The Journal of Rural and Agricultural Research Vol. 22 No. 1, 54-57 (2022)
Received Februry 2022; Acceptance June 2022

Performance of Nitrogen Fertilization and Plant Growth Regulators on Productivity of Wheat (*Triticum aestivum* L.) under Western Uttar Pradesh

MULAYAM SINGH[1], RAJVIR SINGH* AND SATENDRA BABU[2]
Department of Agronomy, R.B.S. College, Bichpuri, Agra-283105 (U.P.)
**Corresponding author Email: drrajjcb@gmail.com*

Abstract

A field experiment on performance of nitrogen fertilization and plant growth regulators on productivity of wheat (Triticum aestivum L.) was conducted at Agricultural Research Farm, R.B.S. College, Bichpuri, Agra on sandy loam soil during Rabi season of 2019-20. Results of the study revealed that application of higher doses of nitrogen up to 125% recommended dose of nitrogen (187.50 Kg ha^{-1}) with growth regulator spray at first node and boot leaf stage and significant positive effect on all morphological characters of wheat crop. Among all the treatments, application of 187.50 kg N ha^{-1} with plant growth regulator spray at first node and boot leaf stages (T_8) showed significantly higher yield attributes and yield (53.48 qha^{-1}) as well as net return (Rs. 102288.25) and B:C ratio (3.36).

Key words: *Growth regulators, Nitrogen fertilization, western Uttar Pradesh, yield attributes*

Introduction

Wheat (*Triticum aestivum* L.) is one of the leading food crop of the world and occupies significant among the cultivated cereals. It is used as a staple food by 10 billion individuals over all the world mainly in 43 countries and contributing 30% to overall grain demand of the world standing at top in cereal crops. It gives around 20% the aggregate food calories for main kind (Ali *et al.* 2018). The Indiaôs share in world wheat area was about 14.0%, whereas it occupied 13.53% share in the total world wheat production. Area production and productivity to wheat in India during 2020-21 was 29.80 million ha, 108.75 million tonnets, and 3424 kg ha^{-1} respectively.

Nitrogen is considered one of the most important factors affecting crop morphology, crop growth rate and grain yield, the most important role of N in the plant is the presence in the structure of protein, the most important building substances from which the living material or protoplasm of every cell is (Amanullah *et al.* 2008). Wheat is very sensitive to insufficient nitrogen and very responsive to nitrogen fertilization. Insufficient N availability to wheat plants results in low yields and significantly reduced profits compared to a properly fertilized crop. Singh *et al.* 2010.

Plant growth regulators (PGRôs) are organic compounds other than nutrients that influence any physiological processes of the plant. The group of PGRôs includes both naturally occurring substances like rhytohormones or other growth substances, but also synthetic compounds or chemical analogues. It is used to control the developmental process of the plant from germination, vegetative growth, reproductive development and maturity, ageing and post-harvest preservation (Basra, 2010). In cereals, most commonly used PGRôs are Chlormequate chloride and Mepiquat chloride. Chlormequate chloride contains a positively charged ammonium group in its structure. This groups 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. In the same way as Chlormequate, mepiquate (Mepiquate chloride) also contains an ammonium group and blocks the synthesis *ent-kaurene* and therefore gibberellin (Rademacher, 2015).

PGRôs applied before the emergence of the ear reduce lodging. Most growth regulators are only active

[1]P.G. Research Scholar, Department of Agronomy, R.B.S. College, Bichpuri, Agra-283105 (U.P.)
[2]Asst. Professor, U.P. Rajarshi Tandon Open University Prayagrag.

for a few days after application and can therefore shorten internodes most effectively when applied during their extension. It was found that applying chlormequate 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

