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Effect of different chemical and organic nutrient management on growth and yield of Linseed (L*inum usitatissimum* L.) Under irrigated conditions

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Abstract

*A field experiment on "Effect of different chemical and organic nutrient management on growth and yield of Linseed (*Linum usitatissimum *L.) Under irrigated conditions" 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. The experiment was carried out in Randomized Block Design and replicated three times consisting of 12 treatments. The soil of the field was of clayey texture having slightly alkaline pH (7.9), medium in organic carbon (0.59%), medium in available nitrogen (262 kg ha^{-1}), medium in available phosphorus (21.4 kg ha^{-1}) and medium in available potassium (137 kg ha^{-1}). The growth and yield attributes of Linseed positive effect on plant height, fresh weight, number of branches and seed yield. The maximum plant height, fresh weight, number of branches and seed yield of (19.90 q/ha) was recorded significantly influenced by T_{12}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1} +* Azotobacter *5 kg ha^{-1}.*

Key words: Linseed, foliar fertilization. Neem cake, *Azotobacter*

Introduction

Linseed (*Linum usitatissimum* L.) is an important oilseed crop grown in India, next to rapeseed-mustard in area as well as in production. Linseed belongs to Linaceae family and its chromosome number is 2n=30. It is mainly raised during *rabi* season It is grown either for oil, extracted from seed or for fibre from stem. Linseed is one oldest cultivated plant grown by human for food and fibre Linseed is an important oil seed and fibre crop. Seed is also known as Alsi in Hindi, Alashi in Marathi, Ousahalu in Telugu and Akshi in Kannada. Linseed is self-pollinated crop but cross pollination occurs at very low level. Every part of linseed plant is utilized commercially either directly or after processing. Out of total linseed oil only 20% used by the farmers of India for edible purpose and rest 80% use for industrial purpose like for manufacture paints, oil cloth, varnish, linoleum and printing ink etc. Linseed seed contain 33 to 47% oil in different varieties. The stem of linseed is stronger than cotton and the fibre obtain from the stem is depend on the length and strength of stem. The important characteristics of linseed crop is survival and cultivation in wide range of sub-tropical, tropical and temperate zone because it bears the biotic and abiotic stresses. Teshome et al., 2020.

The linseed cake also very rich in protein, fibre and total humidity. So, it is very beneficial for health of Cattles. The linseed oil cake also used as manure because it contains 5% nitrogen, 1.4% phosphorus and 1.8% potassium. (Anonymous 2020). It provides protection from soil nematodes and insects. It also improves yields and quality of produce-like taste, flavour and amino acid composition. The linseed cake is brown in colour after the extraction of oil. It contains 21.78% of non-nitrogenous extracts, 29.37% lipids and 27.78% protein,7.02% fibre, 3.40% ash and 10.56% total humidity. It is protein rich feed for livestock (Dash *et al.*, 2017).

Seed varieties possess more branches than flax. The leaves are narrow and short, alternate on

the stem and sessile. Flowers are usually white or blue, complete and perfect with 5 petals, 5 sepal fine stamens. Linseed is normally self-pollinated, although, cross fertilization is possible. The fruit is capsule, which is globular in shape. These are divided into 5 locules where seeds are borne. The seeds are flat, shiny and relatively small. The seed colour ranges from white to shining yellow or light brown.

An India mainly linseed grown under rainfed (63%), utera (25%), and irrigation (12%). Maximum area covered by linseed under *utera* and *paira* system of cultivation in which seeds of linseed are generally broadcasted in standing paddy crop *i.e*., 15-20 days before the harvesting of paddy crop. 13 states of the country cultivated linseed these are Madhya Pradesh, Maharashtra, Chhattisgarh, Uttar Pradesh, Jharkhand, Bihar, Orissa, Karnataka, Nagaland, Assam, West Bengal, Himachal Pradesh and Rajasthan. The productivity is increase in some states like Rajasthan (2006 kg ha^{-1}), Bihar (846 kg ha^{-1}), Nagaland (689 kg ha^{-1}) and Assam (517 kg ha^{-1}).Area under the linseed decline during last few decade because low and unstable yield of crop and uncertainty in return to investment. In Punjab mainly cultivated in Gurdaspur, Hoshiarpur and Ropar district. Anonymous. 2020.

