied in two equal splits at 30 and 60 days after transplanting. The treatment wise growth regulators of GA_3 @ 100 and 200 ppm (foliar spray was done at after 30

DAT).

Analysis of soil sample

The alkaline potassium permanganate oxidized soil nitrogen was determined as per prescribed methodology of Subbiah and Asija, 1956. Phosphorus content in the extract was determined by ascorbic acid method (Watanabe and Olsen, 1965). The soil samples were extracted with 0.5 M $NaHCO_3$; pH 8.5. Available potassium was estimated flame photometrically in neutral normal ammonium acetate extract (Hanway and Heidel, 1952).

Statistical analysis

Data obtained from the field experiment was statistically analyzed following standard statistical methods (Gomez and Gomez, 1984). Analysis of variance pertaining to the different fertilizer treatments for comparison of means was performed using Microsoft Excel and SPSS. Unless otherwise stated, the level of significance referred to in the results is $p< 0.05$.

Table 1: Physico-chemical properties of initial soil sample of experimental field

S.No	Soil Properties	Value
1.	*p*H (1:2.5 soil to water suspension ratio)	8.2
2.	EC (dSm^{-1})	0.35
3.	Texture	Silty loam
4.	Organic Carbon (g/kg)	4.5
5.	Alkaline $KMnO_4$-N (kg ha^{-1})	170.8
6.	Olsens'-P_2O_5 (kg ha^{-1})	9.4
7.	Ammonium Acetate-K_2O (kg ha^{-1})	215.6

Results and Discussion

Plant height

The maximum plant height (88.50 cm) was recorded at 90 DAT with the combination of Sulphur @30kg /ha, zinc @20kg /ha and gibberellin @200ppm as a foliar spray at 30 DAT. However minimum plant height (61.95cm) was recorded in combination of sulphur @0kg /ha, zinc @0kg /ha and gibberellin @100ppm as a foliar spray at 30 DAT. In first year (2021) at 90 DAT highest plant height (88.10 cm) were recorded in combination of Sulphur @30kg /ha, zinc @20kg /ha and gibberellin @200ppm as a foliar spray at 30 DAT and minimum plant height (61.41cm) was recorded in combination of sulphur @0kg /ha, zinc @0kg /ha and gibberellin @100ppm as a foliar spray at 30 DAT. Similar results were obtained by Seema and Patel (2002) also revealed that the plant height was directly proportional to combine application of fertilizers and growth regulators like (Sulphur, zinc and gibberellin). With the application of these nutrients and growth regulators leaves greenness increases and that greenness helps in the formation of food materials in onion (Table 2).

Table 2: Effect of sulphur, zinc and gibberellin on plant height of onion crop

Treatments	90 DAT	
	2021	2022
T_1- S_0+Z_0+G_1	61.41	61.95
T_2 -S_0+Z0+G_2	61.30	62.07
T_3 -S_0+Z_1+G_1	61.60	65.18
T_4 -S_0+Z_1+G_2	61.90	62.62
T_5 -S_0+Z_2+ G_1	63.60	65.06
T_6 -S_0+ Z_2+ G_2	63.80	64.41
T_7 -S_1+Z_0+ G_1	64.80	67.20
T_8 -S_1+Z_0+ G_2	64.90	69.08
T_9 -S_1+ Z_1+ G_1	65.40	66.46
T_{10} -S_1+ Z_1+ G_2	67.00	68.30
T_{11} -S_1+ Z_2+ G_1	71.20	69.97
T_{12} -S_1+ Z_2+ G_2	73.00	73.78
T_{13} -S_2+ Z_0+ G_1	73.10	74.92
T_{14} -S_2+ Z_0+ G_2	73.20	73.21
T_{15} -S_2+ Z_1+ G_1	76.60	79.03
T_{16} -S_2+ Z_1+ G_2	79.10	80.04
T_{17} -S_2+ Z_2+ G_1	83.00	83.33
T_{18} -S_2+ Z_2+ G_2	88.10	88.50
C.D.	2.51	3.80
SE(m)	0.87	1.31

S_0- No Sulphur, S_1-15 kg /ha Sulphur, S_2- 30kg/ha Sulphur, Z_0-No zinc, Z_1- 10kg zinc/ha, Z_2-20kg zinc/ha, G_1-100ppm Gibberellin, G_2- 200 ppm Gibberellin.

Weight of fresh bulb

In first year (2021) maximum fresh weight of bulb (79.70 gm) was recorded with the combine application of Sulphur @30kg /ha, zinc @20kg /ha and gibberellin @200ppm as a foliar spray at 30 DAT. However minimum fresh weight of bulb (60.20 gm) was recorded in combine application of sulphur @0kg /ha, zinc @0kg /ha and gibberellin @100ppm as a

foliar spray at 30 DAT. In second year (2022) highest fresh weight of bulb (83.05 gm) were recorded in combine application of Sulphur @30kg /ha, zinc @20kg /ha and gibberellin @200ppm as a foliar spray at 30 DAT and minimum fresh weight of bulb (61.18 gm) was recorded in combine application of sulphur @0kg /ha, zinc @0kg /ha and gibberellin @100ppm as a foliar spray at 30 DAT (Table 3).

Table 3: Effect of sulphur, zinc and gibberellin on fresh weight of bulb

Treatments	Fresh bulb weight (g) 2021	2022
T_1- S_0+Z_0+G_1	60.20	61.18
T_2-S_0+Z0+G_2	61.00	62.69
T_3-S_0+Z_1+G_1	62.10	64.71
T_4-S_0+Z_1+G_2	62.50	63.12
T_5-S_0+Z_2+ G_1	62.80	64.17
T_6-S_0+ Z_2+ G_2	63.10	64.11
T_7-S_1+Z_0+ G_1	63.50	64.97
T_8-S_1+Z_0+ G_2	65.39	67.53
T_9-S_1+ Z_1+ G_1	67.00	67.44
T_{10}-S_1+ Z_1+ G_2	67.10	68.21
T_{11}-S_1+ Z_2+ G_1	68.40	70.26
T_{12}-S_1+ Z_2+ G_2	69.09	71.14
T_{13}-S_2+ Z_0+ G_1	71.20	72.18
T_{14}-S_2+ Z_0+ G_2	73.09	72.32
T_{15}-S_2+ Z_1+ G_1	76.40	75.58
T_{16}-S_2+ Z_1+ G_2	76.70	78.62
T_{17}-S_2+ Z_2+ G_1	79.1	82.96
T_{18}-S_2+ Z_2+ G_2	79.7	83.05
C.D.	3.01	3.04
SE(m)	1.04	1.05

S_0- No Sulphur, S_1-15 kg /ha Sulphur, S_2- 30kg/ha Sulphur, Z_0-No zinc, Z_1- 10kg zinc/ha, Z_2-20kg zinc/ha, G_1-100ppm Gibberellin, G_2- 200 ppm Gibberellin.

Similar results were found by Josephine *et al.* (2006), Dabhi and Patel (2004) and Smiriti *et al.* (2002) also revealed that the fresh bulb weight was directly proportional to combine application of fertilizers and growth regulators like (Sulphur, zinc and gibberellin). With the application of these nutrients and growth regulators leaves greenness increases and that greenness helps in the formation of food materials in onion which is help full in the formation of healthy bulbs.

Total soluble solid (%)

Table 4: Effect of sulphur, zinc and gibberellin on total soluble solid

Treatments	Fresh bulb weight (g) 2021	2022
T_1- S_0+Z_0+G_1	60.20	61.18
T_2-S_0+Z0+G_2	61.00	62.69
T_3-S_0+Z_1+G_1	62.10	64.71
T_4-S_0+Z_1+G_2	62.50	63.12
T_5-S_0+Z_2+ G_1	62.80	64.17
T_6-S_0+ Z_2+ G_2	63.10	64.11
T_7-S_1+Z_0+ G_1	63.50	64.97
T_8-S_1+Z_0+ G_2	65.39	67.53
T_9-S_1+ Z_1+ G_1	67.00	67.44
T_{10}-S_1+ Z_1+ G_2	67.10	68.21
T_{11}-S_1+ Z_2+ G_1	68.40	70.26
T_{12}-S_1+ Z_2+ G_2	69.09	71.14
T_{13}-S_2+ Z_0+ G_1	71.20	72.18
T_{14}-S_2+ Z_0+ G_2	73.09	72.32
T_{15}-S_2+ Z_1+ G_1	76.40	75.58
T_{16}-S_2+ Z_1+ G_2	76.70	78.62
T_{17}-S_2+ Z_2+ G_1	79.1	82.96
T_{18}-S_2+ Z_2+ G_2	79.7	83.05
C.D.	3.01	3.04
SE(m)	1.04	1.05

S_0- No Sulphur, S_1-15 kg /ha Sulphur, S_2- 30kg/ha Sulphur, Z_0-No zinc, Z_1- 10kg zinc/ha, Z_2-20kg zinc/ha, G_1-100ppm Gibberellin, G_2- 200 ppm Gibberellin

First year (2021) maximum TSS (15.0 %) was recorded with the combine application of Sulphur @30kg /ha, zinc @20kg /ha and gibberellin @200ppm as a foliar spray at 30 DAT. However minimum TSS (10.0 %) was recorded in combine application of sulphur @0kg /ha, zinc @0kg /ha and gibberellin @100ppm as a foliar spray at 30 DAT.

In second year (2022) highest TSS (15.93%) were recorded in combine application of Sulphur @30kg /ha, zinc @20kg /ha and gibberellin @200ppm as a foliar spray at 30 DAT and minimum TSS (10.18 %) was recorded in combine application of sulphur @0kg /ha, zinc @0kg /ha and gibberellin @100ppm as a foliar spray at 30 DAT (Table 4).

Similar results were obtained by Dwivedi and Asati (2019) also revealed that the TSS was positively related to combination of chemical fertilizers and growth regulators like (Sulphur, zinc and gibberellin). With the application of these

fertilizers and growth regulators leaves greenness increases and that greenness helps in the formation of food materials in onion which is help full in the formation of healthy bulbs.

Conclusion

This study compared different doses of fertilizers and less and more doses of growth regulators for onion plant height, weight of fresh bulb and TSS content. Combinations of Sulphur @30kg /ha, zinc @20kg /ha and gibberellin @200ppm as a foliar spray at 30 DAT performed better than rest of the combination. The study led to conclusion that the higher doses of inorganic sulphur and zinc along with doses of 200ppm of gibberellin are advantageous over the out application of sulphur and zinc with 100ppm of gibberellin.

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Exploring the Terminal and Instrumental Values of *Bal-Vikas* children, their parents, and teachers in Uttarakhand

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Abstract

The present study aimed to assess the terminal and instrumental values of Bal-Vikas children, parents, and teachers in the districts of Nainital and Udham Singh Nagar, Uttarakhand, India. A self-constructed questionnaire was utilized to evaluate the socio-personal profiles of the 200 respondents affiliated with Bal-Vikas centres; 120 parents, 60 Bal-Vikas children at the age group of 8 to 18 years, and 20 teachers of both genders. The modified Rokeach Value Survey scale (Rokeach, 1973) consisted of 36 values, encompassing 18 terminal and 18 instrumental values was employed to assess the terminal and instrumental values of the Bal-Vikas children, their parents, and teachers. This study unveiled that majority of the Bal-Vikas children, their parents, and teachers had high levels of both terminal and instrumental values. Notably, the teaching methods employed within the Bal-Vikas centres, included prayer, group activities, role-playing, value-based games, etc. aimed to instil virtues like truth, righteous conduct, love, peace, and non-violence, played a pivotal role in nurturing these elevated human values among children. Based on the notable findings of this research, it is strongly recommended that the Bal-Vikas Programme should be integrated into regular school curriculum, ideally for once in a week, perhaps on Saturdays or for short sessions (1-2 hours) throughout the week. This integration would instil moral values, improve concentration spans, memory power and lifestyles among the students, their parents, and teachers. Certainly, it will not only contribute to their character development but also enhance their academic performance, disciplines, and commitments.

Key words**:** *Bal-Vikas*, terminal, instrumental, Uttarakhand, Rokeach's values

Introduction

In the modern world, parents are overlooking the other facets of education and often prioritizing the schools that promoting superior academic accomplishment in students. Teachers are increasingly emphasizing the grades they assign to their students rather than holistically evaluating the students and their readiness to navigate life's challenges. The schools are currently falling short in imparting these core principles in students which has negative implications on both our students and society as a whole (Kaur, 2016). In contemporary times, some students seem to have reached a stage where they may not necessarily require as much guidance or restraint. Discipline has been replaced by freedom, and authority has been replaced by rising levels of frustration. Moreover, significant advancements in science and technology, rapid growth of globalization, industrialization, and evolving societal structures, have directly impacted the social dynamics in the realms of economics, politics, and the environment. The expeditious technological progress and the intricacies of social relationships underscore the importance of morality, values, and ethics. In this globalized world, it would be more

challenging to effectively integrate and transmit these principles through enhanced curricula and teaching techniques (Chowdhury, 2018).

A study course called "moral education" teaches students how to act morally by embracing the good and rejecting the wrong. The term 'moral' derives from the Latin word 'mos,' signifying habit, practice, regulation, or a method of performing tasks (Ahamed and Ghosh, 2012). Moral values can be viewed as personal principles in which a person sets up to evaluate the moral aspects of right and wrong situations, personalities, and behaviours as well as to choose the course of action based on their desired outcomes. A person's moral character bestows with courage, zeal, kindness, honesty, loyalty, love, and other admirable attributes (Kaur, 2016). Rokeach (1973) classifies values into two types: terminal values, representing beliefs about desirable end-states of life, and instrumental values, reflecting beliefs about desirable modes of behaviour. Values and ethical principles have the capacity to mirror significant societal transformations within communities and across nations (Tuulik *et al*., 2016). In a civil society, individuals uphold the significance of moral values and ethics which serve as guiding principles for conduct of social interactions, within our circles of friends and family, and in our professional and business endeavours. Our spirituality and character are reflected in expression through our values and morals compass. As children closely observe us while shaping their own sense of good and evil, we aspire to be positive role models for not only our own children but also for the youngsters within our community (Banerjee, 2012).

The primary objective of the *Bal-Vikas* centres is to uplift the child's intellect and to guide toward character development by fostering self-discipline, providing positive social interactions, and instilling beneficial habits such as reading, listening, studying, and reciting. The five fundamental human principles i.e., truth, justice, peace, love, and non-violence are imparted to young individuals through classes in schools and devotee houses, that was scheduled on every Sunday for an hour and thirty minutes. Hence, the *Bal-Vikas* classes nurture these children diligently and are willing to make sacrifices when needed to impart the five fundamental human values of truth, righteousness, peace, love, and non-violence. The *Bal-Vikas* initiative aims to cultivate exemplary habits throughout the nine-year program, ensuring that the child develops a robust sense of morality and character. Taking the aforementioned factors into consideration and recognizing the importance of the *Bal-Vikas* centres in instilling moral principles in young children, the present study incorporates the following objectives:

1. To evaluate the socio-personal profiles of Bal-Vikas children, their parents, and teachers.
2. To assess the terminal and instrumental values held by Bal-Vikas children, their parents, and teachers.

Materials and Methods

Locale

In this study, the samples were obtained from active *Bal-Vikas* centres in two districts of Uttarakhand, India, namely Nainital and Udham Singh Nagar. The sample consisted of 200 respondents, encompassing 120 parents, 60 *Bal-Vikas* children aged between 8 to 18 years, and 20 teachers, representing both genders.

Sample selection

A purposive sampling approach was employed to select the sample.

Measures

A self-structured questionnaire in addition to the modified version of the Rokeach Value Survey (RVS) scale, originally developed by Rokeach M. (1973), was administered. The RVS scale consisted of 18 terminal and 18 instrumental values, serving as a tool to evaluate the values held by the respondents. The data was analysed using statistical frequencies and ratios.

Procedure

The respondents were approached and selected for participation after obtaining their consent, with the assistance of school principals and class teachers. During the data collection phase, all respondents were clearly instructed and assured that their information would remain confidential and would not be used for any other purpose. Two sets of questionnaires, each containing 18 questions related to terminal and instrumental values, were distributed to groups of five respondents. They were instructed to complete the questionnaires themselves

under the researcher's supervision.

Results and Discussion

The empirical data was analysed and the findings of the present study are explained under following sub-heads along with the discussions of the relevant facts:

(i) Socio-personal profile of the *Bal-Vikas* Children, their Parents and Teachers

Table 1: Distribution of children according to their background information

S. No.	Socio-Personal Variables	Udham Singh Nagar (n_1=30) Frequency (n)	Percentage	Nainital (n_2=30) Frequency (n)	Percentage	Total (n=60) Frequency (n)	Percentage
1	Age						
	8-12 years	11	36.66	15	50.00	26	43.33
	13-15 years	08	26.66	11	36.66	19	31.66
	16-18 years	11	36.66	04	13.33	15	25.00
2	Gender						
	Male	15	50.00	10	33.33	25	41.66
	Female	15	50.00	20	66.66	35	58.33
3	Religion						
	Hindu	30	100.00	27	90.00	57	95.00
	Muslim	00	0.00	03	10.00	03	5.00
4	Caste						
	General	03	10.00	20	66.66	23	38.33
	Scheduled caste	14	46.66	07	23.33	21	35.00
	Scheduled tribes	05	16.66	00	0.00	05	8.33
	Other backward class	08	26.66	03	10.00	11	18.33
5	Area						
	Rural	30	100.00	27	90.00	57	95.00
	Urban	00	0.00	03	10.00	03	5.00
6	Family type						
	Nuclear	27	90.00	18	60.00	45	75.00
	Joint	03	10.00	12	40.00	15	25.00
7	Father occupation						
	Services	07	23.33	18	60.00	25	41.66
	Business	03	10.00	01	3.33	04	6.66
	Farming	20	66.66	11	36.66	31	51.66
8	Mother occupation						
	Services	00	0.00	02	6.66	02	3.33
	House wife	30	100.00	28	93.33	58	96.66
9	Monthly income of family (In Rupees per month)						
	0-10,000	20	66.66	12	40.00	32	53.33
	10,000-20,000	10	33.33	15	50.00	25	41.66
	20,000-30,000	00	0.00	03	10.00	03	5.00
10	Family Size						
	1-4 (small)	16	53.33	25	83.33	41	68.33
	5-8 (large)	14	46.66	05	16.66	19	31.66
11	Number of siblings						
	1-3	22	73.33	25	83.33	47	78.33
	4-6	07	23.33	03	10.00	10	16.66
	7 and above	01	1.66	02	6.66	03	5.00
12	Presence of grand parents						
	Yes	27	90.00	18	60.00	45	75.00
	No	03	10.00	12	40.00	15	25.00

(ii) Terminal and instrumental values of the *Bal-Vikas* Children, their Parents and Teachers

Socio-personal profile of the Bal-Vikas *Children, their Parents and Teachers:*

The socio-personal traits of respondents are extremely significant in social science research to comprehend them. The level of advancement, comprehension, and perception of an individual is influenced by socio-personal traits. The Table 1, 2, and 3 exhibited the socio-personal profile of the *Bal-Vikas* Children, their Parents and Teachers from currently running the *Bal-Vikas* centres in Nainital and Udham Singh Nagar, distinct districts within Uttarakhand, India. The data shown in Table 1 revealed that most of the children i.e., 43.33 *per cent* belonged to the 8-12 years followed by 31.66 *per cent* to the 13-15 years and 25 *per cent* to the 16-18 years age group. Girls made up 58.33 *per cent* of the sample, while boys made up 41.66 *per cent*. A similar study was performed by Ozmete (2007) on terminal and instrumental values of young individuals, revealed that many of the total participants were boys, i.e., 58.4 *per cent* while 41.6 *per cent* were girls. The data also shows that 95 *per cent* of the children identified as Hindu, followed by 5 *per cent* of Muslims along with general category of the children accounted for 38.33 *per cent*, followed by 35 *per cent* from the scheduled caste, 18.33 *per cent* from the OBC, and 8.33 *per cent* from the scheduled tribe (Table 1). The most of the children are from rural areas i.e., 95 *per cent*, while 5 *per cent* from urban areas, similarly, 75 *per cent* of children belonged to a nuclear family, followed by 25 *per cent* belonged to the joint families (Table 1). The most of the children's father were working as farmers i.e., 51.66 *per cent*, and 41.66 *per cent* as servicemen, and 6.66 *per cent* as business owners, similarly, the majority of the children's mother were housewife i.e., 96.66 *per cent*, and 3.33 *per cent* as service women. A careful perusal of Table 1 also revealed that most respondents had monthly family incomes of less than ten thousand i.e., 53.33 *per cent* followed by 41.66 *per cent* between 10 to 20 thousand, and 5 *per cent* between 20 to 30 thousand per month. Many of the children were from small family size i.e., 68.33 *per cent* while 31.66 *per cent* from large family size. The 78.33 *per cent* of children had 1-3 siblings, 16.66 *per cent* with 4-6 siblings, and 5 *per cent* had more than 7 siblings. The most of the children i.e., 75 *per cent* were residing with their grandparents, followed by 25 *per cent* who were not residing with their grandparents.