A field experiment was conducted during *Rabi* season of 2019-20 at Agricultural Research Farm, R.B.S. College Bichpuri on sandy loam soil having pH 8.1, low in available N, medium in available P and K (181.90, 27.50 and 285 kg/ha respectively). The treatments of an experiment were evaluated in randomized block design with three replications. The variables involved in this study were ten different treatments of nitrogen doses and plant growth regulators viz., absolute control (T_1), 50% recommended dose of N (T_2), 75% recommended dose of N (T_3), 100% recommended dose of N (150 kg N ha^{-1} ï T_4), 125% recommended dose of N (T_5), 150% recommended dose of N (T_6), 100% recommended dose of NPK (150 kg N + 60 kg P_2O_5 + 40 kg ï K_2O $ha^{ï\,1}$ ï T_7), 125% recommended dose of N along with plant growth regulator spray at first node and boot leaf stage (T_8), 150% recommended dose of N with plant growth regulator spray at first node and boot leaf stage (T_9) and 150% recommended dose of N with plant growth regulator spray at first node and boot leaf stage (T_{10}). The recommended dose of fertilizer for wheat variety was taken as 150 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha^{-1}. Full dose of P and K and 1/3rd dose of N were applied (as per recommend dose) as basal to the respective plots as per treatments. The remaining

2/3rd N was applied in two split doses after first and second irrigation by top dressing of urea. The source of N, P and K were urea, D.A.P. and M.O.P. respectively. Chlormequate chloride (Lihocin) used as a growth retardant @ 0.2% and Tebuconazole @ 0.1% (systematic traizole fungicide) plant growth regulators were applied as foliar spray at first node and boot leaf stage to the respective plots as per treatment. The wheat variety H-PBW-01 (Pure Line variety) was used obtained from 11WBR, Kanal, Haryana, under all India coordinated wheat and barley improvement project. Seed treated before sowing with Agrosan GN @ 2g kg^{-1} seed. The seeding material was applied @ 100 kg seed ha^{-1} (on the basis of 1000 seed weight of 38g) in furrows 20 cm apart at the depth of 4-5 cm with the help of *Kudali* and was covered by light planking. During *Rabi* season of 2019-20, 135.4 mm rains were received during crop span. The data relating to each character were analyzed as per the procedure of analysis of variance as suggested by Panse and Sukhatme (1967). Economics of different treatments was worked out on the basis of input and output on the prevailing market prices and B:C ratio was calculated.

Results and Discussion

Effect on growth and development

The maximum plant population $mï^{1}$ row length and number of shoots $mï^{1}$ row length were recorded with the application of 125% recommended dose of N with growth regulator spray at first node and boot leaf stage (T_8) and it was significantly higher than all other levels of nitrogen application without plant growth regulators, might be attributed to its better growth under prevailing weather conditions. Plant height significantly increased with every increase in the doses of nitrogen up to 150% recommended of dose of N. Maximum plant height was also recorded with the application of 150% recommended dose of N at all the stages of crop growth and was statistically at par with those treatments having plant growth regulatorôs. PGRs inhibit different steps during the production (biosynthesis) of GA in plants. Thus, PGRs suppress stem elongation by blocking GA production within plants.

Application of 150% recommended dose of nitrogen resulted in conspicuously more dry matter accumulation in plants of 25 cm now length than all other treatments at all the stages of crop growth except treatment having 150% RDN along with PGRs spray at first node and boot leaf stage and 150% recommended dose of NPK along with PGRs spray at first node and boot leaf stage which retards the cell elongation and ultimately dry matter accumulation. At harvest, the magnitude of increase in dry matter accumulation in plants of 25 cm row length with 125 and 150 per cent of the recommended dose of nitrogen was to the tune of 6.48 and 13.16 per cent, respectively over 100 per cent of the recommended dose of nitrogen. These results are in agreement with those of Singh *et al.* (2013), Imdad *et al.* (2018) and Shekoota and Emam (2018).

Effect on yield attributes and yield

The yield of any crop is generally based on two factors viz. plant population $unit^{-1}$ area is affected by several characterôs like number of Spike, length of spike, number and weight of grains $spikeï^{1}$ and