Materials and Methods

The experimental field was located at Campus for research and advanced studies, Dhablan of P.G. Department of Agriculture, G.S.S.D.G.S Khalsa College, Patiala situated at about 30p 192 North latitude and 76p 242 East longitude at an altitude of about 250 metre above the mean sea level. It is located in south eastern direction in Punjab state and North West India. The experimental site falls in Indo-Gangetic plains. The experimental plot was homogeneous in fertility having assured irrigation and other required facilities.

After the field preparation, replication borders, plots, bunds, irrigation channels and path were made manually. All treatment combinations were applied randomly in each replication using factorial randomized block design. chemical and organic nutrient management was given according to the treatments. Fertilizers were applied before sowing. The required application of fertilizer as per treatments were .

Five plants were randomly selected from each plot and tagged prior to recording of first observation. Plant height was measured at 30, 60, 90 and at harvest. Height of each plant was recorded from the base to the tip of the plant. At maturity, plant height was measured from base to the tip of the main shoot. Plants of one meter row length were selected and cut from each plot for fresh weight was used. Fresh weight of plants was recorded separately for each plot and converted into kg ha^{-1}.

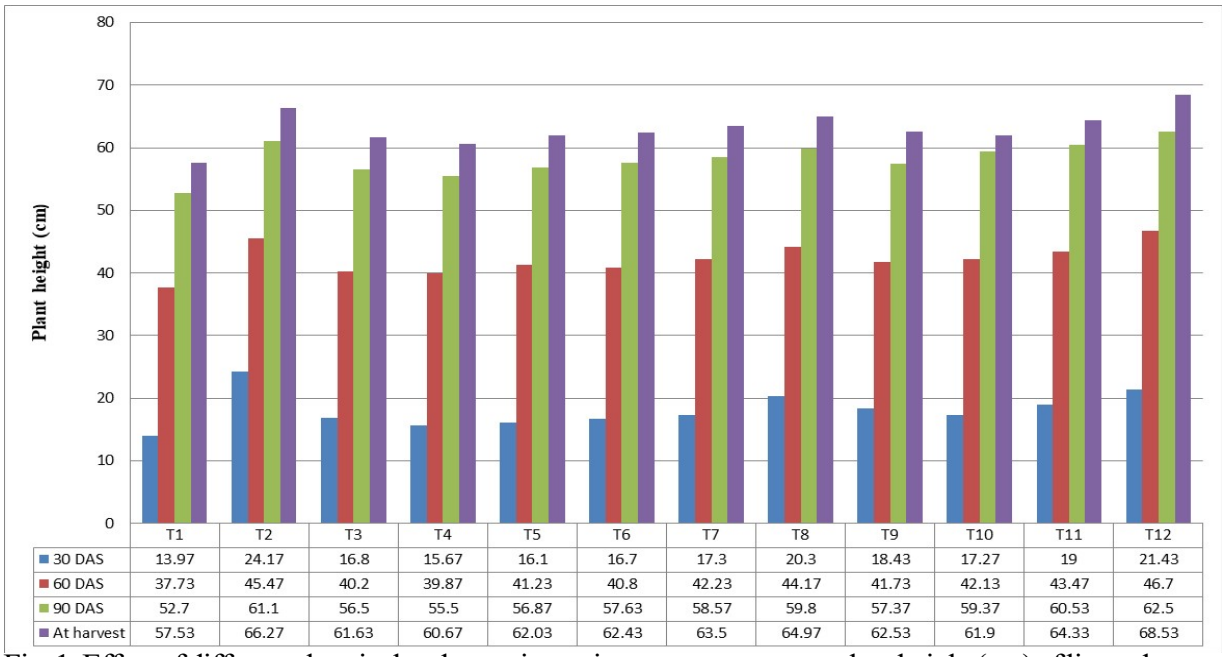
Results and Discussion

Among the treatments of the experimental study recorded significantly higher plants at 30, 60, 90 DAS and at harvesting (Table 1 & Fig. 1). The highest plant height was recorded in the treatment T_{12}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1} + *Azotobacter* 5 kg ha^{-1} (21.43, 46.70, 62.50 and 68.53 cm) where the recommended dose were T_8: 10t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1}+ *Azotobacter* 5 kg ha^{-1} was statistically at par with treatment T_{12}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1} + *Azotobacter* 5 kg ha^{-1} with plant height (20.30, 44.17, 59.80 and 64.97 cm) at 30, 60, 90 DAS and at harvesting. Similar result reported by Zafar *et al.*, 2020