The majority of the parents belonged to the 40-50 years i.e., 65.83 *per cent*, followed by 19.16 *per cent* to the 30-40 years and 15 *per cent* to the 50-60 years age group (Table 2). Half of the parents were male, and the other half were female, as both parents were intentionally chosen for the study. The 95 *per cent* of parents identified as Hindu, with the remaining 5 *per cent* as Muslim (Table 2). The largest proportion of parents belonged to the general category at 38.33 *per cent* followed by 35 *per cent* from the scheduled caste, 18.33 *per cent* from the other backward class, and 8.33 *per cent* from the scheduled tribe. The majority of the parents lived in rural areas i.e., 95 *per cent*, with the remaining 5 *per cent* residing in urban areas. Seventy-five *per cent* of the parents belonged to nuclear families, while the remaining 25 *per cent* were part of joint families. The majority of the parents were from small family sizes, accounting for 68.33 *per cent*, while 31.66 *per cent* of the parents belonged to larger family sizes (Table 2). A significant portion, 78.33 *per cent* of parents, had 1-3 children, while 16.66 *per cent* had 4-6 children, and 5 *per cent* had 7 or more children. The majority of parents (fathers) were engaged in farming constituting 51.66 *per cent* followed by 41.66 *per cent* of servicemen and 6.66 *per cent* of businessmen. The majority of the parents (mothers), specifically 96.66 *per cent*, were housewives, with 3.33 *per cent* being service women. The majority of the parents, at 53.33 *per cent*, belonged to the monthly income group below ten thousand, followed by the 10,000-20,000 monthly income group at 41.66 *per cent*, and the 20,000-30,000 monthly income group at 5 *per cent*. The majority of the parents, comprising 75 *per cent*, had their parents residing with them, while 25 *per cent* of the parents did not have their parents residing with them (Table 2).

Table 3 indicates that majority of the *Bal-Vikas* teachers, accounting for 55 *per cent*, fell within

Table 2: Distribution of parents according to their background information

S. No.	Demographic Variables	Udham Singh Nagar (n_1=30) Frequency (n)	Percentage	Nainital (n_2=30) Frequency (n)	Percentage	Total(n=60) Frequency (n)	Percentage
1	Age						
	30-40 years	12	20.00	11	18.33	23	19.16
	40-50 years	36	60.00	43	71.66	79	65.83
	50-60 years	12	20.00	06	10.00	18	15.00
2	Gender						
	Male	30	50.00	30	50.00	60	50.00
	Female	30	50.00	30	50.00	60	50.00
3	Religion						
	Hindu	60	100.00	54	90.00	114	95.00
	Muslim	00	0.00	06	10.00	06	5.00
4	Caste						
	General	06	10.00	40	66.66	46	38.33
	Scheduled caste	28	46.66	14	23.33	42	35.00
	Scheduled tribes	10	16.66	00	0.00	10	8.33
	Other backward class	16	26.66	06	10.00	22	18.33
5	Area						
	Rural	60	100.00	54	90.00	114	95.00
	Urban	00	0.00	06	10.00	06	5.00
6	Type of family						
	Nuclear	54	90.00	36	60.00	90	75.00
	Joint	06	10.00	24	40.00	30	25.00
7	Male occupation						
	Services	07	23.33	18	60.00	25	41.66
	Business	03	10.00	01	3.33	04	6.66
	Farming	20	66.66	11	36.66	31	51.66
8	Female occupation						
	Services	00	0.00	02	6.66	02	3.33
	House wife	30	100.00	28	93.33	58	96.66
9	Monthly income of family (In Rupees per month)						
	0-10,000	20	66.66	12	40.00	32	53.33
	10,000-20,000	10	33.33	15	50.00	25	41.66
	20,000-30,000	00	0.00	03	10.00	03	5.00
10	Family size						
	1-4 (small)	16	53.33	25	83.33	41	68.33
	5-8 (large)	14	46.66	57	16.66	19	31.66
11	Number of children						
	1-3	22	73.33	25	83.33	47	78.33
	4-6	07	23.33	03	10.00	10	16.66
	7 and above	01	3.33	02	6.66	03	5.00
12	Presence of parents						
	Yes	27	90.00	18	60.00	45	75.00
	No	03	10.00	12	40.00	15	25.00

the 30-40 age group, followed by the 40-50 age group at 30 *per cent*, and the 50-60 age group at 15 *per cent*. Among the teachers, 55 *per cent* were female, while 45 *per cent* were male. All of the teachers, a full 100 *per cent*, identified as Hindu. The majority of the teachers, comprising 60 *per cent*, belonged to the general category, followed by 20 *per cent* from the Scheduled Caste, 15 *per cent* from the

Other Backward Class, and 5 *per cent* from the Scheduled Tribe. The vast majority of the teachers, specifically 95 *per cent*, resided in rural areas, with the remaining 5 *per cent* living in urban areas. The majority of the teachers, totalling 75 *per cent*, were from nuclear families, while the remaining 25 *per cent* were part of joint families. The majority of the teachers, comprising 75 *per cent*, belonged to small family sizes, while 25 *per cent* of the respondents were part of larger family sizes. Ninety-five *per cent* of the teachers had 1-3 children, with the remaining 5 *per cent* having 4-6 children. *Bal-Vikas* teachers often had other occupations, the majority of the teachers, accounting for 65 *per cent*, were involved in service professions, followed by 20 *per cent* engaged in farming, and 15 *per cent* who were businessmen. The majority of the teachers, at 60 *per cent*, fell into the 10,000-20,000 monthly income group, followed by 20 *per cent* in the below 10,000 monthly income group, and another 20 *per cent* in the 20,000-30,000 monthly income group. The majority of the teachers, specifically 65 *per cent*, had their parents residing with them, while 35 *per cent* of the teachers did not have their parents residing with them.

Terminal and instrumental values of Bal-Vikas *Children, their Parents and Teachers*

From the data presented in Table No. 4, it is evident that the majority of the children, constituting 48.33 *per cent*, exhibited high Terminal values, followed by 33.33 *per cent* at a medium level, and 18.33 *per cent* at a low level. In Udham Singh Nagar district, it's noteworthy that the majority of children, precisely 50 *per cent*, exhibited high Terminal values. In this district, 30 *per cent* displayed Terminal values at a medium level, and 20 *per cent* at a low level. A similar pattern emerges in Nainital district, with the majority of children, at 46.66 *per cent*, possessing high Terminal values. Additionally, 36.66 *per cent* exhibited Terminal values at a medium level, while 16.66 *per cent* displayed values at a lower level. Ozmete (2007) drew the conclusion that the most significant terminal values for both young boys and girls were happiness, self-respect, a world at peace, freedom, true friendship, a sense of accomplishment, mature love, national security, and equality. In contrast, the least important terminal values for these individuals were identified as an exciting life, pleasure, and a comfortable life. When it comes to instrumental values, the majority of the children, specifically 56.66 *per cent*, demonstrated high instrumental values, while 28.33 *per cent* exhibited values at a medium level, and 15 *per cent* displayed values at a lower level. In Udham Singh Nagar district, a significant majority of children, precisely 60 *per cent*, displayed high Instrumental values. In this district, 23.33 *per cent* exhibited Instrumental values at a medium level, and 16.66 *per cent* had values at a lower level. In Nainital district, a similar trend was observed, with the majority of children, at 53.33 *per cent*, having high Instrumental values. Additionally, 33.33 *per cent* displayed Instrumental values at a medium level, while 13.33 *per cent* demonstrated values at a lower level. Ozmete (2007) concluded that the most importance instrumental values for both young boys and girls were honest, loving, clean, independent, and obedient, whereas, the least important instrumental values for these individuals were identified as forgiving, and imaginative. Saric *et al.*, (1997) observed that the most significant terminal values for adolescents in his study were hedonism/ gratification, Social/security values, and Self-actualization. For instrumental values ratings, moral/ self-restriction, competence, independence, and benevolence/interpersonal harmony emerged as the most meaningful factors. Nalevska *et al.*, (2023) stated that among adolescents, the most preferred terminal values included an exciting life, true friendship, pleasure, true love, self-respect, self-improvement, and peace of mind. As for instrumental values, the top preferences were ambition, independence, resourcefulness, decisiveness, logic, tact, self-control, and honesty.

A careful perusal of Table 5 revealed that the majority of the parents, specifically 58.33 *per cent*, exhibited high terminal values, while 25 *per cent* displayed values at a medium level, and 16.66 *per cent* had values at a lower level. In Udham Singh Nagar district, it's noteworthy that among the parents, the majority, specifically 50 *per cent*, exhibited high Terminal values. Within this district, 30 *per cent* displayed terminal values at a medium level, and 20 *per cent* had values at a lower level,

Table 3: Distribution of Teachers according to their background information

S. No.	Demographic Frequency (n)	Udham Singh Nagar (n_1=30) Frequency (n)	Percentage	Nainital (n_2=30) Frequency (n)	Percentage	Total (n=60) Frequency (n)	Percentage
1	Age						
	30-40 years	06	60.00	05	50.00	11	55.00
	40-50 years	02	20.00	04	40.00	06	30.00
	50-60 years	02	20.00	01	10.00	03	15.00
2	Gender						
	Male	04	40.00	05	50.00	09	45.00
	Female	06	60.00	05	50.00	11	55.00
3	Religion						
	Hindu	10	100.00	10	100.00	20	100.00
	Muslim	00	0.00	00	0.00	00	0.00
4	Caste						
	General	05	50.00	07	70.00	12	60.00
	Scheduled caste	03	30.00	01	10.00	04	20.00
	Scheduled tribes	01	10.00	00	0.00	01	5.00
	Other backward class	01	10.00	02	20.00	03	15.00
5	Area						
	Rural	10	100.00	09	90.00	19	95.00
	Urban	00	0.00	01	10.00	01	5.00
6	Type of family						
	Nuclear	07	70.00	08	80.00	15	75.00
	Joint	03	30.00	02	20.00	05	25.00
7	Other occupation						
	Services	07	70.00	06	60.00	13	65.00
	Business	01	10.00	02	20.00	03	15.00
	Farming	02	20.00	02	20.00	04	20.00
8	Father occupation						
	Services	03	30.00	05	50.00	08	40.00
	Business	02	20.00	03	30.00	05	25.00
	Farmer	05	50.00	02	20.00	07	35.00
9	Monthly income of family (In Rupees per month)						
	0-10,000	02	20.00	02	20.00	04	20.00
	10,000-20,000	07	70.00	05	50.00	12	60.00
	20,000-30,000	01	10.00	03	30.00	04	20.00
10	Family size						
	1-4 (small)	07	70.00	08	80.00	15	75.00
	5-8 (large)	03	30.00	02	20.00	05	25.00
11	Number of children						
	1-3	10	100.00	09	90.00	19	95.00
	4-6	00	0.00	01	10.00	01	5.00
12	Presence of grand parents						
	Yes	06	60.00	07	70.00	13	65.00
	No	04	40.00	03	30.00	07	35.00

whereas, in Nainital district, a different pattern emerged, with the majority of parents, at 66.66 *per cent*, possessing high Terminal values. Additionally, 20 *per cent* exhibited values at a medium level, while 13.33 *per cent* demonstrated values at a lower level. When it comes to instrumental values, the data indicates that a significant majority of the parents, specifically 60 *per cent*, exhibited high instrumental

values. Additionally, 23.33 *per cent* displayed instrumental values at a medium level, and 16.66 *per cent* demonstrated instrumental values at a lower level. In Udham Singh Nagar district, it's notable that among the parents, the majority, specifically 46.66 *per cent*, exhibited high instrumental values. Within this district, 30 *per cent* displayed instrumental values at a medium level, and 23.33 *per cent* had instrumental values at a lower level. while, in Nainital district, the majority of parents, at 73.33 *per cent*, possessing high instrumental values. Additionally, 16.66 *per cent* exhibited instrumental values at a medium level, while 10 *per cent* demonstrated instrumental values at a lower level. Abdullah *et al*, (2002) suggested that, on the whole, both teenagers and parents demonstrated positive instrumental and terminal values. Furthermore, the analysis indicated that teenagers shared similar terminal and instrumental values with their parents, indicating that parental influence significantly contributes to the development of their children's values. This underscores the crucial role parents play in instilling positive values in their children, thereby helping them resist negative influences.

According to the data in Table 6, the majority of the teachers, specifically 65 *per cent*, exhibited high terminal values. Additionally, 35 *per cent* displayed terminal values at a medium level, with no teachers falling into the low-level category. In Udham Singh Nagar district, it's worth noting that among the teachers, the majority, specifically 70 *per cent*, exhibited high terminal values. Within this district, 30 *per cent* displayed terminal values at a medium level, with none falling into the low-level category. While, in Nainital district, a different pattern emerged, with the majority of teachers, at 60 *per cent*, possessing high terminal values. Additionally, 40 *per cent* exhibited values at a medium level, and none fell into the low-level category. The findings align with the research conducted by Dasari (2017), where prospective teachers similarly ranked terminal values, with freedom taking the top spot, followed by a comfortable life and true friendship. When it comes to instrumental values, the majority of the teachers, specifically 70 *per cent*, demonstrated high instrumental values. Additionally, 30 *per cent* exhibited instrumental values at a medium level, and none fell into the low-level category. In Udham Singh Nagar district, it's significant to note that among the teachers, the majority, specifically 80 *per cent* teachers, demonstrated high instrumental values. Within this district, 20 *per cent* exhibited instrumental values at a medium level, with none falling into the low-level category, whereas, in Nainital district, a different pattern emerged, with the majority of teachers, at 60 *per cent*, possessing high instrumental values. Additionally, 40 *per cent* exhibited instrumental values at a medium level, and none fell into the low-level category. Regarding instrumental values, the findings of Dasari (2017), indicated that prospective teachers assigned the highest priority to ambition, followed by broadmindedness and obedience. This order of preference suggests that they are characterized by open-mindedness, a strong work ethic, and a sense of duty. These values took precedence over qualities such as courage, politeness, capability, helpfulness, responsibility, and forgiveness in the behavior of prospective teachers.

Conclusion

The current study underscores the pivotal role of value-based education and its integration into the school curriculum, aligning with Rokeach's (1973) terminal and instrumental values scale. This emphasis on moral values plays a critical role in influencing children's decision-making processes, judgment, and social behaviour, guiding them toward adopting acceptable norms. Parents and teachers, as role models, have the potential to instil both terminal and instrumental values in their children through their own behaviour and conduct, thereby setting positive examples. The integration of a value-based core curriculum into the education system is indispensable in addressing the escalating issue of moral erosion among young children in India. As a result, school authorities and educators must proactively take steps to instil moral values in children. This study provides a solid foundation for future research, facilitating an investigation into the efficacy of a positive school curriculum in shaping children's values and character.

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Table 4: Distribution of children according to the Terminal and Instrumental Values

Values/Value range	Udham Singh Nagar (n_1=10)						Nainital (n_2=10)						Total (n=20)					
	Low		Medium		High		Low		Medium		High		Low		Medium		High	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Terminal values	06	20.00	09	30.00	15	50	05	16.66	11	36.66	14	46.66	11	18.33	20	33.33	29	48.33
Instrumental values	05	16.66	07	23.33	18	60	04	13.33	10	33.33	16	53.33	09	15.00	17	28.33	34	56.66

Table 5: Distribution of parents according to the Terminal and Instrumental Values

Values/Value range	Udham Singh Nagar (n_1=10)						Nainital (n_2=10)						Total (n=20)					
	Low		Medium		High		Low		Medium		High		Low		Medium		High	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Terminal values	12	20.00	18	30.00	30	50.00	08	13.33	12	20.00	40	66.66	20	16.66	30	25.00	70	58.33
Instrum-ental values	14	23.33	18	30.00	28	46.66	06	10.00	10	16.66	44	73.33	20	16.66	28	23.33	72	60.00

Table 6: Distribution of Teachers according to the Terminal and Instrumental Values

Values/Value range	Udham Singh Nagar (n_1=10)						Nainital (n_2=10)						Total (n=20)					
	Low		Medium		High		Low		Medium		High		Low		Medium		High	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Terminal values	00	0.00	03	30.00	07	70.00	00	0.00	04	40.00	06	60.00	00	0.00	07	35.00	13	65.00
Instrum-ental values	00	0.00	02	20.00	08	80.00	00	0.00	04	40.00	06	60.00	00	0.00	06	30.00	14	70.00

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Effect of Nano-Nitrogen Fertilization on Yield attributes and Yield of barley (*Hordeum vulgare* L.)

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Abstract

*The present investigation entitled Effect of Nano-Nitrogen Fertilization on Growth, Yield and Economics of barley (*Hordeum vulgare *L.) conducted during the 2021-22 (*rabi*) at the Research Field Department of Agronomy, Raja Balwant Singh College Bichpuri Agra. Barley (Variety- BH-946) crop was sown on 10.11.2021 with recommended seed rate of 100 kg/hectare. The experiment planed a randomized block design (RBD) with nine treatments viz. Treatment$_1$-Control (only phosphorus + potash), Treatment$_2$-Control {(only phosphorus + potash) + foliar application of Nano-nitrogen @ 1000 ml/hectare at 30-35 and 60-65 DAS), Treatment$_3$-(50% recommended dose of nitrogen fertilizer + foliar application of Nano-nitrogen @ 500 ml/hectare at 30-35 and 60-65 DAS), Treatment$_4$-(50% recommended dose of nitrogen fertilizer + foliar application of Nano-nitrogen @ 1000 ml/hectare at 30-35 and 60-65 DAS), Treatment$_5$-(75% recommended dose of nitrogen fertilizer + foliar application of Nano-nitrogen @ 500 ml/hectare at 30-35 and 60-65 DAS), Treatment$_6$-(75% recommended dose of nitrogen fertilizer + foliar application of Nano-nitrogen @ 500 ml/hectare at 30-35 and 60-65 DAS), Treatment$_7$-(100% recommended dose of nitrogen fertilizer + foliar application of Nano-nitrogen @ 500 ml/hectare at 30-35 and 60-65 DAS, growth), Treatment$_8$-(100% recommended dose of nitrogen fertilizer + foliar application of Nano-nitrogen @ 1000 ml/hectare at 30-35 and 60-65 DAS) and Treatment$_9$-Recommended dose of fertilizer {60:30:20 (N.P.K.) kg/hectare}. All treatments were repeated three times. The results of the experiment showed that foliar application of Nano-nitrogen and recommended dose of nitrogen fertilizer had the best effect in terms of growth, yield and profitability of barley crop under irrigated conditions. In all treatments, Treatment$_8$-Recommended dose of nitrogen fertilizer (60kg/ha) + foliar application of Nano-nitrogen/ha @ of 1000 ml at 30-35 and 60-65 days after sowing to improve growth, yield and maximum Benefit and cost ratio (2.82) was better. Suggest it is suitable for farmers in the North Western Plains region.*

Keywords: Barley, Growth, Foliar application, Nano-fertilizer and Nitrogen

Introduction

Barley (*Hordeum vulgare* L.) is a major cereal grain that holds significant importance in the global agricultural landscape. It is considered the fourth largest cereal crop in the world, following wheat, rice, and maize, with a share of approximately 7% of global cereal production (Pal et al., 2012). Barley has a long history of cultivation and is recognized as one of the oldest cultivated grains.

