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Research Article

RESPONSE OF WHEAT TO DIFFERENT NITROGEN APPLICATION SCHEDULES USING VARIOUS SOURCES

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Abstract: The field experiment was conducted during *rabi* 2017-18 to study the response of wheat (*Triticum aestivum* L.) to different nitrogen application schedules using various sources. The experiment consisted of 11 nitrogen scheduling treatments *viz*., absolute control, full basal, 2 and 3 splits at different stages undertaken with different doses of nitrogen using randomised complete block design with three replications. Results of the study revealed that the growth attributes like plant height, tiller density and dry matter accumulation in wheat were significantly superior with respect to application of 100% RDN (basal + 1st irrigation) –neem coated urea. Likewise, various yield attributes like effective tiller, ear length, number of grains and test weight of wheat were also found statistically superior with application of 100% RDN (basal + 1st irrigation) – neem coated urea as compared to other treatments. Similarly, grain and straw yield were significantly higher by 184.7 and 164.5%, respectively with the application of 100% RDN (basal + 1st irrigation) – neem coated urea over the control. Interestingly, significantly higher harvest index (44.87 %) was recorded with the application of 50 % RDN through FYM @ 13 q ha^{-1}, vermicompost @ 9.5 q ha^{-1} and mustard cake @ 4.8 q ha^{-1} and 50 % RDN through neem coated urea @ 130.2 kg ha^{-1}. A perusal of the data revealed that the growth parameters, yield attributes and yields of wheat were found significantly superior with application of 100% RDN (basal + 1st irrigation) – neem coated urea as compared to other nitrogen sources.

Keywords: *Neem coated urea, Irrigation, Nitrogen, Wheat*

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Introduction

Nitrogen being the constituent of all amino acids and protein fractions has a great influence on wheat growth and yield attributing characters. Proteins are the most important constituent of wheat when related to its major uses in bread making. The application of a chemical fertilizer or organic manure alone cannot achieve and sustain the required level of crop production under intensive cropping system. The usage of organic manures and chemical fertilizers in conjunction is very essential as this not only sustains higher level of productivity but also improves soil health and increases the nutrient use efficiency. Nitrogen is the most vital nutrient for crops and among various nitrogenous fertilizers, the most widely used one is urea because of its high nitrogen content (46 %) and comparatively low cost of production. However, due to surface runoff, leaching and volatilization losses, the utilization efficiency or plant uptake of urea is generally below 50 percent [1-3]. About 40-70 percent of nitrogen applied through normal fertilizers escapes to the environment and cannot be absorbed by crops, which causes not only large economic and resource losses but also very serious environmental pollution [4,5]. The problem, wheat cultivation confronts is that, for sustaining the productivity levels, it is imperative to apply more and more nutrients, specifically the nitrogen, that has increased the cost of production and led to environmental problems such as nitrate pollution of groundwater. Hence, there is an urgent need for improving the nutrient use efficiency of wheat crop especially for nitrogen. Nitrogen application in split doses has become a well-established practice as urea is famous as highly leaching fertilizer. Hence, two third or half of the quantity should be applied at the time of sowing and remaining one third or half quantity should be top dressed at first irrigation in medium or heavy soil types. Nitrogen scheduling along with balanced fertilization using organic manures like farmyard manure, vermicompost is considered as a promising agricultural practice to sustain yield with increased fertilizer use efficiency and soil fertility.

Materials and Methods

The field experiment was conducted during *rabi* season of the year 2017–18 at Campus for Research and Advanced Studies, Dhablan, Post Graduate Department of Agriculture, General Shivdev Singh Diwan Gurbachan Singh, Khalsa College, Patiala, Punjab, India. The experiment was laid out in Randomized Block Design (RBD) with treatments *viz*., T1- control; T2 - 100% (RDN) Recommended Dose of Nitrogen (Basal)– urea; T3 - 100 % RDN (Basal + 1st irrigation)– urea; T4- 100% RDN (Basal + 1st irrigation + 2nd irrigation)–urea; T5- 150% RDN (Basal)–urea; T6 - 150% RDN (Basal + 1st irrigation)–urea; T7 - 150% RDN (Basal + 1st irrigation + 2nd irrigation)–urea; T8 - 100% RDN (Basal)-Neem coated urea; T9 - 100% RDN (Basal + 1st irrigation)–Neem coated urea; T10 - 100% RDN (Basal + 1st irrigation + 2nd irrigation)–Neem coated urea; T11 - 50% RDN through FYM @ 13 q ha^{-1}, vermicompost @ 9.5 q ha^{-1} and mustard cake @ 4.8 q ha^{-1} and 50% RDN through neem coated urea @ 130.2 kg ha^{-1}. The recommended package of practices was followed for other cultural operations.