The use of chemical and organic nutrient management is considered to be one of the most important factors to increase the plant height. The result of present study showed that significantly increased higher plants with the application of integrated nutrient management to 30, 60, 90 DAS and at harvesting. The plant height was rapidly increased significantly with increasing level of chemical and organic nutrient management. Organic manures are rich in soil enzyme and plant nutrients which provide desired amounts of nutrients to plants. In addition to this, these improve the physical, chemical as well as biological properties of soil, which helps in providing suitable atmosphere for growth of plants and these also promote microbial activity and enhance soil organic matter which have a promising effect on the plant growth. *Rhizobium enhanced* the nodulation which resulted in higher fixation of atmospheric nitrogen and also formation of roots nodules for better absorption of moisture and nutrients which leads to increase in growth of plants. The beneficial effect of chemical and organic

Table 1: Effect of different chemical and organic nutrient management on plant height (cm) of linseed crop

Treatment	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	At harvest
T_1: Control	13.97	37.73	52.70	57.53
T_2: 100% RDF ha^{-1}	24.17	45.47	61.10	66.27
T_3: 75 % RDF ha^{-1}	16.80	40.20	56.50	61.63
T_4: 50 % RDF ha^{-1}	15.67	39.87	55.50	60.67
T_5: 10t FYM ha^{-1}	16.10	41.23	56.87	62.03
T_6: 10t FYM ha^{-1}+ 3t PM ha^{-1}	16.70	40.80	57.63	62.43
T_7: 10t FYM ha^{-1} + 2t VC ha^{-1} + 5 kg Sulphur ha^{-1}	17.30	42.23	58.57	63.50
T_8: 10t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1}+ *Azotobacter* 5 kg ha^{-1}	20.30	44.17	59.80	64.97
T_9:12t FYM ha^{-1}	18.43	41.73	57.37	62.53
T_{10}: 12t FYM ha^{-1}+ 3t PM ha^{-1}	17.27	42.13	59.37	61.90
T_{11}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ + 5 kg Sulphur ha^{-1}	19.00	43.47	60.53	64.33
T_{12}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1} + *Azotobacter* 5 kg ha^{-1}	21.43	46.70	62.50	68.53
SEm(±)	1.15	1.22	1.67	1.52
CD (0.05)	2.61	2.77	3.78	3.43



	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12
30 DAS	13.97	24.17	16.8	15.67	16.1	16.7	17.3	20.3	18.43	17.27	19	21.43
60 DAS	37.73	45.47	40.2	39.87	41.23	40.8	42.23	44.17	41.73	42.13	43.47	46.7
90 DAS	52.7	61.1	56.5	55.5	56.87	57.63	58.57	59.8	57.37	59.37	60.53	62.5
At harvest	57.53	66.27	61.63	60.67	62.03	62.43	63.5	64.97	62.53	61.9	64.33	68.53

Fig. 1: Effect of different chemical and organic nutrient management on plant height (cm) of linseed crop

nutrient on maximum plant height was also reported by Teshome *et al.*, 2020.

The highest number of leaves plant^{-1} which were 26.20, 62.43, 61.07 and 40.47 at 30, 60, 90 DAS and at harvest, respectively were recorded under the treatment T_{12}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1} + *Azotobacter* 5 kg ha^{-1}. Thereafter, it was followed by the treatment T_8: 10t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1}+ *Azotobacter* 5 kg ha^{-1} which were statistically at par with each other. However, the lowest number of leaves at all the stages of crop were found in treatment T_1 (Control). Similar results have also been

Table 2: Effect of different chemical and organic nutrient management on number of leaves plant^{-1} of linseed crop