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Today, it remains one of the most widespread cereals, valued for its versatility and nutritional qualities (Vishnu et al., 2014). Barley is a Rabi season, fast growing, annual grain crop that could be used for green fodder purpose as well as cover crop to improve soil fertility (Ghanbari et al., 2012).

In the context of barley cultivation, the application of Nano nitrogen fertilizers holds significant potential for enhancing crop performance, particularly in semi-arid regions. These regions often face water scarcity and limited nutrient availability, making efficient nutrient management crucial for sustainable agriculture. The incorporation of Nano nitrogen fertilizers into barley cultivation practices could offer a strategic approach to improve nutrient uptake, increase yield, and enhance overall plant growth under water-limited conditions. Overall, the integration of Nanotechnology into fertilizer products, particularly Nano nitrogen fertilizers, holds promise for improving nutrient management and enhancing barley yield. This introduction provides a brief overview of the significance of Nano-fertilizers in agriculture, focusing on Nano nitrogen fertilizers and their potential applications in barley cultivation (Mohsen Janmohammadi et al., 2016). Nanotechnology improves the nutrient use efficiency and reduces costs of environmental protection, slow-release fertilizers are the excellent replacement to soluble fertilizers (Abobatta, 2018). Nano-materials are defined as the materials with a single unit between one and a hundred nm in size in a minimum of one dimension (Liu and Lal, 2015). The Nano coated substances enhance the penetration via stomata with a size exclusion limit above 10 nm (Perez-de-Luque, 2017).

Materials and Methods

The field experiment was carried out during winter (*Rabi*) season of 2021-22 at Agricultural Research Farm, Deptt. of Agronomy, R.B.S. College, Bichpuri, Agra (U.P.). The soil was a sandy loam in texture with pH 7.89, organic carbon %, 0.33 available N 182.30 kg ha^{-1}, P_2O_5 27.95 kg ha^{-1} and Potash 284.26 kg ha^{-1}. The experiment was laid out in 'Randomized Block Design' having 9 treatments. T_1-Control (only phosphorus + potash), T_2-Control (only phosphorus + potash)+foliar application of Nano-nitrogen@1000 ml/ha at 30-35 and 60-65 DAS), T_3-(50% recommended dose of nitrogen fertilizer + foliar application of Nano-nitrogen@500 ml/hectare at 30-35 and 60-65 DAS), T_4-(50% recommended dose of nitrogen fertilizer + foliar application of Nano-nitrogen@1000 ml/hectare at 30-35 and 60-65 DAS), T_5-(75% recommended dose of nitrogen fertilizer + foliar application of Nano-nitrogen@500 ml/ha at 30-35 and 60-65 DAS), T_6-(75% recommended dose of nitrogen fertilizer + foliar application of Nano-nitrogen@500 ml/ha at 30-35 and 60-65 DAS), T_7-(100% recommended dose of nitrogen fertilizer + foliar application of Nano-nitrogen@500 ml/ha at 30-35 and 60-65 DAS, growth), T_8-(100% recommended dose of nitrogen fertilizer + foliar application of Nano-nitrogen@1000 ml/hectare at 30-35 and 60-65 DAS) and T_9-Recommended dose of fertilizer {60:30:20 (N.P.K.) kg/ha} with four replications. CCS HAU, Hisar, has introduced a high-yield six-row feed barley cultivar (BH-946) suitable for Uttar Pradesh timely sown, irrigated conditions. This variety exhibits remarkable resistance to lodging, yellow rust, and leaf blight. With an impressive average grain yield potential of approximately 51.87q/ha, it boasts notably bold grain size.

Results and Discussion

Yield attributes

In case of barley, the key yield-attributing characteristics include the Stand count m^{-2}, Ear head m^{-2}, Length of spike (cm), grain weight $spike^{-1}$ and 1000 grain weight (Test Weight). The variations in these yield attributes due to different doses of RDN and the application of Nano-nitrogen fertilizer were measured and results so obtained were subjected to statistical analyses. The data pertaining to the main effects of all yield attributes have been summarized in Table 1.

Stand count m^{-2}

The data enumerated in Table 1, it is apparent that various treatments exert a significant effect of stand count $metre^{-2}$. Maximum stand count metre-2 (370) was observed with the T8 (RDN + foliar spray of NN @ 1000ml NN/ ha at 30-35DAS + foliar spray of NN @ 1000 ml NN/ ha at 60-65 DAS) which was significantly higher overall treatments by 2.30 to 26.71%. Treatment T_1 had the lowest stand count $metre^{-2}$ and proved its significant inferiority overall other treatments.

Table 1: Yield attributing characters of barley as influenced by various treatments

Treatments	Stand count m^{-2}	Ear head m^{-2}	Length of spike (cm)	Grain weight $spike^{-1}$	1000grain weight (g)
T_1	292.00	269.66	6.05	1.41	32.00
T_2	309.66	283.33	6.28	1.55	33.33
T_3	315.66	299.00	6.58	1.60	34.66
T_4	331.33	310.66	6.95	1.67	35.00
T_5	344.33	323.00	7.10	1.73	36.00
T_6	352.00	332.33	7.50	1.81	38.33
T_7	361.66	339.66	8.02	1.85	39.00
T_8	370.00	346.00	8.14	1.89	40.66
T_9	348.00	328.66	7.36	1.78	38.15
SEm ±	2.44	2.12	0.17	0.00	1.02
CD (p=0.05)	7.39	6.42	0.518	0.02	3.08

Ear head m-2

The data presented in Table 1, shows that various treatments exert a significant effect on the number of ear head $metre^{-2}$. Maximum number of ear (346) head $metre^{-2}$ was observed with the T_8 and which significantly higher overall was other treatments by 1.86 to 28.30%. Treatment T_1 had the lowest number of ear head metre-2 (269.66) and proved its significant inferiority overall other treatments. T_7 was statistically at par with T_8.

Length of spike (cm)

Spike length(cm) of barley varied significantly under different fertility treatment ranging from 8.14 to 6.05 spike length (cm) Table 1 shows that maximum spikes length (8.14 cm) under T_8 followed by T_7 (8.02 cm), T_6 (7.50 cm), T_9 (7.36 cm), T_5 (7.10 cm), T_4 (6.95 cm), T_3 (6.58 cm), T_2 (6.28 cm) and T_1 (6.05 cm) respectively. T_7 was statistically at par with T_8 (RDN + foliar spray of NN @ 1000ml NN/ ha at 30-35DAS + foliar spray of NN @ 1000 ml NN/ ha at 60-65 DAS).

Grain weight $spike^{-1}$

Based on the data in Table 1, it is evident that the application of RDN and Nano-nitrogen fertilizer significantly influences the weight of grains per spike. The maximum grain weight per spike (1.89g) was observed with T_8. This result was statistically comparable to T_7. Treatments T_6, T_9, T_5, and T_4 also resulted in significantly higher grain weight per spike compared to the other treatments, with improvements ranging from 2.16% to 34.04%. The minimum grain weight per $spike^{-1}$ was observed with Treatment T_1 (Control, P+K only).

1000-Grains weight

1000-Grain weight (g) of barley varied significantly under different treatments ranging from 32 to 40.66 g 1000-Grain weight (g) Table 1 with maximum of 40.66 g 1000-Grain weight (g) under T_8 followed by T_7 (39 g), T_6 (38.33 g), T_9 (38.15 g), T_5 (36 g), T_4 (35 g), T_3 (34.66 g), T_2 (33.33 g) and T_1 (32 g) respectively. T_6, T_7 and T_9 was statistically at par with T_8 (RDN +1000ml NN/ ha at 30-35DAS +1000 ml NN/ ha at 60-65 DAS).

Yield parameters

The effects of different RDN doses and foliar spray of Nano-nitrogen fertilizer are summarized in Table 2. The data on barley's biological yield, grain yield, straw yield and harvest index under various treatments is presented in table, indicating the mean squares for the relevant variance components.

Biological Yield (kg ha^{-1})

The data pertaining to biological yield of barley with Treatment T_8 (RDN + foliar spray of NN @ 1000ml NN/ ha at 30-35DAS + foliar spray of NN @ 1000 ml NN/ ha at 60-65 DAS) resulted in significantly higher biological yield (13118.66 kg ha^{-1}) compared to all other treatments, except Treatment T_7 (12673.00 kg ha^{-1}). The increase in biological yield ranged from 3.51% to 78.88%. The minimum biological yield (7333.66 kg ha^{-1}) was observed in Treatment T_1 (Control, P+K only).

Grain yield (kg ha^{-1})

The data pertaining to grain yield of barley under Treatment T_8 (RDN + foliar spray of NN @ 1000ml NN/ ha at 30-35DAS + foliar spray of NN @ 1000 ml NN/ ha at 60-65 DAS) resulted in

Table 2: Biological, Grain yield, Straw yield and Harvest index of barley as influenced by various treatments

Treatments	Biological yield (kg ha^{-1})	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
T_1	7333.33	2967.66	4366.00	40.47
T_2	8200.00	3306.66	4893.33	40.32
T_3	9152.33	3705.66	5446.66	40.48
T_4	10134.00	4119.66	6014.33	40.65
T_5	11123.66	4540.33	6583.33	40.81
T_6	12111.66	4964.00	7147.66	40.98
T_7	12673.00	5215.33	7457.66	41.15
T_8	13118.66	5499.00	7619.66	41.94
T_9	11894.70	4875.00	7020.00	40.47
SEm ±	242.92	90.51	155.09	0.19
CD (p=0.05)	728.33	271.38	464.99	0.58

significantly higher grain yield (5499.00kg ha^{-1}) compared to all other treatments. The increase in biological yield ranged from 5.44% to 85.29%. The minimum grain yield (2967.66 kg ha^{-1}) was observed in Treatment T_1 (Control, P+K only).

Straw yield (kgha^{-1})

The data relevant that the various doses of RDN and foliar spray of Nano-nitrogen fertilizer significantly influenced straw yield. Treatment T_8 (RDN + foliar spray of NN @ 1000ml NN/ha at 30-35DAS + foliar spray of NN @ 1000 ml NN/ ha at 60-65 DAS) resulted in significantly higher straw yield (7619.66 kg ha^{-1}) compared to all Other treatments, with it increase ranging from 2.26% to 74.52%. The next best treatment was T_7 (7457.66 kg/ha), it was statistically at par with T_8. The lowest straw yield was observed in Treatment T_1 (4366.00 kg ha^{-1}).

Harvest index (%)

Harvest index of barley varied significantly under different doses of RDN and foliar spray of Nano-nitrogen fertilizer at 500 and 1000 ml/ha during the 30-35 and 60-65 DAS stage. However, the maximum harvest index was observed with Treatment T_8 (RDN + foliar spray of NN @ 1000ml NN/ ha at 30-35DAS + foliar spray of NN @ 1000 ml NN/ ha at 60-65 DAS) (41.94%), while the minimum harvest index (40.47%) was found with Treatment T_1.

Conclusion

Application of 100% recommended dose of nitrogen (RDN) (60 kg ha^{-1}) along with foliar spray of Nano-nitrogen fertilizer @ 1000 ml/ha at 30-35 and 60-65 DAS resulted in optimal growth and development of the barley crop. The highest grain yield (5499.00 Kg ha^{-1}) was achieved by fertilizing the crop with 100% RDN and two foliar sprays of Nano-nitrogen fertilizer @ 1000 ml/ha at 30-35 and 60-65 DAS (T_8), followed by T_7 (100% RDN + foliar spray of Nano-nitrogen fertilizer @ 500 ml/ha at 30-35 and 60-65 DAS).

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Physical and Chemical Properties of Drumstick (*Moringa oleifera* L.) Pods

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Abstract

*Drumstick (*Moringa oleifera *L.) is an important vegetable grown in India and throughout the world. It is a miracle tree because it contains a good amount of nutrition. Apart from its nutrition it has a good meditational value and used in other useful items. Drumstick pod was studied for physical and chemical properties. The average weight, length, diameter of pod was found 56.95 g, 48.48 cm, 11.32 mm respectively. Average number of seeds per pod were counted 12 and average firmness was measure 26.07 kgf. The moisture content of pod was found 83.10±2 %. The ascorbic acid (120 mg/100 g), chlorophyll content (0.7±0.5 mg/g), protein content (2.5±0.5 g/100g), total carbohydrate (3.7±0.6 g/100g), total soluble solids (5±0.5 ºBrix), pH (5±0.5), fiber content (4.0±1.0 g/100g) and ash content (5.0±0.7%.). From the study it was concluded that drumstick pod contain good amount of nutrition and it can be used in other value added products.*

Keywords: Drumstick, physical properties, chemical properties, nutritional value

Introduction

Moringa (*Moringa oleifera* L.) is the most widely cultivated species of the genus Moringa, which is the only genus in the family *Moringaceae*. *Moringa oleifera* is well-known by many names such as moringa tree, drumstick tree (from the appearance of the long, slender, triangular seed-pods), horseradish tree (from the taste of the roots, which resembles horseradish), ben oil tree, or benzoil tree (from the oil which is derived from the seeds). It is native to the southern foothills of the Himalaya in north western India and possibly parts of Africa, Arabia, South East Asia, South America and the Pacific and Caribbean Islands. It is fast growing and drought resistant tree. Among the countries, India is the well-known producer of drumsticks with annual production 1.1 to 1.3 million tonnes of tender fruits from an area of 380 km^2 in which Andhra Pradesh lead in both, area and production (156.65 km^2) followed by Karnataka (102.8km^2) and Tamil Nadu (74.08 km^2) (Ramasubramania Raja *et al.* 2016).

Moringa oleifera is known as a miracle tree because it has so many unbelievable nutrients. Moringa has 25 times the amount of iron as spinach, 10 times vitamin A of a carrot, 1.5 times vitamin C of an orange, 17 times calcium of the milk, 15 times in potassium of a banana, and 9 times protein of the yogurt (Fuglie, 1999). Drumsticks and its leaves have been used to fight malnutrition for infants and help to nursing mother for increasing milk production and also regulate thyroid hormone imbalance. Drumstick leaves, fruits and flowers also used to make water purified for hand washing and it contain aceton which help to prepare herbal medicine which is a very effective anti-malaria bio agent.(Patel *et al.* 2010, Leone *et al*. 2015).Virtually, each parts of drumstick tree have long been consume by humans. The seed oil is used in arts and for lubricating watches and other delicate machinery and useful in the manufacture of perfumes and hairdressings. After oil extraction the pressed cake obtained may be used as a fertilizer. In addition, it has also many industrial

uses include the use of its wood in paper and textile industries, bark in the tanning industry and the seeds in water purification (Bhattacharya *et al*. 1982, Mayer and Stelz, 1993, Palada, 1996 and Tauscher, 1994). It has also various uses such as alley cropping, animal forage, biogas, domestic cleaning agent, blue dye, foliar nutrient, gum (from tree trunks), ornamental plantings, bio pesticide, pulp, rope, tannin for tanning hides, water purification, and hair care products (Fuglie, 1999).

Both perennial and annual drumstick tree are cultivated in India. The crop comes in the month of March to August at that time the price of pods per kg remain very low. Further, the price of pods can be rise during September and October as the productivity start to decline. During November to February the pods are available in a very scanty due to the season which has heavy rainfall, low temperature leads to the drop in flowers leading to poor pod set which is considered to be the off-season period of the year. During this particular period the cost of the pods remain very high.

Materials and Methods

The present investigation was carried out in the Department of Processing and Food Engineering, Junagadh. The experiment was carried out on Drumstick (*Moringa oleifera* L.) pods. For this, fresh, mature, green colour drumstick pods without any damage were purchased from local farmer in junagadh, Gujarat. All the chemicals of analytical grade and glassware required for this study were used from the Department of Processing and Food Engineering, Junagadh.

Physical properties

To investigate the physical properties of drumstick pods fresh, healthy and uniform size of pods were selected. The physical parameters such as weight, length, diameter number of seeds per pod and firmness were studied. A digital weighing balance with measurement precision of ±0.001 g was used for weight measurement. The diameter of individual pod was measured using digital vernier calliper having a least count of 0.01mm. Length was measured by scale and number of seeds per pod was counted manually. Firmness of the drumstick pods were determined by Texture analyzer (TA. XT. Plus, Stable Micro System Ltd., UK.). Ten pods were selected and values of each parameter were recorded

Chemical Properties

The chemical properties such as moisture content, ascorbic acid, chlorophyll content, true protein, total carbohydrate, total soluble solid, pH, fibre content and ash content were analyzed.

Moisture content

Moisture content of drumstick was determined by hot air oven method. Approx. 5 g sample were kept in a petridish and placed inside a hot air oven at 105-110 ºC for 2 hours (till the samples attained the constant weight). After that the samples were cooled in desiccators and weighed. The difference in initial and final weights of the samples were taken as the weight of water removed and the moisture content was calculated by using the formula given below.

$$\text{Moisture content (\%)} = \frac{\text{Weight of water removed(g)}}{\text{Initial weight (g)}} \text{X } 100$$

Ascorbic acid

Ascorbic acid was determined by titrimetric method, as describes by Ranganna (2000). Ascorbic acid (mg/100 g) was calculated using following equation.

$$\text{Ascorbic acid, mg /100 g} = \frac{\text{Titre x Dye factor x Volume made up x 100}}{\text{Aliquot taken x Weight of sample}}$$

Chlorophyll content

The chlorophyll was determined by colorimetric method as described by Sadasivam and Manickam (1996). According to this method, 1 g drumstick sample was ground by adding 80% acetone. After that, centrifuge and collect the supernant in 50 ml volumetric flask. Repeat this procedure until the sample become colourless. The absorbance was recorded at 645 and 663 nm against blank. The amount of chlorophyll present in extract mg chlorophyll per g.

True protein

True protein content was determined by folin lowry method as described by Ranganna (2000).

$$\text{True protein (\%)} = \frac{\text{GF x OD (Sample Reading) x Total Volume x 100 x } 10^{-6}}{\text{Sample Aliquot x Wt.of sample (gm)}}$$

Total carbohydrate

Total carbohydrate content of drumstick was determined by phenol sulphuric acid method, as described by Sadasivam and Manickam (1996). The total carbohydrate was calculated as following.

$$\text{Total carbohydrate (\%)} = \frac{\text{GF x OD x Total Volume x 100 x } 10^{-6}}{\text{Sample Aliquot x Wt.of sample (g)}}$$

Total soluble solid

Total soluble solids of drumstick were determined by hand refractometer (Model Erma 0-32 %, Tokyo, Japan). Scraped out the pulp from drumstick and grind into fine paste. Then one or two drop of pulp was put onto the prism of refractometer and TSS was directly read from refractometer. The observations were recorded in ^{o}Brix.

pH

The pH of drumstick pulp was measured by digital pH meter with a glass rod (Model P-775, made in Japan). The pulp was scraped from pod and ground with 10 ml distilled water and collected in the beaker. The electrode placed in the beaker and measured pH number were recorded directly from display of pH meter.