Results and Discussions

Growth attributes

Among different growth attributes, the emergence count (m^{-2}) was significantly higher with the application of 100% RDN (basal + 1st irrigation)-neem coated urea. This might be due to the availability of nutrients to emerging wheat plants which was higher with fertilizer application when applied in two splits than organic sources as these release nutrients slowly after mineralization and on the flip side, chemical fertilizers rapidly make available the nutrients required to achieve higher germination rate [3]. Plant height of wheat crop has been presented in [Table-1], which showed that significantly higher plant height (99.5 cm) was witnessed with application of 100% RDN (Basal + 1st irrigation)-Neem coated urea at harvest owing to nutrient availability was higher with the application of chemical fertilizer-

Table-1 *Effect of integrated nitrogen management on various growth attributes of wheat*

Treatment	Plant height at harvest (cm)	Tiller density at harvest (m^{-2})	Dry matter accumulation at 90 DAS (kg ha^{-1})
Control	74.2	108.6	10298.3
100% Recommended Dose of Nitrogen (Basal) – urea	97.8	169.0	9748.4
100 % RDN (Basal + 1st irrigation) – urea	95.2	168.7	15838.0
100% RDN (Basal + 1st irrigation + 2nd irrigation) – urea	91.8	172.4	14006.4
150% RDN (Basal) – urea	92.1	169.6	11697.3
150% RDN (Basal + 1st irrigation) – urea	89.6	170.2	7371.3
150% RDN (Basal + 1st irrigation + 2nd irrigation) – urea	92.0	190.5	10938.3
100% RDN (Basal) – Neem coated urea	94.8	172.4	6401.7
100% RDN (Basal + 1st irrigation) – Neem coated urea	99.5	233.9	20820.5
100% RDN (Basal + 1st irrigation + 2nd irrigation) – Neem coated urea	95.2	172.5	11898.5
50 % RDN through FYM @ 13 q ha^{-1}, vermicompost @ 9.5 q ha^{-1} and mustard cake @ 4.8 q ha^{-1} and 50 % RDN through neem coated urea @ 130.2 kg ha^{-1}	91.6	209.0	16328.5
SE(m) ±	1.0	6.6	1088.6
CD (5%)	3.2	19.7	3212.0

Table-2 *Effect of integrated nitrogen management on effective tillers, ear length, number of grains and test weight of wheat*

Treatment	Effective tillers (m^{-2})	Ear length (cm)	Number of grains ear^{-1}	Test weight (g)
Control	107.0	5.9	38.0	44.7
100% Recommended Dose of Nitrogen (Basal) – urea	167.5	8.5	51.7	44.7
100 % RDN (Basal + 1st irrigation) – urea	166.1	7.9	47.3	45.3
100% RDN (Basal + 1st irrigation + 2nd irrigation) – urea	168.0	8.8	47.9	45.3
150% RDN (Basal) – urea	165.3	8.7	49.6	44.7
150% RDN (Basal + 1st irrigation) – urea	166.0	9.9	49.5	44.7
150% RDN (Basal + 1st irrigation + 2nd irrigation) – urea	185.1	11.3	53.6	48.0
100% RDN (Basal) – Neem coated urea	171.3	8.0	46.5	46.0
100% RDN (Basal + 1st irrigation) – Neem coated urea	231.5	8.5	48.1	45.0
100% RDN (Basal + 1st irrigation + 2nd irrigation) – Neem coated urea	168.4	10.4	50.5	46.7
50 % RDN through FYM @ 13 q ha^{-1}, vermicompost @ 9.5 q ha^{-1} and mustard cake @ 4.8 q ha^{-1} and 50 % RDN through neem coated urea @ 130.2 kg ha^{-1}	205.4	11.0	45.4	44.3
SE(m) ±	7.5	0.6	2.0	1.2
CD (5%)	22.4	1.9	6.1	3.6

Table-3 *Effect of integrated nitrogen management on grain yield, straw yield and harvest index of wheat*