Treatment	Number of leaves plant^{-1}			
	30 DAS	60 DAS	90 DAS	At harvest
T_1: Control	17.77	52.47	51.90	29.77
T_2: 100% RDF ha^{-1}	28.73	60.97	59.67	39.23
T_3: 75 % RDF ha^{-1}	21.10	54.77	54.20	32.77
T_4: 50 % RDF ha^{-1}	20.77	53.17	53.83	31.10
T_5: 10t FYM ha^{-1}	22.13	53.97	54.90	34.03
T_6: 10t FYM ha^{-1}+ 3t PM ha^{-1}	22.80	55.30	56.07	34.53
T_7: 10t FYM ha^{-1} + 2t VC ha^{-1} + 5 kg Sulphur ha^{-1}	23.63	56.13	57.00	34.00
T_8: 10t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1}+ *Azotobacter* 5 kg ha^{-1}	25.07	57.80	57.80	36.73
T_9:12t FYM ha^{-1}	22.63	55.03	55.00	34.30
T_{10}: 12t FYM ha^{-1}+ 3t PM ha^{-1}	23.50	56.77	55.27	31.97
T_{11}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ + 5 kg Sulphur ha^{-1}	24.90	58.70	57.93	35.43
T_{12}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1} + *Azotobacter* 5 kg ha^{-1}	26.20	62.43	61.07	40.47
SEm(±)	1.22	1.24	1.15	1.17
CD (0.05)	2.76	2.79	2.61	2.65

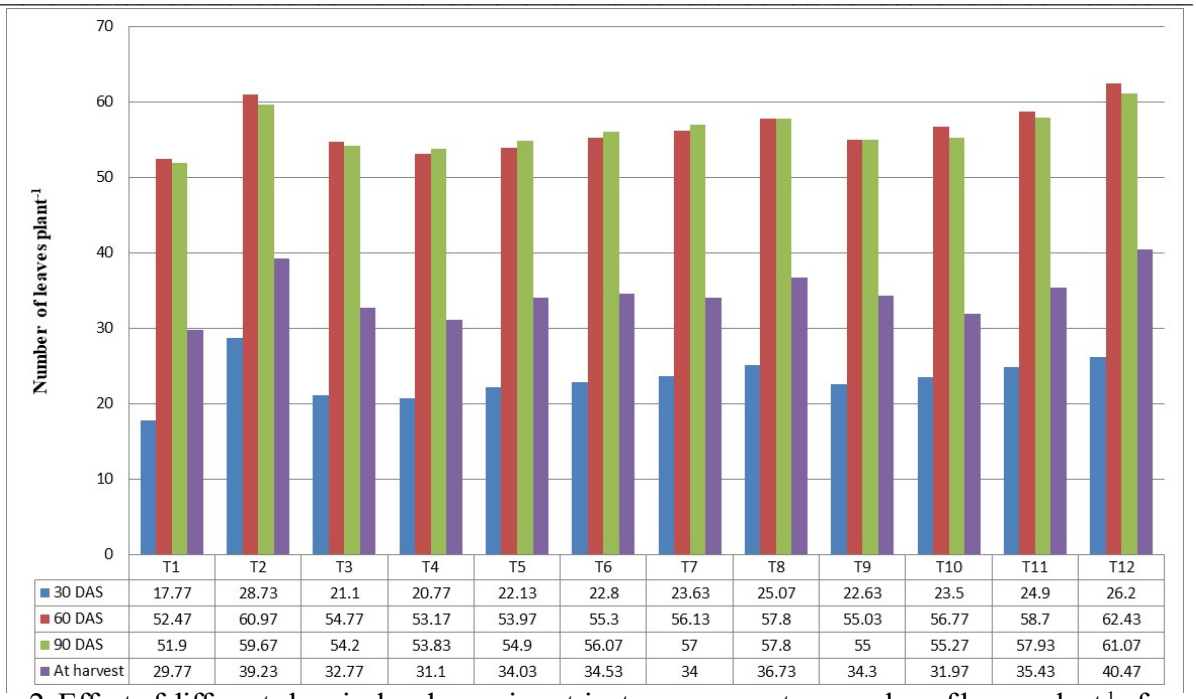


Fig. 2: Effect of different chemical and organic nutrient management on number of leaves plant^{-1} of linseed crop

reported by Zafar *et al.*, 2020 and Ialam *et al.*, 2018.