Crude fibre content

The crude fibre content of drumstick was determined by fibertherm method as described by Sadasivam and Manickam (1996). The fibre content was calculated using following equation.

$$\text{Crud fibre (\%)} = \frac{(W2-W1)-(W3-W1)}{Sample\ weight} \times 100$$

Where,

$W1$ = weight of crucible and sample

$W2$ = weight of crucible and sample after oven drying

$W3$ = weight of crucible and sample after muffle furnace

Ash content

Ash content of drumstick was determined by using muffle furnace. 2 g sample was weighed and put in clean dry pre weighed crucible. After that the crucible was placed in muffle furnace at 600^{o}C for 5 hrs. After drying cooled the crucible and weighed. The ash content was calculated as following.

$$\text{Ash (\%)} = \frac{\text{weight of Ash}}{\text{weight of sample}} \times 100$$

Table1: Physical properties of drumstick pods.

S.No	Weight	Length	Diameter	No of seeds/pod	Firmness
1	44.12	48.6	10.69	15	26
2	42.16	46.5	11.65	12	25
3	49.06	51.1	10.29	12	26.5
4	43.73	49.3	12.53	12	26
5	57.22	47.6	10.89	10	26
6	60.45	50.5	11.9	8	25.9
7	52.54	49.2	10.22	14	26.5
8	81.79	47.7	10.55	10	26
9	71.32	48.6	12.68	12	26
10	67.14	45.7	11.84	15	26.8
Av.	56.953	48.48	11.32	12	26.07
Max	81.79	51.1	12.68	15	26.8
Min	42.16	45.7	10.22	8	25
SD	13.247	1.673	0.9113	2.260	0.483

Results and discussion

Physical properties of Drumstick pod

The physical properties of drumstick such as weight, length, diameter, number of seeds per pod and firmness of drumsticks are presented in Table 1. It was observed a variation in all the values. The maximum weight, length, diameter no. of seeds and firmness were recorded to be 81.79g, 51.1cm, 12.68mm, 15 and 26.8kgf, while minimum was 42.16 g, 45.7 cm 10.22 mm, 8 and 25kgf with their standard deviation as 13.24, 1.67, 0.91, 2.2 and 0.48 respectively. The average value of weight, length, diameter, no of seeds and firmness of drumsticks were measured as 56.95g, 48.48 cm, 11.32 mm, 12 and 26.07kgf respectively. this result is

Chemical Properties of Drumstick pods

The chemical properties such as moisture content, ascorbic acid, chlorophyll content, true protein, total carbohydrate, total soluble solid, pH, fibre content and ash content were presented in table 2.

Moisture content is one of the very important parameter for storage of any biological material. It was observed from the table 2 that, drumstick pod

Table 2: Chemical properties of drumstick pod

S No	Chemical Properties	Results
1	Moisture content (%)	83.10±2
2	Ascorbic acid (mg/100g)	120±2
3	Chlorophyll content (mg/g)	0.7±0.5
4	True protein (g/100g)	2.5±0.5
5	Total carbohydrate (g/100g)	3.7±0.6
6	Total soluble solids (ºBrix)	5±0.5
7	Ph	5±0.5
8	Crude fibre content (g/100g)	4.0±1.0
9	Ash content (%)	5.0±0.7

contain very high moisture content i.e. 83.10±2 %. The ascorbic acid (Vitamin C) content was found 120 mg/100 g. Vitamin C content is less in drumstick pod as compared to drumstick leaves i.e. 211 mg/ 100g (Chaudhary et al., 2023). Chlorophyll content was found 0.7±0.5 mg/g. Drumstick pod contain good amount of protein content i.e. 2.5±0.5 g/100g so it can be include in daily diet. The total carbohydrate content was found 3.7±0.6 g/100g which indicates a good source of energy. Total soluble solid content was found 5±0.5 ºBrix. pH of drumstick pod was found 5±0.5 which indicates a moderately acidic nature. Drumstick pod contains a very good amount of fibre i.e. 4.0±1.0 g/100g on consumption it stimulates digestion and facilitate regular bowel movement. The ash content was found 5.0±0.7%. Ash is the composition of minerals so it is generally taken to find out minerals profile in food.

Conclusion

Drumstick (*Moringa oleifera L.)* is an important vegetable. All parts of the *Moringa oleifera* is useful whether in case of food, medicine as well as other useful items. Drumstick pods and leaves are mostly consumed as a vegetable in India. Drumstick pods contain good amount of moisture, protein, vitamin C, carbohydrate, fiber content, and total soluble solids which made it healthy. Drumstick pod contain a good nutritional value so it can be use to make value added product like dehydrated drumstick pod power, ready to cook soup, other ready to make thepla or paratha floor mixed with drumstick power etc.

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Evaluation of Onion (*Allium cepa L.*) Varieties for its Suitability in Sikar District of Rajasthan

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Abstract

*The present study was carried out to evaluate the performance of improved varieties with a scientific package of practices on production and profitability of onion crop. The extent of adoption of improved new agriculture technology is a crucial aspect under innovation diffusion process and the most important for enhancing agriculture production at a faster rate. These aspects On Farm Trial (OFT) is one of the most powerful tools for assessment and transfer of technology. An on farm research trial entitled "Evaluation of Onion (*Allium cepa *L.) Varieties for its suitability in Sikar district of Rajasthan" was conducted during two consecutive* Rabi *seasons, at farmer's fields of district Sikar, to find out the best suitable variety of onion for the area. The field experiment was laid out with three treatments in four villages of two blocks. On Farm trials were conducted according to standard recommended practices of onion at farmers' field with two new high yielding onion varieties* viz*., NHRD Red (L-28) and NHRD Red-2 (L-355) and compared with existing local varieties being grown by the farmers of the area. These check plots were maintained by the farmers according to their own traditional cultivation practices. The results revealed that highest TSS (13.8%) was reported from NHRDF Red and the lowest in local variety (7.5%). Similarly, the onion variety NHRDF Red-2 recorded maximum bulb size (4.5 cm), bulb yield (341.10 q/ha), along with minimum bolting percentage (3.90) followed by NHRDF Red, whereas it was observed lowest in farmer's practice. Highest gross return (272880 Rs/ha.) net return (181755 Rs/ha.) and B:C Ratio (3.00) was reported from cultivation of onion variety NHRDF Red-2. It was concluded from the study that the onion variety NHRDF Red-2 had better performance in the trial and can be recommended for cultivation in Sikar district of Rajasthan.*

Key Words: Bulb yield, Marketability, Onion, OFT, Gross return, Cost of cultivation, Net return.

Introduction

Onion (*Allium cepa* L.) is one of the most important bulbous vegetable crops belonging to the family Amaryllidaceae (Alliaceae) and chromosome number 2n=16. Onion, the principal *Allium*, ranks second in value after tomatoes on the list of cultivated vegetable crops globally; In addition over 20 other *Allium* species have been consumed by humans (Ratan *et al*., 2017). Onion as food, medicine and religious objects was known as early as 3200 BC in Egypt and in India since 600 BC. The onions are used for salad, chutneys, pickles, condiments,

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curries, sauces, soups and seasoning foods. The crushed bulb contains colourless, odourless volatile oil known as *allyl propyl disulphide*. The colour of the outer skin of onion bulbs is due to "*quercetin*" which has antibacterial properties. It is a strictly cross pollinated crop. Onion called the 'Queen of Kitchen' due to its flavor, aroma, medicinal properties and unique taste as part of many dishes (Selvaraj, 1976). The edible portion of onion is a modified leaf which is known as bulb and develops underground. It is one of the few versatile vegetable crops that can be kept for a fairly long time and can safely withstand the hazards of rough handling including long distance transport.

The area under onion in Sikar district is about 20210 ha with productivity of 270 q/ha. The package of practices followed by the farmers is not very scientific, like they use local seed, imbalance nutrients, faulty weedicide with wrong method and time. Successful onion production depends on the selection of suitable varieties that are adapted to different conditions imposed by specific environments. It is well established that the high yielding varieties contributed maximum in increasing production and productivity as farmers gradually replaced their low yielding traditional varieties with high yielding. A number of onion varieties being grown by the farmers are the best performing varieties of onion having desirable quantitative and qualitative characters such as adaptability to adverse environment conditions, resistance to biotic and abiotic stresses resulting in better monetary return to the vegetable growers. This is a common fact that the varieties showing better performance under agro climatic zone may not be suitable for another agro climatic zone. Hence, the present experiment was conducted to study the evaluation of some improved varieties of onion (*Allium cepa* L.) for their suitability for cultivation in Sikar district of Rajasthan.

Materials and Methods

The present study was carried out by the Krishi Vigyan Kendra, Fatehpur-Shekhawati, Sikar (SKN Agriculture University, Jobner-Jaipur) during the rabi seasons of 2019-20 and 2020-21 in the farmer's field of two adopted blocks *viz*., Laxmangarh and Dhod of Sikar district through on farm trials. Total 60 trials in a 6.0 hectare area were conducted at 20 farmer's fields. All the trials were conducted by the active participation of farmers with the objective to evaluate the improved technologies of onion production in adopted villages. The experiment consisted of three varieties namely NHRDF Red (L-28), NHRDF Red 2 (L-282) and local variety with three replications. In trials plots, a few critical inputs in the form of quality seed of improved varieties, seed treatment with tricoderma, line sowing, raised nursery bed, weed control technique, recommended dose of fertilizer, etc. were emphasized. In case of farmer's practices, existing practices used by farmers were followed. The soil in the demonstration areas was sandy loam in texture with pH ranges 7.8 to 8.3. 45-50 days old, healthy and vigorous seedlings were selected and transplanted in plots during December at a spacing of 15 x 10 cm. Before conducting the trials, training to the framers of respective villages was imparted with respect to envisaged technology interventions; site selection, farmer's selection, layout of trials, and farmer's participation etc were followed. The crop was harvested when 75 per cent tops start falling over but before the foliage is completely dry. The bulbs were harvested by hand pulling and hand hoe. Ten plants were randomly selected in each entry to record observations on quality and yield parameters. The total soluble solids of the onion bulb in each treatment were found out through a hand refractometer and expressed as percentage. Economics of onion was worked out based on the current market price of inputs and outputs.

Results and Discussion

Quality and yield attributing traits

The results obtained from the present investigation on the evaluation of different varieties of onion in Sikar district during 2019-20 and 2020-21 are discussed given Table 1. The highest total soluble solids (13.8%) were reported from NHRDF Red and the lowest in local variety (7.5%). This type of varietal difference in TSS was also reported by Singh *et al*. (2020) and Sharma *et al*. (2014) in onion. The variety NHRDF Red-2 recorded minimum bolting of the bulb (3.90%), whereas it was maximum (8.65%) in farmers' practices *i.e.*, local variety. It may be due to high temperature prevalence throughout the crop period and varietal character.

Table 1: Evaluation of different onion varieties for quality and yield contributing parameters

Varieties	No. of trials		Area(ha.)		TSS (%)			Bolting (%)			Bulb Size (cm)			Yield (q/ha)		
	2019	2020	2019	2020	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
T_1-Farmer's Practice (Local)	10	10	1.0	1.0	7.4	7.6	7.5	7.5	9.8	8.65	4.2	4.0	4.10	288.15	260.4	274.28
T_2 – NHRDF Red (L-28)	10	10	1.0	1.0	13.8	13.8	13.8	3.7	4.6	4.15	4.3	4.4	4.35	325.67	333.9	329.79
T_3 -NHRDF Red-2 (L-355)	10	10	1.0	1.0	13.4	13.2	13.3	4.0	3.8	3.90	4.4	4.6	4.5	334.20	348.0	341.10

Table 2: Evaluation of different onion varieties for economics parameters

Varieties	Cost of cultivation (Rs./ha)			Gross Returns (Rs./ha)			Net Returns (Rs./ha)			B:C Ratio		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
T_1-Farmer's Practice (Local)	77850	80400	79125	201705	182280	219420	152670	127920	140295	2.59	2.27	2.43
T_2 – NHRDF Red (L-28)	89500	92750	91125	260536	267104	263820	171036	174354	172695	2.91	2.88	2.90
T_3 -NHRDF Red-2 (L-355)	89500	92750	91125	267360	278400	272880	177860	185650	181755	2.99	3.00	3.00

These results are in conformity with the finding of Vibhute and Singh (2019); Singh *et al*. (2020) and Tarai *et al*. (2015) in onion. The maximum bulb size (4.50 cm) and bulb yield (341.10 q/ha) were recorded with the NHRDF Red-2, whereas, it was minimum (4.10 cm) and (274.28 q/ha) in farmers practices, respectively. Similar results were also reported by Vibhute and Singh (2019), Sarada *et al.* (2009) and Dikshit *et al.* (2020) in onion they observed similar trends in different varieties at different locations.

Economics of On Farm Trials

Economic parameters are presented in table 2. The inputs and outputs prices of commodities prevailed during the study of on farm trials were taken for calculating gross return, cost of cultivation, net return and benefit: cost ratio. Economic evaluation in terms of gross expenditure, gross returns; net returns and BC ratio clearly revealed that the net returns from the recommended practice were substantially higher than control *i.e.*, farmers practice. Higher net returns (Rs. 181755/ha and 172695/ha) were obtained in the on farm trial plots of NHRDF Red-2 and NHRDF Red, respectively compared to farmers' practice plots (Rs 140295/ha). Higher cost of cultivation under recommended practice was attributable to higher seed cost of improved onion varieties. The average B: C ratio was calculated 3.00 and 2.90 in OFT plots compared to 2.43 in farmer's plots. The cost of cultivation under recommended practice was recorded Rs. 91125 while it was Rs. 79125 under farmers practice. Thus, favorable cost benefit ratio and higher net returns proved the economic viability of the intervention made under recommended practice and convinced

the farmers of the utility of intervention technology provided in real farming situations. Similar findings were reported by Sable *et al*. (2023); Dikshit *et al*. (2020); Kushwah *et al*. (2016); Choudhary *et al*. (2021) and Kumari *et al*. (2022) in onion crop.

Summary

On Farm Trials (OFT) are playing important role in assessment of technologies and motivating the farmers for adoption of these improved agriculture technology resulting in increasing their yield and profits. On the basis of results of OFT conducted during two consecutive years, It was concluded that the results of different varieties tested for cultivation in *Rabi* season revealed that the variety NHRDF Red- 2 can be adopted for cultivation during *Rabi* season in Sikar district of Rajasthan because of its higher yield, varietal performance and market preference.

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Development of a custard apple harvester

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Abstract

A picking force measurement apparatus was developed to obtain the required force in the detachment of custard apple. Two custard apple harvesters were developed based on the force requirement and tool review, which was lighter in weight and a front conical shape to easily penetrate the plant canopy. After that, the experiment for the harvesting of custard apple was performed for 5 min duration. The average picking force of custard apple varied between 3.00-9.80 kgf, 3.00-10.80 kgf, and 6.20-15.40 kgf with an average value of 5.48, 7.34, and 10.06 kgf for thin average and thick branches respectively. The plucking force required by cutting action, pulling by the tool, and detaching by hand varied between 3.10-12.00, 3.00-10.50, and 3.00-15.40 kgf with an average value of 8.23, 7.13, and 7.53 kgf respectively. The custard apple harvester with blades harvested 3 more fruits from mango harvester and 1 fruit from custard apple harvester without blades in a 5 min harvesting experiment, which is about 13% and 4% more than the mango harvester and custard apple harvester without blades respectively by male person at the top canopy. The custard apple harvester with blades harvested 3 more fruits from mango harvester and also from custard apple harvester without blades, which is about 15% more than the mango harvester and custard apple harvester without blades by female person at the top canopy. The minimum change in pulse rate was observed in the case of custard apple harvested with blades, indicating minimum physical stress observation with the developed custard apple tool without blades followed by custard apple harvester with blades.

Key words: Custard apple, harvester, fruit picking force

Introduction

Custard apple is a very sweet fruit with a pleasant flavor, mild aroma has a universal liking (Pilania *et al.* 2010). Annona aquamosa L. is the scientific name of a custard apple and it is belonging to annonaceae family. Custard apple is believed to be native of the West Indies but it was carried in early times through Central America to southern Mexico. It is also known as sugar apple. It is found wildly and cultivated throughout India up to an altitude of 900 m. It is growing widely in hilly tracts, wastelands and has become completely neutralized in several districts of Gujarat (middle, north Gujarat and Saurashtra), Andhra Pradesh, Panjab, Rajasthan, Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Assam, Maharashtra, Karnataka, Kerala, and Tamil Nadu (Kumar *et al.* 2015). It is known by a different name in the different regions such as in Hindi: Sitafal; Gujarat: Sitafal; Assames: Atlas, Ata; Panjab: Sharifa; Oriya: Ato. The fruit is round to conical, 5-10 cm in diameter and 6-10 cm long and weighing 100-240g, with a thick rind composed of knobby segments (Suchitra, 2015). The custard apple tree is not especially attractive. It is erect with a rounded or spreading crown trunk 25-35cm thick, height ranges from 4-10m. Custard apple is a multipurpose tree with antioxidant, anti-diabetic, hepatoprotective, cytotoxic activity, antitumor activity, and anti-lice agent. (Pandey and Barve, 2001).

The harvesting of custard apple is generally done by handpicking, which sometimes need more force or may damage thin branches along with fully undeveloped fruits. Therefore, there is a need to improve the fruit penetrometer for the development of the fruit picking/ cutting force measurement apparatus required to design the harvesting tool.

The custard apple tree is about 10 to 15 feet in height. There is a problem with harvesting the fruit placed above the reach of a person. The major harvesting losses observed were due to the dropping of fruits while harvesting get damaged and become dark in colour within the short period of time. 2-4 % harvesting losses were found during harvesting and 1-3 % during grading and packaging. The total harvesting losses of the fruit were about 3-7 %. However, no attempt has been made to date for the development of custard apple harvester. Therefore, the present investigation was undertaken to design and development of a harvesting tool for two objectives: (i) development of fruit picking /cutting force measurement apparatus and (ii) development of custard apple harvester.

Materials and Methods

The custard apple harvesting was performed manually, which enhances the amount of damage in the fruits placed at the higher canopy of the tree. The stress for picking the custard apple from tree has the main role in developing the tool. Therefore, a fruit picking force measurement apparatus was developed.

Fruit picking force measurement apparatus

The picking force measurement apparatus was fabricated with wood. The materials needed for the fabrication viz. teak wood, penetrometer, plywood sheet, nails, hook, etc. First, a rectangular wooden support board (16 cm width and 32 cm length) was made from a 10 mm plywood sheet with four holes drilled to fix the board rigidly on the wall. The rectangular base (16cm × 9.5 cm× 6 cm) size block was made from teak wood having a cavity (62 mm × 30 mm) made at the centre to easy holding of penetrometer. The penetrometer was put safely in a cavity of the base. After that, a cover of two square wooden blocks placed on the base to cover or hold the penetrometer tightly to prevent slipping the tool during operation. Then a rectangular frame with a hook at the bottom was placed freely on the probe of the penetrometer and kept straight.

To determine the picking force, first, the fruit's stem diameter was noted then, fruits were separated into three lots according to the diameter of the branch (<5mm, 5-6mm, >6mm). The fruits were then tied at the hook of the rectangular frame using thread and moved downward slowly until the detachment of fruit, while the frame of the apparatus remained straight. The reading of the maximum applied force was noted from the dial. The penetrometer was set to zero again after the experimentation for the next experiment.