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

Treatments	Length of spike (cm)	Plant Stand count m^2	No. of Ear head m^2	No. of grains $spike^{-1}$	Grain weight (g) $spike^{-1}$	1000-grain weight (g)
T_1	4.10	207.92	190.16	35.18	1.36	38.73
T_2	5.57	248.94	231.89	45.26	2.00	44.41
T_3	6.85	251.00	236.51	47.48	2.06	43.49
T_4	7.84	253.04	235.18	49.18	2.06	42.12
T_5	8.09	255.41	237.44	52.56	2.10	40.08
T_6	8.20	258.55	240.46	57.53	2.24	39.16
T_7	8.25	260.19	241.32	57.58	2.41	41.92
T_8	8.74	270.41	252.26	64.18	2.67	41.76
T_9	8.31	264.32	246.14	59.04	2.38	40.36
T_{10}	8.37	266.43	248.52	61.19	2.48	40.61
SEm ±	0.236	3.588	3.356	1.430	0.058	1.288
CD at 5%	0.702	10.660	9.970	4.250	0.170	3.840

RDN = Recommended dose of Nitrogen

T_1 ï Absolute control ($N_0 + P_0 + K_0$)
T_2 ï 50% RDN (75 kg ha^{-1})
T_3 ï 75% RDN (112.50 kg ha^{-1})
T_4 ï 100% RDN (150 kg ha^{-1})
T_5 ï 125% RDN (187.50 kg ha^{-1})
T_6 ï 150% RDN (225 kg ha^{-1})
T_7 ï 100% NPK (150+60+40 kg ha^{-1})
T_8 ï 125% RDN with PGRs spray at first node and flag leaf stage
T_9 ï 150% RDN with PGRs spray at first node and flag leaf stage
T_{10} ï 150% NPK with PGRs spray at first node and flag leaf stage

1000grain weight. Nitrogen is one of the important inputs of wheat cultivation for obtaining good yield. Recommended dose of nitrogen is a subject matter of agronomic research for harvesting a higher yield of wheat crop at different agro-climatic conditions of western Uttar Pradesh.

The data assembled in Table 1 very well indicate that length of spike, stand count m², number of ear head m^{-2} and number of grains $spike^{-1}$ were appreciably increased with the application of 125% recommended dose of N with PGRs spray at first node and boot leaf stage (T_8) which was statistically at par with T_6 (150% recommended dose of N), T_7 (100% recommended dose of NPK), T_9 (150% recommended dose of N with PGRôs spray at first node and boot leaf stage) and T_{10} (150% recommended dose of NPK with PGRs spray at first node and boot leaf stage). The better results in plant population and dry matter per 25 cm row length might be held responsible for higher biological yield ha^{-1}. Thus significantly higher biological yield (133.15 qha^{-1}) was obtained with the application of 125% recommended dose of N with PGRs spray at first node and boot leaf stage. These results are in close conformity with those of Rewal *et al.* 2016 and Imdad *et al.* 2018.

The data assembled in Table 2 shows that the grain yield ha^{-1} due to 125% RDN, 150% RDN and 150% recommended dose of NPK along with plant growth regulator spray at first node and boot leaf stage, was 53.48, 51.28 and 52.47 Q ha^{-1}, respectively. Similarly, higher doses of nitrogen had significant effect on length of spike and number of grains $spike^{-1}$ and 1000ï grain weight. These yield attributes might have resulted in significantly higher grain yield $plant^{-1}$ which, in turn, may be responsible for higher grain yield ha^{-1}. Similar results were also found by Tulsaram *et al.* 2005, Madan and Munjal, 2009. The maximum straw yield was also found with treatment with the application of 125% recommended dose of N with PGRs spray at First 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. Better plant growth in terms of number of shoots, plant height and dry matter accumulation in plants of 25 cm now length might be held responsible for higher straw yield ha^{-1}. However, different levels of nitrogen and PGRs did not exert significant effect on harvest index. Similar findings was also reported by Sen *et al.* 2003 and Baranyiova and Klem 2016 and Rewal *et al.* 2016.

Based on the cost analysis, the maximum net profit of Rs. 102288.35 ha^{-1} and B: C ratio (3.36) were obtained with application of 125% recommended dose of N with PGRs spray at first node and boot leaf stage (T_8). Additional benefit with each rupee invested in the case of T_8 was due to low cost of cultivation.