Number of green leaves plant^{-1} increased probably due to more activities of meristematic tissues of plant. The increased vigour of plant during vegetative phase thus contributed towards the higher production of branches and also increased the dry matter accumulation at different growth stage.

Data in the table 2 and Fig. 2 indicated that number of leaves plant^{-1} also significantly influenced by different fertility levels. It is possible that at higher

Table 3: Effect of different chemical and organic nutrient management on dry weight plant^{-1} of linseed crop

Treatment	Dry weight (g) plant^{-1}			
	30 DAS	60 DAS	90 DAS	At harvest
T_1: Control	5.07	37.07	39.63	64.13
T_2: 100% RDF ha^{-1}	11.73	48.23	54.57	72.27
T_3: 75 % RDF ha^{-1}	6.70	38.07	46.33	67.00
T_4: 50 % RDF ha^{-1}	6.37	40.80	47.50	66.67
T_5: 10t FYM ha^{-1}	7.57	41.27	47.97	66.43
T_6: 10t FYM ha^{-1}+ 3t PM ha^{-1}	7.77	42.00	48.87	67.37
T_7: 10t FYM ha^{-1} + 2t VC ha^{-1} + 5 kg Sulphur ha^{-1}	7.90	44.97	50.10	68.10
T_8: 10t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1}+ *Azotobacter* 5 kg ha^{-1}	10.33	46.93	53.63	70.97
T_9: 12t FYM ha^{-1}	7.83	42.70	49.40	67.57
T_{10}: 12t FYM ha^{-1}+ 3t PM ha^{-1}	8.23	46.37	53.07	68.97
T_{11}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ + 5 kg Sulphur ha^{-1}	9.37	47.33	54.03	70.53
T_{12}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1} + *Azotobacter* 5 kg ha^{-1}	11.60	48.97	55.67	73.50
SEm(±)	0.91	0.84	0.69	0.96
CD (0.05)	2.05	1.90	1.57	2.17