Custard apple harvester

Two custard apple harvesters were developed based on already developed other harvesters. One of the harvesters was fabricated for detaching the fruit by pulling action, whereas blades were provided in the other harvester for cutting action. The harvester was made of aluminum pipe. The material required for tool viz. aluminum hollow pipe, blades, was procured from the College of Agricultural Engineering and Technology, Godhra. Whereas, nylon net and wooden handle and nails were purchased from the local market, Godhra, Gujarat.

A 9mm inner diameter and 12mm outer diameter aluminum hollow pipe which was light in weight and sufficient strength to bear up to 2-3 kg load was used to make a frame. It was shaped by bending manually as a conical side of the tool was kept for the front side so that it can easily penetrate the plant canopy. Two blades one, 7cm and the other 6cm of mild steel were attached at the conical side of the frame with a 35 angle kept between blades so it can easily grip the branch for the proper cutting action. A 1.5 m long wooden handle was attached with the support bar. At last, the basket from nylon net to catch and store the fruits.

Testing of developed tools

The testing was performed at village Boriyavi, Distict Mahisagar. The time was measured along with the number of fruits harvested. The test was conducted by a male and female person.

Blood pressure measurement

Blood pressure was measured using blood pressure monitor in millimetres of mercury (mmHg).

The ideal blood pressure for a young healthy adult is 120/80 or lower.

Pulse rate measurement

Pulse rate indicates tiredness of our body after the experiment. The pulse rate measured using a blood pressure monitor (citizen). The ideal range of pulse rate of the human body is 60-100.

The actual time of harvesting was noted. The number of fruits harvested was noted. The stopwatch was paused after five minutes and the total time of harvested fruit was noted.

Results and discussions

The picking force was measured using fruit picking force measurement apparatus. Later, harvesting of custard apple was also performed for 5 min duration.

Picking force measurement

The average picking force of custard apple varied between 3.00 – 9.80 kgf, 3.00 – 10.80 kgf, and 6.20 – 15.40 kgf with an average value 5.48, 7.34 and 10.06 kgf for thin, average and thick branches respectively suggested that the picking force was more for the thick branches (> 6 mm) in comparison to average and thin branches. From the table it can be observed that the F value for the branch thickness was 9.68 against Fcritical value of 2.47, indicating the variation in picking force with the thickness of plant branches is significant (P<0.10). Similarly, from Table 1, it was observed that plucking force required by cutting action, pulling by a tool, and detaching by hand varied between 3.10-12.00, 3.00-10.50, and 3.00-15.40 kgf with an average value of 8.23, 7.13 and 7.53 kgf respectively. However, the F value for plucking action was 0.37 against the Fcritical value of 2.47, indicating variation in force due to plucking action was not significant (P<0.10).

Harvesting of custard apple by a male person at the top canopy

From the figure 1, it was observed that the custard apple harvester with blades harvested 3 more fruits from the mango harvester and 1 fruit from the custard apple harvester without blades in a 5-minute harvesting experiment, which was about 13% and 4% more than the mango harvester and custard apple harvester without blades respectively. The better performance of custard apple harvester with blades may be due to lightweight and front conical shape, which might have helped the person for easy holding and handling of fruits. The average time taken to harvest a single fruit was 13.64, 11.80, and 11.96 s for mango harvester, custard apple harvester with blades and without blades respectively whereas, time was taken to harvest average fruit were 3 to 30 s, 4 to 24 s, and 3 to 23 s respectively.

Harvesting of custard apple by a female person at the top canopy

It was observed from the figure 2, that the custard apple harvester with blades harvested 3 more fruits from the mango harvester and also from the custard apple harvester without blades, which is 15% more than both harvesters. The better performance of custard apple harvester with blades is also in line with the findings of earlier experiments for male persons. The average time taken to harvest a single fruit was 13.75, 12.96, and 14.60 s for mango harvester, custard apple harvester with blades and without blades respectively. It was also noted that the average time taken to harvest the fruit was longer in the case of a female person, which is evident due

Table 1: ANOVA for picking force measurement

Source of variation	SS	df	MS	F	P-value	Fcrit.
Variation due to branch size						
Between group	127.06	2	63.53	9.68	0.00	2.47
Within group	216.50	33	6.56			
Total	343.55	35				
Variation due to plucking action						
Between group	7.56	2	3.78	0.37	0.69	2.47
Within group	335.99	33	10.18			
Total	343.55	35				

Table 2: ANOVA for change in pulse rate

Source of variation	SS	df	MS	F	P-value	Fcrit
Between groups	52.67	2	26.33	3.28	0.08	3.00
Within groups	72.25	9	8.03			
Total	124.92	11				

Table 3: Cost estimation of the developed tool with blades

S. No.	Parts	Amount	Cost (Rs.)
1	Frame (Aluminium hollow pipe, dia.=9 mm)	1m	20
2	Handle support	1m	20
3	Blades	2 Nos.	20
4	Screw and Bolts	10	10
5	Wire net	1	100
6	Plastic hollow pipe	0.25m	5
7	Labour	0.1 man days	30
	Total		205

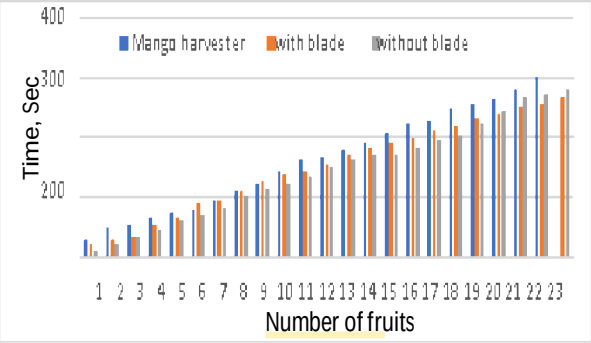

Figure 1: Fruit harvested by a male at top canopy

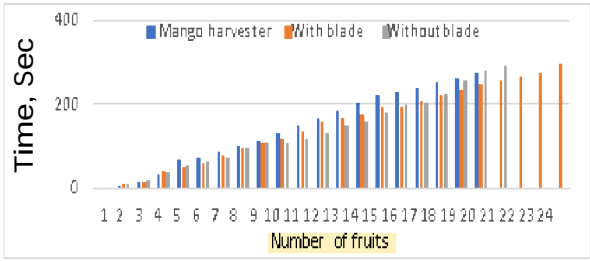

Figure 2: Fruit harvested by a female at top canopy

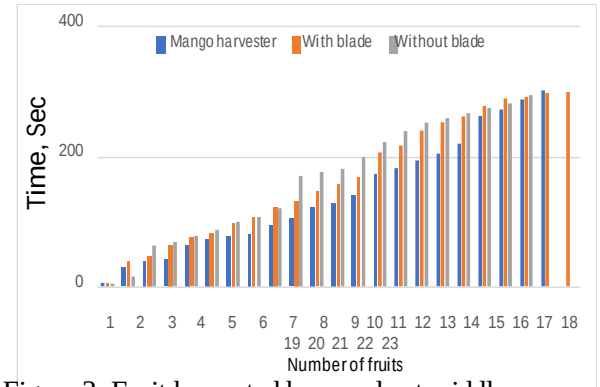

Figure 3: Fruit harvested by a male at middle canopy

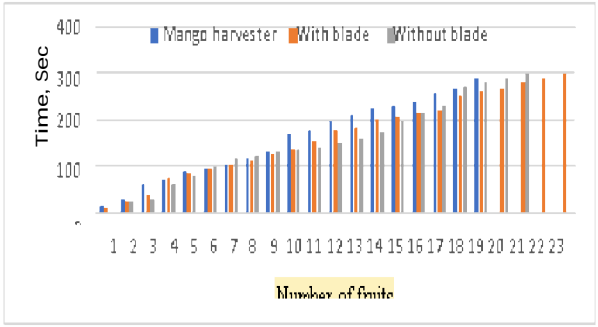

Figure 4: Fruit harvested by a female at middle canopy

to the difference in the physical strength of a male and female person.

Harvesting of custard apple by a male at the middle canopy

The custard apple harvester with blades harvested 1 more fruit from the mango harvester and 2 more fruits from the custard apple harvester without blades, which is 4.5% and 9.5% more than the mango harvester and custard apple harvester without blades respectively. The better performance of the custard apple harvester with blades was in line with the performance observed in the harvesting of the top canopy (Figure 3). The average time taken to harvest a single fruit was 13.64, 13.00, and 14.00 s for mango harvester, custard apple harvester with blade and without blades respectively. It was also found that the average time taken to harvest from the middle canopy was almost similar to harvest from the top canopy, indicating the earlier in handling in both cases.

Harvesting of custard apple by a female at the middle canopy

It was found that the custard apple harvester with blades harvested 4 (21%) more fruits from the mango harvester and 2 (9.5%) more fruits from the custard apple harvester without blades (Figure 4). The average time taken to harvest a single fruit was 15.32, 12.91, and 14.14 s for mango harvester, custard apple harvester with blades and without blades respectively. In this case, also the average time taken to harvest from the middle canopy was almost similar to harvest from the top canopy, indicating the earlier in handling in both cases.

Ergonomic study

It can be observed from the Table 2, that the systolic and diastolic blood pressure remailed107-138 and 66-96 respectively. The blood pressure also changes -6 units to 15 units, and the variation was random, indicating the good physical fitness of the person involved in the experimentations.

It can also be observed from the table that the pulse rate increased after the harvesting from 4 to 15 units per minute. The variation in pulse rate was significant. The minimum change in pulse rate was observed in the case of custard apple harvested with blades, indicating minimum physical stress observation with the developed custard apple tool without blades followed by custard apple harvester with blades.

Cost of the developed tool with blades

The developed custard apple harvester with blades prepared in Rs. 205 only, which is low cost and economic (Table 3).

Conclusion

Based on the tool reviewed, two custard apple harvesters were developed, which was light in weight and with a front conical shape to penetrate in the plant canopy later, harvesting custard apple was also performed for 5 min duration. From the data analysis, it was concluded that the custard apple harvester with blades performed better in comparison to mango harvester and developed tool without blades and harvested more number to other tools with minimum physical stress.

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Assessing Present Constraints in Fisheries Extension System and Fish Farmers' Outlook for Future Advancements: A Case Study in District Ganderbal, Jammu & Kashmir

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Abstract

This research delves into the intricate challenges confronted by fish farmers in the Ganderbal district of Jammu and Kashmir, shedding light on the limitations within the existing fisheries extension systems. The topography of district Ganderbal, coupled with its abundant water resources and a significant majority (80%) engaged in agriculture, positions it as a vital centre for fish farming. Employing a comprehensive research design that combines descriptive and inferential methods, the study utilizes surveys to explore various variables associated with fish farming. Data sources encompass inputs from the Department of Fisheries and the Regional Fish Farmers Development Agency in Ganderbal. A sample size of 99 respondents, chosen through a proportionate random sampling technique, forms the basis for the study. The research identifies prevalent challenges, with non-availability and poor quality of feed emerging as the most prominent, accounting for a staggering 72.7%. Subsequent challenges include the high cost of feed at 66.6% and concerns about suboptimal seed quality at 49.4%. Additional challenges comprise infrequent visits by Fisheries Department members (19.1%), a deficit in field visits and educational tours (15.1%), and fish mortality (15.1%).

The study not only underscores the existing challenges but also illuminates the farmers' anticipations for future enhancements in the extension system. These expectations encompass various facets, notably insurance coverage, provision of affordable high-quality seed and feed, intensified training programs, timely departmental visits, improved communication channels, and regular field visits and educational tours. These expectations collectively underscore the imperative for comprehensive support to mitigate risks, enhance accessibility to inputs, and foster continuous learning among fish farmers.

In conclusion, the identified challenges necessitate a holistic approach to address issues ranging from feed quality concerns to communication gaps within the fisheries sector. The expressed expectations from fish farmers underscore the urgency for an improved extension system that aligns with their evolving needs. Such enhancements are crucial for ensuring the sustainability and triumph of aquaculture ventures in the dynamic and vital Ganderbal region.

Key words: Challenges, Ganderbal, fish farmers, Aquaculture

Introduction

The research was conducted in the Ganderbal region of Jammu and Kashmir, characterized by its distinctive hilly terrain and abundant green forests. Ganderbal boasts a rich network of water resources,

including the River Sindh, Wangath stream, Chattergul, Markul, Tulmulla spring, and high-altitude lakes such as Kishen Sar, Vishan Sar, Gangbal, Gad Sar, Larkul, among others. The district's topography presents significant potential for developing cold water and warm water fisheries.

Notably, the River Sindh, beyond providing water for cultivation, stands as the exclusive river in Jammu and Kashmir hosting three operational hydroelectric generating plants. The river's sand, known as bajri, holds substantial value for its quality. The district also supports trout habitation in its streams and lakes for angling purposes, with established trout-rearing units at Margund and Mammer. Additionally, a recreation pond at Sonamarg enhances the district's fishing opportunities on a permit basis, contributing to recreational pursuits. Furthermore, a significant portion of the district's population, approximately 80%, is engaged in agriculture and related activities. Registered fishermen, often below the poverty line, sustain their livelihoods by harnessing the fisheries wealth from various water bodies in the district. The private sector has witnessed a surge in the number of fish farms, indicating a growing interest in fisheries-related professions within the Ganderbal District.

Methodology

The current study utilized a combined descriptive and inferential research design, employing a survey strategy for comprehensive data collection with the aim of accurately and systematically describing a population, phenomenon, or situation. Various research methods were employed to investigate multiple variables.

Data sources for the study were derived from The Department of Fisheries and the Regional Fish Farmers Development Agency in Ganderbal. An interview schedule was meticulously prepared in line with the study's objectives, and the researcher conducted personal interviews with selected farmers who had benefited from training programs and schemes.

In selecting the study area, District Ganderbal was purposively chosen due to the substantial engagement of its population in fish farming. The district, comprising six blocks-Ganderbal, Kangan, Lar, Safapora, Gund, and Wakura, underwent a proportionate random sampling technique for the identification of respondents. Criteria for respondent selection were based on schemes and training programs outlined by the Government of India, sourced from the Regional Fish Farmers Development Agency (RFFDA) and Fisheries Department. The determined sample size of 99 respondents (comprising male and female fish farmers) was achieved using Cochran's formula from 1997.

Prior to the main study, the interview schedule underwent pre-testing on a separate group of six non-sampled respondents. The researcher provided a concise explanation of the study's objectives and clarified any ambiguous language in the interview schedule. Subsequent revisions to the final format were made based on the data received during the pre-testing phase and the researcher's experience.

Instrumentation involved the selection of variables for the study, grounded in an extensive literature review, expert consultations, and insights from previous studies on related subjects. The study encompassed dependent variables focused on farmers' perceptions of the usefulness of training and schemes imparted by the Department of Fisheries. Independent variables covered various personal, socio-economic, and communication characteristics, providing a comprehensive framework for understanding the dynamics of fish farming in the Ganderbal region.

Results and Discussion

Challenges faced by fishers

The recorded shortcomings were systematically tabulated, and the frequency of each shortfall was meticulously calculated and transformed into percentages. Each shortfall was then assigned a rank based on its respective percentage. The compiled data are presented in Table 1. Upon careful examination of the table, it becomes evident that the preeminent challenges reported by respondents were as follows: non-availability and poor quality of feed, accounting for a substantial 72.7%; the high cost of feed, registering at 66.6%; and concerns regarding the suboptimal quality of seed, constituting 49.4%. Additionally, respondents highlighted other notable challenges,

Table 1: Challenges faced by fishers

S.No	Shortfalls	Frequency (N=99)	Percentage	Rank
1.	No feed availability and bad quality of feed.	72	72.7	I
2.	Bad quality seed	49	49.4	III
3.	Costly feed	66	66.6	II
4.	Minimal visit by department	19	19.1	IV
5.	less field visit/education tour.	15	15.1	V
6.	Fish mortality	15	15.1	V

including infrequent visits by members of the Fisheries Department (19.1%), a scarcity of field visits and educational tours (15.1%), and fish mortality (15.1%).

Interestingly, a limited proportion of respondents (10.10%) indicated that they encountered no specific challenges with the Department of Fisheries. In summary, the discussion reveals that the majority of respondents faced challenges related to the non-availability and poor quality of feed, ranking as the most prevalent issue. Following closely were concerns about the high cost of feed, securing the second position, and issues surrounding the quality of seed, ranking third. Other general challenges reported included infrequent visits by Fisheries Department members (ranked fourth), a shortage of field visits and educational tours (ranked fifth), and fish mortality (also ranked fifth).

Limited Availability and Poor Quality of Feed

Farmers grapple with the dual challenge of limited feed availability and substandard quality. The reliance on a distant Manasbal feed mill in Ganderbal district amplifies transportation costs, impacting overall farm profitability. The poor-quality feed exacerbates the situation, sinking and evaporating in raceways, directly affecting fish growth and farm output, especially during feed mill breakdowns.

High Cost of Feed

The high cost of feed, particularly for high protein starter feed for trout and pelleted trout feed, poses a significant financial hurdle. The formulated nature of the feed leads to increased production costs compared to natural alternatives, placing an economic burden on farmers.

Sub optimal Seed Quality

Dissatisfaction with the quality of fish seed procured from the Fisheries Department results in reduced stock due to mortality during transportation. The challenge is compounded by the difficulty in sourcing high-quality seed locally, prompting some farmers to seek cheaper, higher-quality seed from alternative sources like Kolkata.

Infrequent Departmental Visits

Farmers face challenges due to infrequent visits by Fisheries Department officials, leading to a communication gap with severe consequences. Maintaining regular contact with farmers post-subsidy provision is recommended to fortify extension services and foster a stronger connection between farmers and the department.

Reduced Field Visits and Educational Tours

The absence of field visits and educational tours, exacerbated by the COVID-19 outbreak, is a notable challenge. This hampers knowledge transfer and skill development among farmers, hindering their ability to adopt better farming practices.

Uncertain Fish Mortality

Uncertain fish mortality, attributed to factors such as insufficient knowledge about pond management, disease outbreaks, improper diet, and inappropriate handling, creates significant financial losses for farmers.

Expectations for Future Extension System

Insurance Coverage

Farmers stress the importance of insurance coverage during fish mortality events and for bund constructions/repairment. Recognizing the substantial losses incurred in fish farming, insurance

becomes a crucial component for risk mitigation.

Provision of Affordable, High-Quality Seed and Feed

Farmers anticipate the Fisheries Department providing cost-effective and high-quality seed and feed. This expectation aligns with the need to enhance overall farm yield and reduce dependency on external sources.

Enhanced Training Programs

Farmers express the need for more off-campus training programs focused on new technologies. These programs aim to increase awareness and empower farmers to tackle challenges while adopting advanced and sustainable farming practices.

Timely Visits to Fish Farms

Timely visits by Fisheries Department officials are deemed essential for guiding farmers and providing solutions to day-to-day challenges in farm practices. This would contribute to the overall improvement of farm management.

Improved Communication

Establishing proper communication channels between farmers and extension agents is emphasized for community betterment. Positive relationships between farmers and the Fisheries Department hinge on effective communication, fostering a collaborative and supportive environment.

Arrangement of Field Visits and Educational Tours

Farmers expect the Fisheries Department to organize regular field visits and educational tours. This initiative aims to encourage continuous learning, keeping farmers updated on industry best practices and innovations for better production outcomes.

Conclusion

The challenges outlined in the fisheries sector underscore the need for a holistic approach to address issues ranging from feed quality to communication gaps. Farmers' expectations for the future extension system reveal a desire for comprehensive support, including risk mitigation through insurance, access to affordable high-quality inputs, and continuous learning opportunities. As the fisheries sector evolves, an improved extension system that aligns with these expectations will be pivotal in ensuring the sustainability and success of aquaculture ventures.