Table 2: Biological, grain and straw yield, Harvest index, net return and B: C ratio of wheat as influenced by various treatments

Treatments	Biological yield (qha^{-1})	Grain yield (qha^{-1})	Straw yield (qha^{-1})	Harvest index (%)	Net Return (Rs. ha^{-1})	B: C ratio
T_1	53.31	21.41	31.90	40.16	17764.25	1.45
T_2	98.06	39.54	58.52	40.32	64991.26	2.61
T_3	102.82	43.30	59.53	42.07	70028.75	2.72
T_4	106.54	43.31	63.23	40.65	73630.13	2.78
T_5	110.92	45.28	65.65	40.82	78074.10	2.87
T_6	117.53	48.17	69.36	40.98	85087.47	3.01
T_7	119.95	49.35	70.60	41.14	84908.34	2.87
T_8	133.15	53.48	79.67	40.21	102288.35	3.36
T_9	123.58	51.28	72.30	41.50	91029.22	3.08
T_{10}	126.97	52.47	74.50	41.32	91382.34	2.95
SEm±	2.284	1.136	1.663	0.663	-	-
CD at 5%	6.785	3.374	4.941	NS	-	-

NS = Not Significant, RDN = Recommended dose of Nitrogen

References

Agricultural statistics at a glance (2019). *Govt. of India, Ministry of Agriculture & Farmer's welfare, Directorate of Economics and statistics.*

Ali, Nasir; Durrani, Saba; Shabaz, M.A.; Abdul Hafeez and Abdul Waheed (2018). Effect of Different Nitrogen Levels on Growth, Yield and Yield Contributing Attributes of Wheat, *International Journal of Scientific & Engineering Research*, **9**(9):595:602.

Amanullah, R.A.; Khattak, N. and Khalil, S.K. (2008). Effects & plant density and N on phenology and yield of cereal. *Plant Nutrition journal.* 32:246-260.

Baranyiova and Klem, K. (2016). Effect of application of growth regulators on the physiological and yield parameters of winter wheat under water deficit, *Plant soil Environ.,* **62**(3):114-120.

Basra, A.S. (2010). Plant Growth Regulators in Agriculture and Horticulture. Ed. Binghamton, U.S.A: *The Haworh Press*.

Herbert, C.D. (2012). Chemical Manipulation of Crop Growth and Development (J.S.MC LarenEdt,). *Butterworth scientific, London*.

pp. 315-32.

Imdadullah, Nasir Ali; Saba Durrani and Muhammad Adeel (2018). Effect of Different Nitrogen levels on Growth, yield and yield. Contributing Attributes of wheat. *International Journal of scientific & Engineering Research*, **9**(9): 596-602.

Rademacher, W. (2015). Plant Growth Regulators: Backgrounds and Uses in Plant Production. *Journal of plant growth regulation*, **34**(4):

845-872.

Panse, V.G. and Sukhatme, P.V. (1967). *Statistical methods for Agricultural workers. ICAR, New Delhi.*

Rawal, N.; Chalise, D and Khatri, N. (2016). Response of the most promising wheat genotypes with different nitrogen levels, *International journal of Applied Science and Biotechnology*, **4**(4): 470-474.

Sen, A.; Pandey, M.D.; Sharma, S. N.; Singh, R.K.; Kumar, A.; Prakash, S. and Srivastava, V. K. (2003). Surface seeding of wheat (*Triticum aestivum* L.) as affected by seed rate and nitrogen level. *Indian. J. Agril. Sci.,* **73**(9): 509-511.

Shekoofa, A. and Emam, V. (2018). Effects of Nitrogen Fertilization and Plant Growth Regulators (PGRs) on yield of wheat (*Triticum aestivum* L.) cv. Shiraz. *J. Agric. Sci. Technol.,* 10: 101-108.

Singh, B.N.; Vishwakarma, S.R. and Singh, V.K. (2010). Character association and Path analysis in elite lines of wheat (*Triticum aestivum* L.). *Plant Archives*. 10: 845 ï 847.

Singh, S.; Singh, T.B.; Singh, A.K. and Singh, R.K. (2019). Effect of nitrogen levels and plant growth regulators on growth, lodging, yield and economics of wheat (*Triticum aestivum* L.). *Journal of Pharmacognosy and phytochemistry*, **8**(4): 665-671.