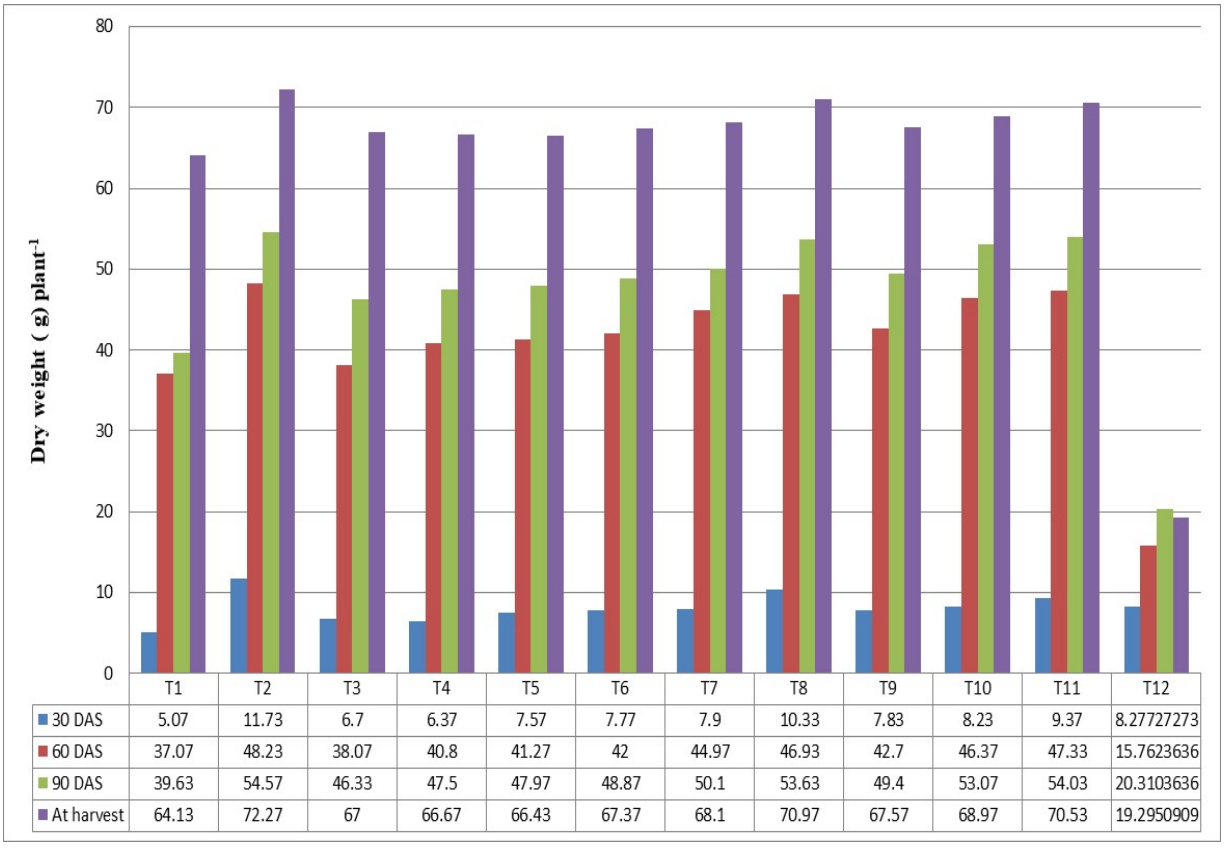


Fig. 3: Effect of different chemical and organic nutrient management on dry weight (g) plant^{-1} of linseed crop

Table 4: Effect of different chemical and organic nutrient management on yield q ha^{-1} of linseed crop

Treatment	Yield q ha^{-1}		
	Seed yield	Stover yield	Biological yield
T_1: Control	7.00	38.17	45.17
T_2: 100% RDF ha^{-1}	18.10	46.30	64.40
T_3: 75 % RDF ha^{-1}	13.40	41.93	55.33
T_4: 50 % RDF ha^{-1}	13.07	40.20	53.27
T_5: 10t FYM ha^{-1}	13.90	41.57	55.47
T_6: 10t FYM ha^{-1}+ 3t PM ha^{-1}	14.63	42.00	56.63
T_7: 10t FYM ha^{-1} + 2t VC ha^{-1} + 5 kg Sulphur ha^{-1}	14.97	43.10	58.07
T_8: 10t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1}+ *Azotobacter* 5 kg ha^{-1}	16.70	44.50	61.20
T_9: 12t FYM ha^{-1}	14.50	41.93	56.43
T_{10}: 12t FYM ha^{-1}+ 3t PM ha^{-1}	15.17	42.97	58.13
T_{11}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ + 5 kg Sulphur ha^{-1}	16.40	44.23	60.63
T_{12}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1} + *Azotobacter* 5 kg ha^{-1}	19.90	46.67	66.57
SEm(±)	0.77	1.09	1.31
CD (0.05)	1.75	2.47	2.96