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Digital Library Consortia: Challenges and Future Perspectives

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Abstract

Digital library consortia play a pivotal role in advancing scholarly communication and research by fostering collaboration among institutions to share resources and infrastructure. This abstract explores the challenges faced by digital library consortia and envisions future perspectives to address these issues. The challenges encompass diverse domains, including technological, organizational, and financial aspects. Technical hurdles involve interoperability issues, varying metadata standards, and the need for robust cybersecurity measures. Organizational challenges arise from diverse institutional policies, differing goals, and the complexity of coordinating multiple stakeholders. Financial constraints pose a significant hurdle, as sustaining digital library consortia requires substantial investment in technology, content acquisition, and personnel. Moreover, ensuring equitable participation and resource allocation among consortium members adds another layer of complexity.Looking ahead, future perspectives entail leveraging emerging technologies like artificial intelligence and blockchain to enhance interoperability and security. Collaborative efforts to establish common standards for metadata and content delivery will streamline operations. Sustainable funding models and innovative partnerships will be crucial for the long-term viability of digital library consortia.

Ultimately, navigating these challenges and embracing evolving technologies will empower digital library consortia to fulfill their mission of democratizing access to knowledge and fostering collaborative research in the digital age.

Keywords: Digital library consortia, Scholarly communication Research collaboration, Interoperability, Knowledge access, Information sharing, Institutional policies and Future perspectives

Introduction

Digital library consortia have emerged as critical entities in the contemporary landscape of information and knowledge dissemination. These consortia bring together libraries, institutions, and organizations to collaboratively address the challenges posed by the digital era and enhance access to a wealth of scholarly resources. As technology continues to evolve, digital library consortia play a pivotal role in supporting research, facilitating resource sharing, and promoting collaborative initiatives. This introduction delves into the significance of digital library consortia, outlines the challenges they face, and provides a glimpse into the future perspectives that can shape their trajectory.

Definition of Digital Library Consortia:

A Digital Library Consortium refers to a collaborative partnership established among multiple institutions, such as libraries, archives, museums, academic institutions, and other cultural organizations, with the shared objective of collectively acquiring, managing, and providing access to digital resources. These resources can include digitalized books, scholarly articles, multimedia content, archival materials, and other forms of digital content. The

primary purpose of forming a consortium is to leverage the combined expertise, resources, and infrastructure of participating institutions to enhance the efficiency and effectiveness of digital library services and operations.

In a digital library consortium, member institutions work together to address common challenges associated with digital content, including acquisition costs, technological infrastructure, and legal considerations such as copyright and licensing agreements. By pooling their resources, institutions within a consortium can negotiate better terms for acquiring digital materials, share the costs of developing and maintaining technological infrastructure, and collaborate on initiatives that benefit the broader academic and cultural community.

These consortia can take various forms, ranging from regional or national alliances to international collaborations, depending on the scope and objectives of the participating institutions. Digital library consortia play a crucial role in facilitating access to a diverse range of digital resources, promoting collaboration in the development of digital collections, and contributing to the overall advancement of digital scholarship and knowledge dissemination.

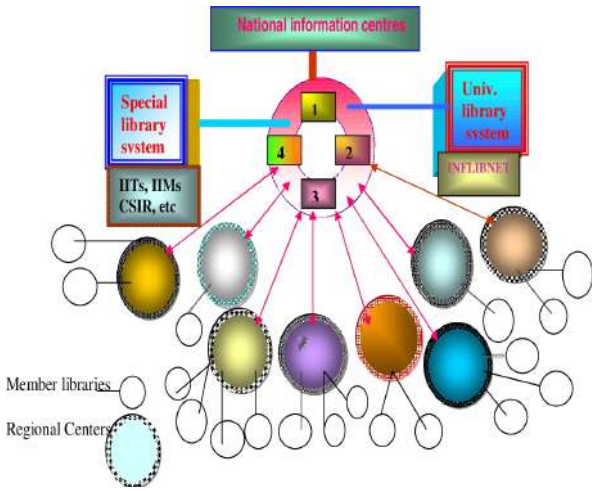
Types of Library Consortia in India

In India, library consortia play a significant role in enhancing access to information resources and services for various institutions. These consortia are formed to address common challenges, share resources, and collaborate on initiatives that benefit the participating libraries. Here are some types of library consortia commonly found in India:

1. National Information Centre of Consortia:

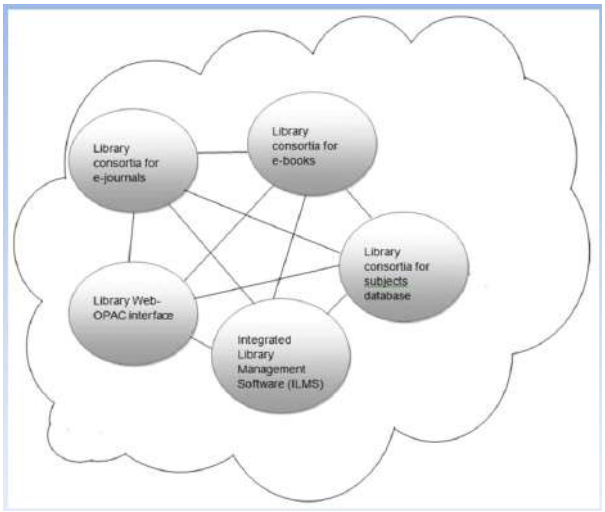
o Informatics e-Resources Consortium (INDEST): INDEST is a national-level consortium initiated by the Ministry of Human Resource Development (MHRD), Government of India. It focuses on providing access to electronic resources, including e-journals, databases, and other scholarly content, to academic and research institutions across the country.

o Consortium for Educational Communication (CEC): CEC is another national consortium that facilitates access to educational content, including e-resources,



for educational institutions in India. It primarily focuses on providing resources related to media and communication studies.

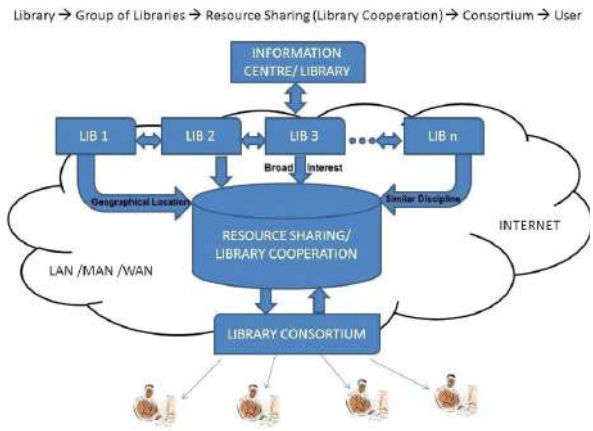
1. State-Level Library Consortia:



o Maharashtra Knowledge Corporation Limited (MKCL) Library Consortium: This state-level consortium in Maharashtra aims to provide access to digital resources and promote collaboration among libraries in the state.

o Karnataka State Library Association (KSLA) Consortium: KSLA Consortium focuses on collaboration among libraries in Karnataka, providing a platform for sharing resources, expertise, and promoting the use of technology in libraries.

2. University Library Consortia:



- o Maharashtra Knowledge Corporation Limited (MKCL) Library Consortium: This state-level consortium in Maharashtra aims to provide access to digital resources and promote collaboration among libraries in the state.
- o Karnataka State Library Association (KSLA) Consortium: KSLA Consortium focuses on collaboration among libraries in Karnataka, providing a platform for sharing resources, expertise, and promoting the use of technology in libraries.

3. University Library Consortia:

- o Consortium for e-Resources in Agriculture (CeRA): CeRA is a consortium of agricultural universities in India. It focuses on providing access to e-resources related to agriculture and allied subjects.
- o Indian National Digital Library in Engineering Sciences and Technology (INDESTAICTE Consortium): This consortium is specifically designed for engineering institutions and aims to provide access to digital resources in the fields of engineering, technology, and sciences.

4. Subject-Specific Consortia:

- o Health and Medical Libraries Consortium (HELINET): Focused on medical and health sciences, HELINET is a consortium providing access to electronic resources for medical colleges and healthcare institutions in India.
- o Indian Consortium for Educational Transformation (I-CONSENT): I-CONSENT focuses on resources related to education and aims to transform the educational landscape in India through collaborative efforts.

5. Digital Repository Consortia:

- o National Digital Library of India (NDLI): While not a traditional library consortium, NDLI is a digital repository initiative that collaborates with various institutions and organizations to provide access to a wide range of digital resources, including books, articles, and multimedia content.

6. Interdisciplinary Consortia:

- o Consortium for Academic and Research Ethics (CARE): CARE is an interdisciplinary consortium focusing on ethical issues in academic and research practices. It brings together institutions to promote ethical conduct in research and scholarly activities.

These are just a few examples of the diverse types of library consortia in India. The formation of such consortia reflects the collaborative efforts within the country to overcome resource constraints, enhance library services, and promote knowledge sharing among institutions in various domains.

Significance of Digital Library Consortia

In an age marked by the proliferation of digital content, digital library consortia serve as catalysts for efficient and equitable access to information. Traditional libraries, with their physical collections, faced limitations in providing timely access to a growing body of knowledge. Digital library consortia address these limitations by leveraging technology to aggregate, organize, and disseminate digital resources. Through collaboration, these consortia enhance the collective capabilities of participating institutions, ensuring that researchers, students, and academics have access to a diverse array of scholarly materials. One of the primary contributions of digital library consortia is the facilitation of resource sharing. Institutions within a consortium can pool their resources, thereby expanding the breadth and depth of available content. This not only reduces redundancy in acquisitions but also optimizes budgetary allocations for content procurement. Access to a shared repository of digital resources empowers member institutions to provide a more comprehensive and diverse collection to their user communities.

Furthermore, digital library consortia foster collaboration among member institutions in research

and academic initiatives. By breaking down barriers to information access, these consortia create an environment conducive to interdisciplinary research and knowledge exchange. Researchers can draw from a broader spectrum of resources, leading to innovative discoveries and advancements across various fields. In addition to resource sharing and collaborative research, digital library consortia contribute to the preservation and curation of digital content. The digital realm introduces challenges related to the long-term storage and accessibility of electronic resources. Consortia play a crucial role in developing best practices and standards for digital preservation, ensuring that valuable scholarly materials remain accessible over time.

Challenges Faced by Digital Library Consortia

While digital library consortia have made significant strides in enhancing access to information, they are not without their share of challenges. These challenges span technological, organizational, and financial dimensions, necessitating strategic interventions for sustainable operation and continued growth.

Technological Challenges

Interoperability emerges as a prominent technological challenge for digital library consortia. Member institutions often utilize different library management systems, digital platforms, and metadata standards. Achieving seamless integration and interoperability among these diverse systems is a complex task. Inconsistencies in metadata formats, cataloging practices, and access protocols can hinder the efficient sharing and retrieval of digital resources.

Cybersecurity concerns pose another formidable technological challenge. The digital landscape is fraught with security risks, including data breaches, unauthorized access, and cyberattacks. Digital library consortia must implement robust cybersecurity measures to safeguard sensitive user information, intellectual property, and the integrity of digital collections.

Organizational Challenges

Digital library consortia operate within a dynamic ecosystem comprising institutions with distinct organizational structures, policies, and priorities. Aligning the diverse goals and interests of member institutions presents a significant organizational challenge. Variations in institutional policies, decisionmaking processes, and levels of technological readiness can impede the smooth functioning of consortia. Effective governance and leadership are critical components of overcoming organizational challenges. Clear communication, shared decision-making frameworks, and mechanisms for conflict resolution are essential for fostering collaboration and ensuring that the collective objectives of the consortium are prioritized over individual institutional interests.

Financial Constraints

Sustainable funding models are essential for the longevity and effectiveness of digital library consortia. Many consortia grapple with financial constraints, relying on a combination of membership fees, grants, and external funding sources. Ensuring equitable financial contributions from member institutions, especially in the face of budgetary constraints, is a persistent challenge. Additionally, consortia must navigate the complexities of evolving licensing models, subscription costs, and the financial implications of expanding digital collections.

Resource Allocation

Efficient resource allocation is intricately linked to financial considerations. Consortia must strike a balance between acquiring new digital resources, maintaining existing collections, and investing in technological infrastructure. Decisions regarding resource allocation can be contentious, as member institutions may have varying priorities and preferences. Transparent and collaborative approaches to resource allocation are essential for mitigating conflicts and ensuring that the consortium meets the evolving needs of its user community.

Institutional Policies

The coexistence of different institutional policies within a consortium introduces complexities in areas such as copyright, data sharing, and access protocols. Harmonizing these policies to create a cohesive framework for collaborative endeavors is a persistent challenge. Legal and ethical considerations, such as copyright compliance and data privacy, further complicate the development of standardized policies that accommodate the diverse needs of member institutions.

Future Perspectives for Digital Library Consortia

As digital library consortia navigate the current landscape of challenges, several future perspectives offer potential avenues for innovation, growth, and sustainability.

Emerging Technologies

The integration of emerging technologies holds immense promise for addressing the technological challenges faced by digital library consortia. Artificial intelligence (AI) can enhance metadata management, automate cataloging processes, and improve search functionalities, thereby promoting efficient resource discovery. Blockchain technology offers opportunities to enhance the security and transparency of digital transactions and access protocols within consortia.

Collaborative efforts among consortia and technology developers can drive the adoption of standardized protocols and tools that facilitate interoperability. By embracing emerging technologies, consortia can not only streamline their operations but also enhance the user experience by providing advanced search capabilities and personalized recommendations.

Sustainable Funding Models

The quest for sustainable funding models remains a critical aspect of the future viability of digital library consortia. Beyond traditional approaches such as membership fees and grants, consortia can explore innovative funding sources. Partnerships with industry stakeholders, philanthropic organizations, and collaborative grant applications can diversify funding streams.

Additionally, consortia can explore cost-sharing models, where member institutions jointly fund specific initiatives or services based on their usage. This approach not only distributes financial responsibility but also fosters a sense of ownership and collaboration among member institutions.

Collaborative Standardization

Standardization of metadata, access protocols, and content delivery mechanisms is crucial for achieving seamless interoperability among digital library consortia. Collaborative initiatives to establish and promote common standards can simplify the integration of diverse systems. Consortia can actively participate in or initiate working groups, consortial agreements, and international collaborations aimed at developing and maintaining standards relevant to their operations.

Innovative Partnership Models

Digital library consortia can explore innovative partnership models to strengthen their impact and extend their reach. Partnerships with other consortia, academic publishers, research organizations, and industry stakeholders can facilitate the exchange of resources, expertise, and best practices. Consortia can also engage in cross-disciplinary partnerships to support emerging fields of research and innovation.

User-Centric Approaches

A user-centric approach is fundamental to the success of digital library consortia. Future perspectives should prioritize the enhancement of user experiences through user-friendly interfaces, personalized services, and responsive support mechanisms. User feedback and engagement should be actively solicited to inform decision-making processes and shape the evolution of consortia services.

Open Access Advocacy

Digital library consortia are well-positioned to champion open access initiatives. By advocating for open access policies, promoting the use of open educational resources, and supporting open publishing models, consortia can contribute to a more equitable and inclusive scholarly communication ecosystem. Open access initiatives align with the mission of consortia to democratize access to knowledge and promote the widespread dissemination of research outcomes.

Collaborative Research Initiatives

The future of digital library consortia lies in their ability to foster collaborative research initiatives among member institutions. As the scholarly landscape continues to evolve, consortia can play a central role in breaking down disciplinary silos and facilitating interdisciplinary research. By providing a platform for researchers from different institutions to collaborate, consortia can contribute to the generation of new knowledge and innovative solutions to complex problems.

Consortia can actively promote research partnerships by establishing grant programs, organizing interdisciplinary workshops, and creating virtual collaboration spaces. The integration of

research data repositories within consortial frameworks can further support data-intensive collaborative projects. This collaborative research ethos aligns with the broader goals of consortia to advance knowledge creation and dissemination.

Global Collaboration and Inter consortial Partnerships

The future of digital library consortia extends beyond regional or national boundaries. As the global nature of research and education becomes increasingly evident, consortia can explore opportunities for international collaboration and inter-consortial partnerships. Collaborative initiatives on a global scale can lead to the sharing of diverse perspectives, resources, and expertise.

Inter consortial partnerships can involve joint projects, shared infrastructure, and collaborative advocacy efforts. Consortia can work together to negotiate favorable licensing agreements with content providers, ensuring cost-effective access to a broader array of digital resources. Such partnerships also enable the pooling of expertise in areas such as digital preservation, metadata standards, and technological innovation.

Diversity, Equity, and Inclusion Initiatives

Future perspectives for digital library consortia must prioritize diversity, equity, and inclusion initiatives. Consortia should actively work towards ensuring that their services and resources are accessible and relevant to a diverse user base. This includes considerations for different languages, cultural contexts, and educational needs.

Consortia can implement policies and practices that promote inclusivity, such as providing resources in multiple languages, supporting initiatives that address underrepresented topics or communities, and actively seeking feedback from diverse user groups. By embracing diversity, digital library consortia can contribute to a more equitable distribution of knowledge and opportunities in the academic and research communities they serve.

Education and Digital Literacy Initiatives

Digital library consortia are well-positioned to contribute to education and digital literacy initiatives. In an era where information literacy is paramount, consortia can develop programs to enhance the digital skills of their user communities. This includes providing training on effective information retrieval, critical evaluation of online resources, and ethical use of information.

Consortia can collaborate with educational institutions to integrate information literacy into curricula and offer workshops or webinars on relevant topics. Additionally, they can support the development of open educational resources (OER) and promote their adoption to reduce barriers to access for learners globally.

Adaptability to Technological Advances

The landscape of technology is ever-evolving, and digital library consortia must remain adaptable to harness the potential of emerging technologies. As artificial intelligence, machine learning, and data analytics continue to advance, consortia can leverage these technologies to enhance the discoverability of resources, personalize user experiences, and optimize resource allocation.

Blockchain technology, with its potential for decentralized and secure transactions, can be explored further to address issues of trust, authentication, and provenance within consortia. Continuous monitoring of technological trends and proactive engagement with technological communities will be essential for consortia to stay at the forefront of innovation.

Digital library consortia have emerged as transformative entities in the digital age, facilitating collaboration, resource sharing, and access to a wealth of scholarly content. However, these consortia face a myriad of challenges, ranging from technological hurdles to organizational complexities and financial constraints. Addressing these challenges requires strategic planning, collaborative efforts, and a commitment to innovation.

Looking ahead, digital library consortia can embrace emerging technologies, explore sustainable funding models, engage in collaborative standardization efforts, foster innovative partnerships, prioritize usercentric approaches, and champion open access initiatives. By doing so, consortia can not only overcome current challenges but also position themselves as dynamic and indispensable components of the evolving landscape of scholarly communication and knowledge dissemination. As they navigate the complexities of

the digital era, digital library consortia play a pivotal role in shaping the future of collaborative research and access to information.

Conclusion

In conclusion, the future of digital library consortia holds tremendous promise as these collaborative initiatives navigate the evolving landscape of information management, technology, and user expectations. Digital library consortia have become essential players in the global dissemination of knowledge, addressing challenges and capitalizing on opportunities to shape a more inclusive, efficient, and interconnected future for information access.

As we anticipate the coming years, it is evident that open access initiatives will continue to gain prominence, fostering a commitment to freely accessible scholarly content and the development of Open Educational Resources. The integration of advanced technologies, including artificial intelligence and machine learning, will enhance the efficiency of digital library operations, offering smarter curation, personalized user experiences, and innovative approaches to content discovery.

Global collaboration is poised to expand, with consortia forming international partnerships that transcend geographical boundaries. This interconnectedness will contribute to a more comprehensive representation of global knowledge and cultural heritage, enriching digital collections and fostering cross-cultural collaboration.

The user-centric design will be a guiding principle, ensuring that digital library services are tailored to individual preferences and diverse user communities. Digital library consortia will actively engage in advocacy efforts, championing equitable access to information through policy initiatives that support open access, fair use, and copyright reform.

Consortia will play a crucial role in curating diverse and specialized collections, addressing niche research interests, and preserving unique materials. The focus on digital preservation strategies will be paramount, safeguarding born-digital content and ensuring its long-term accessibility.

Educational and outreach initiatives will be central to consortia activities, as they strive to raise awareness about the value of digital libraries. Training programs, workshops, and outreach efforts will extend to underserved populations, promoting inclusivity and democratizing access to information.

In essence, digital library consortia are poised to be catalysts for positive change in the information ecosystem. By embracing openness, technology, collaboration, and user-centricity, these consortia are not merely adapting to future challenges—they are actively shaping the future of digital scholarship, ensuring that knowledge remains accessible, diverse, and relevant to a global audience. As they continue to evolve, digital library consortia will undoubtedly contribute significantly to the advancement of scholarship, education, and cultural preservation in the digital age.

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Impact of Skill Development Training on Mushroom Cultivation in Udham Singh Nagar District of Uttarakhand

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Abstract

Mushroom production plays a substantial role to improve poverty and generate employment opportunity for educated unemployed youth in rural areas. Present study was conducted with the objective to weigh the impact of training on knowledge gain about mushroom production as an enterprise. A seven days training on Mushroom Production was organized by MRTC, GBPUA&T, Pantnagar and Social Development Department Kichha. The training program on mushroom production was focused on farm women who have interested in self-employment or to set up enterprise. Detailed training on different parameters of mushroom production in context to cultivation techniques, preparation of spawn, substrates preparation, marketing of fresh product, preservation and value addition etc was imparted to a total number of 50 participants. The impact of the training was assessed by pre and post evaluation testing in terms of improvement in knowledge for different parameters. It was observed that ….per cent of the trainees gained knowledge on types of mushroom, preservation techniques and importance of casing after training. Thus, it can be inferred that exposure to training had increased the knowledge of respondents related to all the sub- components of mushroom production. It may therefore, be concluded that trainees succeeded in acquiring knowledge after exposure to training on mushroom production.

Key words: Impact, skill, development, training, mushroom, cultivation

Introduction

India is primarily an agriculture based country due to diversity in soil and climatic conditions that allows a production of variety of crops in different parts of the country. This also provides vast potential for the cultivation of mushrooms due to ample availability of raw materials and favorable climatic conditions. Agriculture being one of the basic practice and necessity of human from the ancient time. To sustain the resources for future scenario one has to switch our farming practices from conventional to 'Sustainable Intensive Agriculture'. Hatai and Singh (2019) suggested that to mitigate the environmental shift and increasing population demand the only way is to integrate sustainable agricultural practices for eradication of poverty and hunger and to fill the cleft between the different economic classes along with contributing to reliance with sustainability of the ecosystem.

Global market is witnessing the increasing trend for mushroom as a commodity due to shift in consumer's choice from animal protein to mushroom. Mushroom being highly nutritious food and raising health consciousness is increasing the demand of such nutritious food. Thus, mushroom becoming popular and familiar face in developed and developing market. As per reported by Mistry and Iquabal (2020) Global mushroom market size was valued at 46.1 billion in 2020 and is expected to grow at CAGR (Compound Annual Growth Rate) of 9.5 percent from 2021 to 2028.Asia Pacific is the leading region in Global market with 10.26MT volumetric consumption of mushroom.

In a country like India, where vegetarians dominate, attempt should be made to popularize a vegetable protein source like mushroom documented by Bahl (2000). Mushroom growing has been

appreciated as a technically feasible and profitable venture and widely accepted by the researchers as a good venture for higher income, employment generation and rural development. Sharma *et. al.* (2021). However, mushroom growing can help in a long way in the efficient utilization of agricultural and industrial waste. Extension trainings have been considered an outlet for exchange of concepts with in a community. Sajeev *et. al.* (2012). Therefore, trainings have been widely accepted strategy with high returns on investment. There is an urgent need to impart technical knowledge to farm women and youth in order to adopt mushroom production as an income generating activity for enhancing their income.

Keeping in view the increasing demand of mushroom due to globalization and opening of the economy, the present study was undertaken with the objective to assess the impact of training on knowledge about mushroom production as an enterprise.

Materials and Methods

The training program on mushroom production was focused on farm women who are interested in self-employment. The study was conducted at GBPUA&T, Pantnagar. Fifty trainees were imparted training on mushroom cultivation. A questionnaire was formulated comprising of general information, background of participants, landholding etc. A pre evaluation test was conducted to know the level of knowledge of participants regarding cultivation techniques, preparation of spawn, substrates preparation, marketing of fresh product, preservation, value addition, etc. Thorough training on various aspects of mushroom production was imparted during the training program. Similarly, after completion of the training course, post evaluation was performed in order to assess the knowledge gained by the trainees and effectiveness of training.

To test the knowledge of trainees, a set of 10 questions related to mushroom growing, nutrients present in mushroom, different products prepared from mushroom, storage and harvesting of mushroom etc. were used. Hence, Deviation or gain in knowledge was calculated from the difference of scores obtained in pre and post knowledge test of the trainees.

$$\text{Deviation/gain in Knowledge} = \frac{\text{Post evaluation score} - \text{Pre evaluation score}}{\text{Total respondents}} \times 100$$

Results and Discussion

Socio-economic profile

The participants differed in their socio-economic status based on education, occupation, landholding and annual income etc (Table 1). Majority of the participants (60%) were in age group of 31-40 whereas 24% were below 30 year and 8 per cent are above 40 year of age. Information with respect to caste showed that 50% of the participants belong to Scheduled caste followed by General Caste (26%) and Backward Caste (24%). Assessment of the trainees with respect to education indicated that 32 per cent studied up to secondary level followed by primary level (18%) and Post-Graduation (16%) and Graduation (14%). Information with respect to occupational background revealed that 32% are farming followed by housewife 34% and business 24%. It was found that, 54% of the participants were getting medium annual income followed by 30% of them had low annual income and remaining 16 per cent were getting high annual income.

Table 1: Socio-Economic Profile of Trainees undergone Mushroom Cultivation

S.No.	Particular	Frequency	Percentage
1.	**Age**		
a.	Up to 30	12	24
b.	30-40	30	60
c.	Above 40	8	16
2.	**Caste**		
a.	General	13	26
b.	OBC	12	24
c.	SC/ST	25	50
3.	**Education**		
a.	Primary	9	18
b.	Secondary	16	32
c.	Graduation	7	14
d.	Post-Graduation	8	16
4.	**Occupation**		
a.	Farming	16	32
b.	Service	5	10
c.	Business	12	24
d.	Housewife	17	34
5.	**Annual Income**		
a.	Low	15	30
b.	Medium	27	54
c.	High	8	16

Table 2: Reasons of participation in training programme in mushroom cultivation

S.No.	Reason	Frequency	Percentage	Ranking
1	To adopt mushroom growing as an enterprise	38	76	II
2	To learn about mushroom growing techniques for self consumption	50	100	I
3	To teach fellow farmers about mushroom growing	18	36	III
4	Just to know about mushroom growing	9	18	IV

Table 3: Gain in knowledge after training with respect to different components

S.No.	Reason	Frequency	Percentage	Ranking
1.	Nutritive value	38	76	V
2.	Optimum growing condition	49	98	I
3.	Types of mushroom	37	74	VI
4.	Suitable substrate	30	60	IX
5.	Mushroom spawn	47	94	II
6.	Marketing channels	46	92	III
7.	Preservation techniques	39	78	IV
8.	Importance of casing	35	70	VII
9.	Harvesting methodology	34	68	VIII
10.	Mushroom recipes	49	98	I

Reasons of participation

The factors which motivated the participants to undergo the training were given for ranking in order of importance as perceived by them. As shown (Table 2), all the respondents joined training course to learn about mushroom growing techniques followed by 76% respondents attended training to adopt mushroom growing as an enterprise. Total 36 per cent respondents attended training to teach fellow farmers about mushroom growing followed by 18 per cent just to know about mushroom growing.

Gain in knowledge after training

Majority of respondents (98 per cent) gain knowledge in Optimum growing condition and Mushroom recipes followed by Mushroom spawn (94 per cent) and Marketing channels (92 per cent). Most of the respondents also gain in knowledge in different aspects as Nutritive value (76%), Types of mushroom (74%), Importance of casing (70%).

Conclusion

From the above discussion, it can be concluded that majority of respondents were middle age group, general caste educated up to secondary level, farming as major occupation, medium income group family. Majority of them have attended training programme to learn about mushroom growing techniques for self-consumption followed by to adopt mushroom growing as an enterprise and just to know about mushroom growing. Majority of respondents' knowledge was increased in optimum growing condition followed by type of mushroom spawn, marketing channel etc.

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Role of Librarians and Libraries in Institutional Ranking

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Abstract

Librarians and libraries play a crucial role in influencing institutional rankings by contributing to academic excellence, research productivity, and overall institutional reputation. Libraries serve as the intellectual hubs of educational institutions, providing essential resources, both physical and digital, to support teaching, learning, and research. Librarians, as information specialists, collaborate with faculty and researchers to curate and manage extensive collections, ensuring access to relevant and up-to-date materials. This directly impacts the quality of academic programs and research output, which are key factors considered in institutional rankings. Moreover, librarians play a pivotal role in advancing information literacy skills among students and faculty, fostering a culture of critical thinking and scholarly inquiry. Libraries also contribute to research prominence by facilitating access to scholarly journals, databases, and other research tools. The availability of comprehensive resources enhances the institution's research productivity, leading to increased citations and academic impact—a critical aspect in many ranking methodologies. Furthermore, libraries contribute to the visibility and global reach of an institution by participating in interlibrary collaborations, digitization projects, and open-access initiatives. These efforts not only expand the institution's research influence but also contribute positively to its overall reputation.

In conclusion, the active involvement of librarians and the vitality of libraries are integral to an institution's academic standing and, consequently, its positioning in various global and national rankings. Their multifaceted contributions impact research, teaching, and learning outcomes, thereby influencing the holistic evaluation of an institution's academic prowess and, consequently, its ranking in the academic landscape.

Keywords: Librarians, Libraries, Institutional Ranking, Academic Excellence and Research Productivity

Introduction

The role of librarians and libraries in shaping institutional rankings is a multifaceted and dynamic aspect of higher education. As educational institutions worldwide strive for excellence and recognition, the significance of the contributions made by librarians and libraries cannot be overstated. This introduction delves into the various dimensions of this crucial relationship, exploring how libraries serve as pivotal components in the academic and research landscape, impacting institutional reputation, research productivity, and, ultimately, positioning in global rankings.

Libraries have historically been regarded as repositories of knowledge, housing vast collections of books, journals, and other scholarly resources. However, their role extends far beyond mere bookkeeping. In the contemporary academic environment, libraries are dynamic entities that adapt

to technological advancements and changing pedagogical needs. Librarians, traditionally seen as custodians of information, have evolved into information specialists and educators, actively engaging with faculty, students, and researchers.

One of the primary roles of librarians is to facilitate access to a diverse range of resources, both physical and digital. In the context of institutional rankings, the quality and comprehensiveness of a library's collection are often considered indicators of academic strength. A well-curated collection reflects the institution's commitment to providing a conducive environment for learning and research. Librarians collaborate with faculty members to understand the specific needs of different academic programs, ensuring that the library's holdings align with the curriculum and research interests.

Furthermore, librarians play a crucial role in fostering information literacy—a skill set that is indispensable in today's knowledge-driven society. Information literacy goes beyond the ability to locate and retrieve information; it encompasses critical evaluation, ethical use, and effective communication of information. As institutions aim to produce well-rounded graduates equipped with the skills necessary for success in the information age, the role of librarians in nurturing information literacy becomes increasingly vital. In the realm of research, libraries are pivotal in providing the infrastructure necessary for scholarly inquiry. Librarians collaborate with researchers to identify and acquire relevant literature, assist in navigating complex databases, and support data management and preservation. The availability of comprehensive research resources within a library directly influences an institution's research productivity—a key metric in many ranking systems. High-quality research output not only contributes to the academic discourse but also enhances the global visibility and impact of the institution.

Libraries also play a critical role in supporting open access initiatives and interlibrary collaborations. Through initiatives such as open-access repositories and digitization projects, libraries contribute to the democratization of knowledge, making research outputs more widely accessible. Interlibrary collaborations further amplify the reach of an institution's resources, enabling students and researchers to access materials beyond the confines of their home institution. These collaborative efforts contribute positively to an institution's reputation and standing within the academic community.

In the context of institutional rankings, the impact of libraries is evident in several key areas. The quality of academic programs, measured by factors such as faculty-student ratios and student satisfaction, is influenced by the support provided by libraries. Additionally, the research prominence of an institution, reflected in citation metrics and the publication output of faculty, is intricately linked to the resources and expertise available within the library.

This introduction sets the stage for a comprehensive exploration of the multifaceted role of librarians and libraries in institutional rankings. As we delve deeper into the various dimensions of this relationship, it becomes clear that libraries are not passive entities but dynamic contributors to an institution's academic success and global recognition. The subsequent sections will examine these contributions in detail, shedding light on how librarians and libraries shape the academic landscape and, consequently, influence the positioning of institutions in the competitive realm of global rankings.

Institutional Ranking in India

In India, the National Institutional Ranking Framework (NIRF) is a significant and widely recognized system for ranking higher education institutions. NIRF is an initiative of the Ministry of Education, Government of India, and it aims to assess and rank Indian institutions across various parameters. The rankings cover a wide range of institutions, including universities, engineering colleges, management institutes, pharmacy colleges, and others. The parameters used for ranking include Teaching, Learning & Resources; Research and Professional Practices; Graduation Outcomes; Outreach and Inclusivity; and Perception Here are some key points about the NIRF:

1. NIRF Methodology:

- NIRF uses a comprehensive methodology that includes quantitative and qualitative parameters to evaluate institutions.
- Parameters include Teaching, Learning &

Institutional Ranking 2023 of Indian Universities

Resources, which involves factors like facultystudent ratio and financial resources; Research and Professional Practices, which assesses publications, patents, and collaborative projects; Graduation Outcomes, which considers placement and student success; Outreach and Inclusivity, which evaluates diversity and societal outreach; and Perception, which involves opinions from stakeholders.

2. ***NIRF Categories:***

o NIRF categorizes institutions into various domains such as Overall, Universities, Engineering, Management, Pharmacy, and others. This allows for a nuanced evaluation specific to each type of institution.

3. ***Annual Ranking:***

o The NIRF rankings are released annually, providing an updated assessment of institutions across the country.

o Rankings are usually announced in multiple categories, and institutions are ranked within their respective categories.

4. ***Public and Private Institutions:***

o Both public and private institutions are considered for ranking, creating a comprehensive assessment of the higher education landscape in India.

5. ***Importance for Institutions:***

o NIRF rankings are often considered important for institutions as they provide a benchmark for per formance and contribute to an institution's reputation.

o Many students and parents use NIRF rankings as one of the factors in making decisions about higher education.

6. ***Other Rankings:***

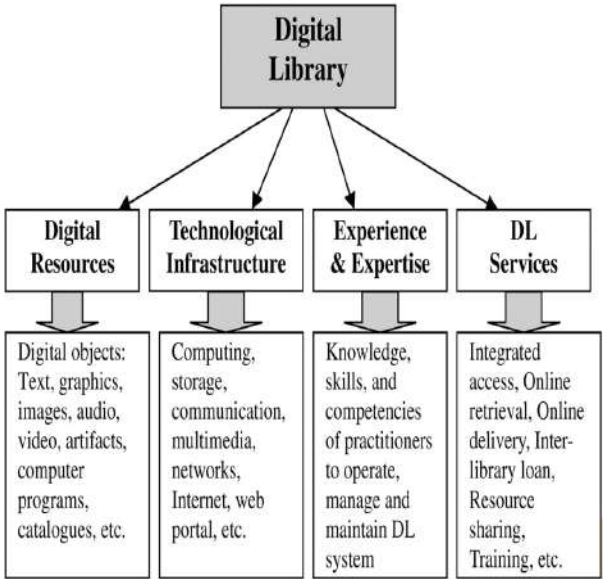
o In addition to NIRF, other organizations and publications also release rankings specific to certain disciplines or parameters. These may include rankings by media outlets or professional organizations.

It's important to note that while rankings provide a snapshot of an institution's performance, they may not capture all aspects of its strengths and uniqueness. Prospective students and stakeholders are encouraged to consider multiple factors, including program offerings, faculty expertise, infrastructure, and cultural fit when making decisions about higher education institutions in India.

Institutional Ranking and Role of Library

In the competitive landscape of higher education, institutional rankings have become integral benchmarks for assessing the quality and standing of universities and colleges globally. These rankings, often compiled by reputable organizations such as QS, Times Higher Education, and Academic Ranking of World Universities (ARWU), consider a multitude of factors to evaluate institutions comprehensively. While traditional metrics such as academic reputation, faculty-to-student ratio, and research output dominate these evaluations, the role of libraries and librarians is increasingly recognized as a significant influencer in institutional rankings.

One of the fundamental ways in which libraries contribute to institutional rankings is by enhancing academic excellence. The quality of academic programs is a key criterion in many ranking systems, and libraries play a pivotal role in supporting teaching and learning. Librarians collaborate closely with faculty members to ensure that the library's resources align with the curriculum and the research needs of different academic disciplines. A well-equipped library, offering a diverse



Role of Library in Digital Environment

collection of books, journals, and electronic resources, contributes to the overall learning experience of students and enhances the institution's academic reputation.

Libraries are not only repositories of information but also crucial hubs for fostering information literacy— a skill set essential for academic success and lifelong learning. Librarians, as educators, play a central role in imparting information literacy skills to students. This involves teaching them how to critically evaluate information, navigate databases, and use information ethically. As institutions strive to produce graduates who are not only knowledgeable but also adept at navigating the complexities of the information age, the role of libraries in nurturing information literacy becomes a vital aspect of institutional success and, consequently, its standing in rankings.

Research productivity is another significant factor influencing institutional rankings, and libraries are instrumental in supporting and facilitating high-quality research. Librarians collaborate with researchers to identify relevant literature, assist with literature reviews, and provide training on research tools and methodologies. The availability of extensive and up-to-date research resources within the library directly contributes to the institution's research output—a metric often measured through publications, citations, and research impact. The stronger the support from the library, the more likely an institution is to excel in research-related indicators, positively impacting its position in rankings.

Moreover, libraries contribute to the visibility and impact of an institution's research outputs. Through openaccess initiatives, institutional repositories, and digitization projects, libraries make scholarly works more accessible to the global academic community. This increased visibility enhances the institution's reputation and can positively influence its standing in global rankings. A university or college with a strong commitment to open access and global knowledge dissemination is likely to receive recognition for its contributions to the broader academic community.

Libraries also play a role in the internationalization of institutions, a factor increasingly considered in rankings. Collaborations between libraries, interlibrary loan programs, and participation in global library networks contribute to an institution's global reach. As universities and colleges strive to create a diverse and inclusive academic environment, the role of libraries in facilitating access to a broad range of international resources becomes crucial. This global perspective can enhance an institution's reputation and contribute to its performance in rankings that consider internationalization metrics.

In the context of institutional rankings, the impact of libraries is not only confined to tangible resources but also extends to the quality of services provided. The efficiency of library services, including user-friendly interfaces, responsive assistance from librarians, and the integration of cutting-edge technologies, can positively influence student and faculty satisfaction. Metrics related to student satisfaction and support services are increasingly factored into ranking methodologies, making the role of libraries in providing excellent services an essential component of institutional success.