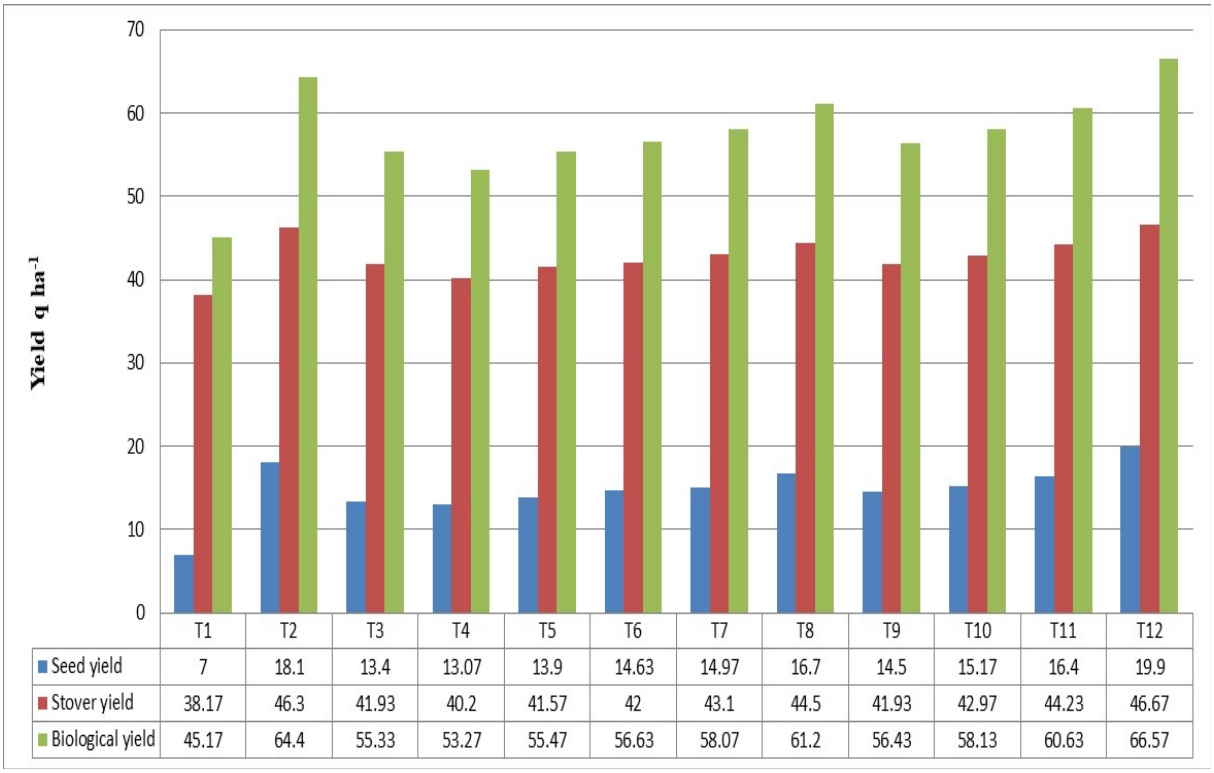


Fig. 4: Effect of different chemical and organic nutrient management on yield q ha^{-1} of linseed crop

levels of NPKS fertilization enhanced cell division and cell multiplication, which brought higher number of leaves plant^{-1}.

The minimum dry weight was recorded in control where no fertilizer was applied. In general, integrated fertigation increased the dry weight of plant. The dry weight of the plant increased significantly with combined application of fertilizer. Further, significant difference in dry weight of the plant was observed at 30, 60, 90 DAS and at harvesting (Table 3 & Fig. 3).

The result indicate that the fertilizer dose with T_{12}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1} + *Azotobacter* 5 kg ha^{-1} recorded significantly higher dry weight of the plant at 30, 60, 90 DAS and at harvesting where the treatment combination T_8: 10t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1}+ *Azotobacter* 5 kg ha^{-1} at par to T_{12}. Similar results have also been reported by Gaikwad *et al.*, 2020.

It is clear from the results in table 4 and Fig 4 that seed yield significantly influenced due to the fertility level treatments. Amongst all the fertility treatments, T_{12}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1} + *Azotobacter* 5 kg ha^{-1} obtained significantly higher seed yield as compared to the other treatments. The maximum seed yield (19.90 q ha^{-1}) recorded at treatment in control minimum seed yield (7.00 q ha^{-1}) recorded. It is possible that at higher levels of organic and inorganic fertilization had vigorous plant growth might have produced more photosynthates, which enhanced the seed yield. This finding is in conformity with the results of Diwan *et al.*, 2019.

It is evident from the table 4.6 that the straw yield significantly different with seed rate treatment. The straw yield increased with increase in the levels of organic and inorganic nutrient management. The maximum straw yield was recorded at treatment T_{12}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1} + *Azotobacter* 5 kg ha^{-1}. Maximum straw yield (46.67 q ha^{-1}) recorded in treatment and minimum straw yield (38.171 q ha^{-1}) Zafar *et al.*, 2020 reported the similar results in straw yield.

It is indicated from the results in the table that straw yield significantly varied with the fertility treatments. The treatment T_{12}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1} + *Azotobacter* 5 kg ha^{-1} obtained significantly higher straw yield as compared to the other treatments.

It is evident from the table 4.6 that the straw yield significantly different with seed rate treatment. The bilogical yield increased with increase in the levels of organic and inorganic nutrient management. The maximum biological yield was recorded at treatment T_{12}: 12t FYM ha^{-1}+ 1.5t VC ha^{-1}+ 0.5t Neem cake ha^{-1} + *Azotobacter* 5 kg ha^{-1}. Maximum biological yield (66.57 q ha^{-1}) recorded. Similar results have also been reported by Dash *et al.*, 2017.

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