In conclusion, the role of libraries and librarians in institutional rankings is multifaceted and influential. Libraries contribute significantly to academic excellence by providing essential

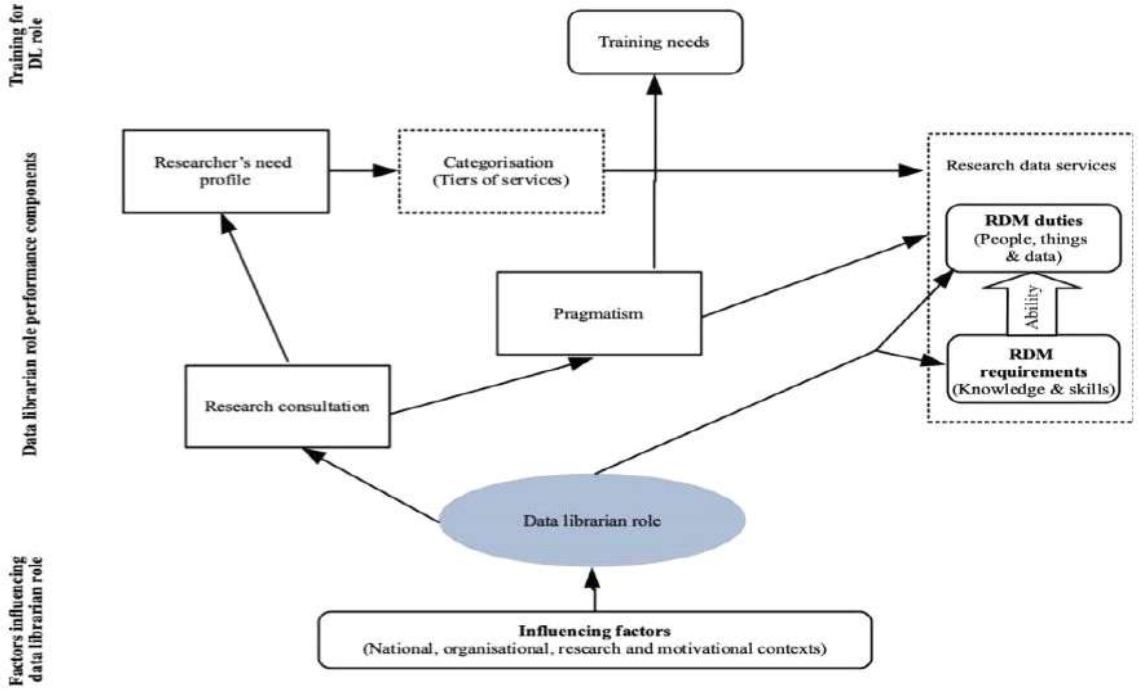
resources, fostering information literacy, and supporting teaching and learning. Their role in research productivity, visibility, and internationalization further enhances an institution's standing in global rankings. As universities and colleges continue to adapt to evolving educational landscapes, the collaboration between academic librarians and the broader academic community becomes increasingly critical for institutional success and recognition in the competitive world of higher education rankings.

Institutional Ranking and Role of Librarians

In the intricate web of factors that determine institutional rankings in higher education, the role of librarians emerges as a crucial and often underestimated influence. As universities and colleges vie for recognition on global platforms, the contributions of librarians become increasingly significant in shaping the academic landscape. This discussion explores how librarians, in their multifaceted roles, impact institutional rankings and contribute to the overall success of academic institutions.

Librarians serve as the custodians of knowledge within academic institutions, playing a pivotal role in curating and managing extensive collections of books, journals, and electronic resources. The quality and comprehensiveness of these collections are integral to an institution's academic excellence, a key factor in various ranking systems. Librarians collaborate closely with faculty to understand the specific needs of academic programs, ensuring that the library's resources align with the curriculum and support the research goals of different disciplines. A well-equipped library, tailored to the needs of the academic community, contributes significantly to an institution's reputation and standing in rankings that emphasize academic quality.

Beyond serving as repositories of information, libraries and librarians are central to fostering information literacy—a skill set essential for students' academic success and lifelong learning. Librarians play a crucial role in teaching students how to critically evaluate information, navigate databases, and use resources ethically. In an era where information is abundant but often overwhelming, the guidance provided by librarians in developing information literacy skills is invaluable. This aspect directly influences the quality of



Role of Librarian in Digital Library

education provided by an institution and contributes to its standing in rankings that consider teaching and learning outcomes.

Research productivity is a key determinant in many institutional rankings, and librarians play an instrumental role in supporting and enhancing research endeavors. Librarians collaborate with researchers to identify relevant literature, assist with literature reviews, and provide training on research tools and methodologies. The availability of comprehensive and up-to-date research resources within the library directly contributes to an institution's research output—a factor measured through publications, citations, and research impact. The stronger the support from the library, the more likely an institution is to excel in research-related indicators, positively impacting its position in rankings.

Libraries also contribute to the internationalization of institutions, a factor increasingly considered in rankings. Librarians facilitate global access to resources through interlibrary collaborations, international partnerships, and participation in global library networks. As institutions seek to create a diverse and globally connected academic environment, the role of libraries in facilitating access to a broad range of international resources becomes critical. This global perspective not only enriches the academic experience for students and researchers but also positively influences an institution's performance in rankings that emphasize internationalization.

Moreover, the efficiency and effectiveness of library services play a role in shaping institutional rankings. User-friendly interfaces, responsive assistance from librarians, and the integration of cutting-edge technologies contribute to student and faculty satisfaction. Metrics related to student satisfaction and support services are increasingly factored into ranking methodologies, making the role of libraries in providing excellent services an essential component of institutional success.

In conclusion, the role of librarians in institutional rankings is nuanced and impactful. Their contributions to academic excellence, research productivity, information literacy, internationalization, and quality library services collectively shape the overall success and recognition of an academic institution. As universities and colleges navigate the competitive landscape of global rankings, recognizing and appreciating the indispensable role of librarians becomes imperative for sustained academic excellence and prominence.

Conclusion

In conclusion, the intricate interplay between librarians and institutional rankings underscores the pivotal role that libraries play in shaping the academic landscape of higher education. Librarians, traditionally seen as custodians of knowledge, have evolved into dynamic contributors to an institution's success across various metrics considered in global rankings.

The quality and comprehensiveness of library collections directly impact academic excellence, with librarians collaborating closely with faculty to align resources with the curriculum and research needs. This alignment contributes significantly to an institution's reputation, a critical factor in many ranking systems. Librarians' role in fostering information literacy enhances the academic experience for students, equipping them with essential skills for navigating the information age. As rankings increasingly consider teaching and learning outcomes, the impact of librarians in cultivating information literacy becomes a valuable asset. Research productivity, another key metric in rankings, is intricately linked to the support provided by librarians. Their collaboration with researchers, provision of relevant resources, and facilitation of research processes contribute to an institution's standing in global research indicators.

Libraries and librarians also contribute to the internationalization of institutions by facilitating global access to resources and participating in international collaborations. This global perspective enhances an institution's reputation and positively influences rankings that emphasize internationalization efforts. Moreover, the efficiency and effectiveness of library services, including user-friendly interfaces and responsive assistance from librarians, contribute to student and faculty satisfaction. As satisfaction metrics gain prominence in ranking methodologies,

the role of libraries in providing excellent services becomes integral to institutional success.

In essence, the multifaceted contributions of librarians and libraries extend beyond the conventional role of information repositories. They are dynamic agents shaping the academic and research environment, thus influencing an institution's position in the competitive realm of global rankings. Recognizing and investing in the invaluable role of librarians is not only essential for achieving institutional excellence but also for securing a prominent position in the evolving landscape of higher education. As academic institutions continue to adapt to changing paradigms, the partnership between librarians and the broader academic community remains a cornerstone for success and recognition.

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Effect of nutrient sources on the Growth and Yield of Tomato (*Lycopersicon esculentum* Mill.) Cultivar

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Abstract

Impact of different nutrient sources was assessed on growth and yields under tomato crop. Thirty two treatments combinations arranged in factorial randomized block design. Three replications were maintained under all the treatments. A research experiment was conducted at Main Research Farm, RBS College, Bichpuri, Agra, U.P. India in year 2021-22 and 2022-23. Both year experiments were conducted in the rabi *season. Regarding the variety factor, throughout all growth stages, Number of fruits per plant and yield per ha Variety V_2 exhibited superior compared to V_1. The highest plant height, number of fruits per plant and yield per ha were observed in N_4 (75% RDF + 25% VC), followed by N_3 (75% VC + 25% VC), and N_6 (50% RDF + 50% VC). In this experiment two different variety was used* viz. *Sahoo (TO-3251) and Namdhari-592.*

Keywords: *Growth, yield, Variety, nutrient, tomato*

Introduction

Tomato (*Lycopersicon esculentum* L.) is the second most important vegetable or fruit crop next to potato (*Solanum tuberosum* L.). Tomato is a member of the Solanaceae family, which includes several other economically important crops such as eggplant (*Solanum melongena* L.), potato and pepper (*Capsicum annuum* L.) representing one of the most valuable plant families for vegetable and fruit crops. Tomato is a climacteric fruit and dramatic metabolic changes occur during its fruit development. It has worldwide utility both as fresh as well as in processed forms and is a good source of vitamins and minerals. Tomato being a moderate nutritional crop is considered an important source of Vitamin A and C and minerals which are important ingredients for table purposes, sambar preparation, chutney, pickles, ketchup, soup, juice, pure etc. (Sekhar *et al.*, 2010). It possesses 750 I.U. of vitamin 'A' and 25-30 mg of ascorbic acid/ 100 gm of edible part. It is an extensively grown vegetable in the world with its wider adaptability to various agro-climatic conditions. It is one of the most attractive crops. The yield of tomatoes in the tropics is very low. Among the various factors limiting the yield of tomatoes, a nutrition problem is one of them. For getting higher yield adequate supplies of balance nutrients are needed. Nutrition plays a key role in the yield as well as the quality of fruit. For getting higher production of tomatoes adequate fertilizers should be provided. Many researchers have worked on the nutritional requirement of tomatoes, but their results have been varying, often influenced by the ambient climatic conditions as well as soils. The present study was carried out to determine the optimum fertilizer dose for tomatoes for the particular climate prevalent and soil condition of U.P. Traditionally supply of nutrients to tomato crops has been through the conventional fertilizer i.e., Urea, SSP, MOP etc. However, with changing scenarios water soluble fertilizers (WSF) are used both for drip as well as foliar application is a good complementary source of nutrition beneficial for

boosting the yield as well as productivity of tomato crops. The present investigation is a study in the step to standardize the optimum mix of both the conventional as well as foliar application of fertilizer to get the maximum yield from the crop. The yield of tomatoes in the tropics is very low. Among the various factors limiting the yield of tomatoes, a nutrition problem is one of them. For getting higher yield adequate supplies of balance nutrients are needed. Nutrition plays a key role in the yield as well as the quality of fruit. For getting higher production of tomatoes adequate fertilizers should be provided. Traditionally supply of nutrients to tomato crops has been through the conventional fertilizer *i.e.*, Urea, SSP, MOP etc. However, with changing scenarios water soluble fertilizers (WSF) are used both for drip as well as foliar application is a good complementary source of nutrition beneficial for enhancing the yield as well as productivity of tomato crops.

Research Methodology

Site description

The present study was carried out at Main Research Farm, RBS College, Bichpuri, Agra, Dr. B. R. Ambedkar University, Agra over two consecutive years (2021-22 and 2022-23) to evaluate the effect of nutrient sources on the growth, yield, quality parameters of tomato. The initial soil properties of the experimental site were silty loam soil with a pH of 8.2 and EC 0.35 dS/m (Table 1). Organic carbon content was measured at 4.5 g/kg and the available nitrogen, phosphorus and potassium levels were recorded at 170.8, 9.4 and 215.6 kg/ha, respectively. Tomato sowing take place during *rabi* season (November–April), followed by tomato sowing in subsequent next same (rabi) season (November–April).

Table 1: Physico-chemical properties of initial soil sample of experimental field

S.No	Soil Properties	Value
1.	pH (1:2.5 soil to water suspension ratio)	8.2
2.	EC (dSm^{-1})	0.35
3.	Texture	Silty loam
4.	Organic Carbon (g/kg)	4.5
5.	Alkaline $KMnO_4$-N (kg ha^{-1})	170.8
6.	Olsens'-P_2O_5 (kg ha^{-1})	9.4
7.	Ammonium Acetate-K_2O (kg ha^{-1})	215.6

Fertilizer treatments and experimental design

This study comprised thirty-two treatments combinations arranged in factorial randomized block design. Three replications were maintained under all the treatments. Well-rotten FYM @ 200q /ha was applied at the time of field preparation the inorganic fertilizers in the form of Urea, SSP and MOP were applied @ 125, 75 and 60 kilograms per hectare in individual plots before the transplanting of seedlings. Before applying chemical fertilizers, 2 baskets full of well-decomposed FYM were applied to each plot before the last ploughing. The total amount of phosphorous and 20% of potash and nitrogen were applied to the soil before planting. The remaining amount of nitrogen and potash were applied in the other two splits. The first top dressing was done 20 days after transplanting @ 40% each of nitrogen and potash. The second top dressing was done 40 days after planting at doses similar to that of the first top dressing.

Analysis of soil sample

The alkaline potassium permanganate oxidized soil nitrogen was determined as per prescribed methodology of Subbiah and Asija, 1956. Phosphorus content in the extract was determined by ascorbic acid method (Watanabe and Olsen, 1965). The soil samples were extracted with 0.5 M $NaHCO^3$; pH 8.5. Available potassium was estimated flame photometrically in neutral normal ammonium acetate extract (Hanway and Heidel, 1952).

Statistical analysis

Data obtained from the field experiment was statistically analyzed following standard statistical methods (Gomez and Gomez, 1984). Analysis of variance pertaining to the different fertilizer treatments for comparison of means was performed using Microsoft Excel and SPSS. Unless otherwise stated, the level of significance referred to in the results is $p< 0.05$.

Results and Discussion

Growth attributing characters

Regarding the variety factor, throughout all growth stages (30, 60, and 90 DAT), Variety V_2

Table 2: Effect of nutrient sources on Growth attributing characters (plant height)

Treatments	Plant height (cm)					
	30 DAT		60 DAT		90 DAT	
	1st	2nd	1st	2nd	1st	2nd
Variety						
V1	34.515	35.25	69.393	70.392	113.932	114.393
V2	35.636	36.38	70.153	71.153	114.153	115.15
SEm	0.183	0.205	0.406	0.398	0.673	0.64
CD	0.365	0.409	NA	NA	NA	NA
Biofertilizer						
B1	34.803	35.54	69.614	70.614	113.614	114.61
B2	34.803	36.09	69.932	70.931	113.932	114.93
SEm	0.183	0.205	0.406	0.398	0.673	0.64
CD	0.365	0.409	NA	NA	NA	NA
Organic manure						
N1	29.18	29.92	66.71	67.71	110.70	111.70
N2	31.06	31.81	67.50	68.50	111.50	112.50
N3	38.83	39.58	71.69	72.69	115.69	116.69
N4	39.25	39.97	72.52	75.53	116.53	117.53
N5	38.19	38.94	70.50	71.50	114.50	115.50
N6	38.44	39.18	71.00	72.00	115.00	116.00
N7	32.31	33.06	69.48	70.48	113.48	114.47
N8	33.31	34.06	68.75	69.75	112.75	113.75
SEm	0.366	0.409	0.812	0.79	1.34	1.29
CD	0.731	0.818	1.62	1.59	2.69	2.59

exhibited superior plant height compared to V_1 (Table 2). Specifically, at 30 DAT, V_2 had a plant height of 35.636 cm, while V_1 had 34.515 cm in 2021-22, and 36.386 cm for V_2 and 35.256 cm for V_1 in 2022-23. At 60 DAT, V2 displayed 70.153 cm and V_1 showed 69.393 cm in 2021-22, whereas in 2022-23, V_2 had 71.153 cm and V_1 had 70.392 cm. At 90 DAT, during 2021-22, V_2 recorded 114.153 cm and V_1 113.93 cm; during 2022-23, V_2 had 115.153 cm and V_1 114.393 cm.

Probable reason of this variation in plant height at various stages may be due to better nutrient availability provided by bio fertilizers and nutrient source and better uptake by variety. Similar result was reported by Poul *et al*. (2004) and Ray *et al*. (2005).

Number of fruits per plant

The variety factor, during the flowering and fruiting stages, Variety V_2 showcased a higher number of fruits per plant compared to V_1. Specifically, V_2 displayed 25.626 while V_1 showed 25.396 in 2021-22. In 2022-23, V_2 recorded 28.226 and V_1 recorded 27.996. In terms of the nutrient factor, the highest number of fruits per plant was observed in N_4 (75% RDF + 25% VC), followed by N_3 (75% VC + 25% VC), and N_6 (50% RDF + 50% VC). For example, V_2 with N_4 recorded 28.675 followed by N_3 with 27.655 in 2021-22. In 2022-23, V_2 with N_4 recorded 31.275 and N_3 recorded 30.225 (Table 3).

Proper supplementation of nutrients increase accumulation of important secondary metabolites which positively increased fruit weight. These result are accordance with the findings of Kamal *et al.* (2018).

Yield per ha (q/ha)

The nutrient factor, the highest yield per hectare was observed in N_4 (75% RDF + 25% VC), followed by N_3 (75% VC + 25% VC), and N_6 (50% RDF + 50% VC). For example, V_2 with N_4 yielded 328.25 q/ha followed by N_3 with 313.85 q/ha in 2021-22. In 2022-23, V_2 with N_4 yielded 329.95 q/ha and N_3 yielded 315.55 q/ha (Table 3). As for interactions, notable effects were solely observed between

Table 3: Effect of nutrient sources on number of fruits per plant and yield per ha (q/ha)

Treatments	No. of fruits/plant		Yield (q/ha)	
	1st	2nd	1st	2nd
Variety				
V1	25.39	27.99	254.97	256.67
V2	25.62	28.49	257.67	259.37
SEm	0.12	0.15	3.07	c1.28
CD	0.25	0.30	1.54	2.57
Biofertilizer				
B1	25.32	27.92	253.91	255.61
B2	25.69	28.29	258.73	260.43
SEm	0.12	0.15	3.07	1.28
CD	0.25	0.30	1.54	2.57
Organic manure				
N1	22.02	24.62	178.35	180.05
N2	22.42	25.02	185.80	187.50
N3	27.65	30.25	313.85	315.55
N4	28.67	31.27	328.25	329.95
N5	26.53	29.13	284.00	285.70
N6	27.12	29.72	292.65	294.35
N7	24.27	26.87	213.85	215.55
N8	25.37	27.97	253.85	255.55
SEm	0.25	0.30	3.08	2.57
CD	0.51	0.60	6.15	5.14

variety and biofertilizers, and variety and nutrients in both years. Apart from these cases, no other substantial interaction effects were identified in either year of experimentation. Number of flowers per plants, flowers per cluster and fruit setting % are directly associated yield per hectare and these characters well reported with the application of better supplementation of Nutrients and Biofertilizers. These results are accordance with Kumar and Sharma (2007), and Nasrin *et al.* (2008).

Conclusion

There was an interaction effects were only observed between variety and biofertilizers at 30 DAT in 2021-22, 60 DAT in both years, and Nutrient variety and biofertilizers on 60 days in 2022-23. Besides these instances, no other significant interaction effects were identified in both years of experimentation. Nutrient factor, the highest number of fruits per plant was observed in (75% RDF + 25% VC), followed by (75% VC + 25% VC), and (50% RDF + 50%.

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