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
Control	1703	2583	39.47
100% Recommended Dose of Nitrogen (Basal) – urea	3717	6007	38.17
100 % RDN (Basal + 1st irrigation) – urea	3697	6860	35.53
100% RDN (Basal + 1st irrigation + 2nd irrigation) – urea	3900	5787	41.00
150% RDN (Basal) – urea	3670	5480	40.07
150% RDN (Basal + 1st irrigation) – urea	3830	6033	36.70
150% RDN (Basal + 1st irrigation + 2nd irrigation) – urea	4440	6710	39.70
100% RDN (Basal) – Neem coated urea	3723	5367	40.30
100% RDN (Basal + 1st irrigation) – Neem coated urea	4850	6833	41.47
100% RDN (Basal + 1st irrigation + 2nd irrigation) – Neem coated urea	3853	6730	36.70
50 % RDN through FYM @ 13 q ha^{-1}, vermicompost @ 9.5 q ha^{-1} and mustard cake @ 4.8 q ha^{-1} and 50 % RDN through neem coated urea @ 130.2 kg ha^{-1}	4110	5197	44.87
SE(m) ±	2.32	3.29	1.67
CD (5%)	6.84	9.78	4.93

which acts as fast releasing, that increases photosynthetic activity in plant thereby rapid cell division and elongation which further leads to better growth of plants [6,7]. Studies revealed that the application of 120 kg N ha^{-1} significantly increased the plant height by showing the positive changes in soil available N content. A perusal of data in [Table-1], Indicated that statistically higher tiller density (188.4) was observed with the application of 100% RDN (Basal + 1st irrigation)-neem coated urea due to the timely and balanced availability of nitrogen to wheat crop plants by supplying chemical fertilizer in two split doses. The application of 120 kg N ha^{-1} obtained higher tiller count in wheat [8]. Significantly higher dry matter accumulation was observed with the application of 150% RDN (Basal)-urea at 30 DAS due to the increased nutrient availability to crop plants for uptake by supplying higher dose of nitrogenous chemical fertilizer.

Yield attributes and yield

Data pertaining to the yield attributes of wheat *viz*., effective tiller, ear length, number of grains ear^{-1} and test weight have been presented in [Table-2]. The data revealed that significantly higher number of effective tillers (231.5) was observed with the application of 100% RDN (Basal + 1st irrigation)-neem coated urea as compared to other treatments. This enhanced yield attribute might be due to adequate supply of assimilates at the reproductive stage which led to increased number of effective tillers. Relatively higher number of effective tillers produced with the application of N in two splits was also witnessed by [11]. The ear length was significantly higher under 150% RDN (Basal + 1st irrigation + 2nd irrigation)-urea as compared to others, but the difference between 50 % RDN through FYM @ 13 q ha^{-1}, vermicompost @ 9.5 q ha^{-1} and mustard cake @ 4.8 q ha^{-1} and 50 % RDN through neem coated urea @ 130.2 kg ha^{-1} remain statistically at par with each other. This enhanced nitrogen availability after irrigation to wheat crop led positive effect on photo- and protein-synthesis which increased the translocation of assimilates in the ears. Enhanced wheat growth after attaining crown root initiation stage followed by fertilizer application was also reported by other researchers [9,10]. A close observation of data revealed that maximum number of grains was recorded with the application of 150% RDN

(Basal + 1st irrigation + 2nd irrigation)- urea as compared to other sources. This might be due to the reason that fertilizer when applied in 3 equal splits increased continuous nitrogen availability which channelizes more assimilates to reproductive organs that led to a greater number of grains ear^{-1}[9]. A perusal of data revealed that the significantly higher test weight (48.0 g) was recorded by applying 150% RDN (Basal + 1st irrigation + 2nd irrigation)-urea. In another study conducted at Rajasthan revealed that test weight increased significantly when N was applied in splits rather than single dose application either as basal or at tillering stage [11].

A perusal of data given in [Table-3] revealed that significantly higher grain yield (4850 kg ha^{-1}) was recorded with the application of 100% RDN (Basal + 1st irrigation)-Neem coated urea owing to the reason that 100% neem coated urea when supplied in two equal splits enhanced the continuous supply of nutrients to the growing plants which increased the growth and yield contributing attributes of wheat *viz*., tiller density and effective tiller density to the maximum possible bearing a positive effect on grain yield. The findings are inconformity with another study which revealed that the application of 100% recommended dose of fertilizers in conjunction with higher moisture levels increased higher grain yields in wheat [10]. It is clear from data presented in [Table-3] that two treatments *viz*., 100 % RDN (Basal + 1st irrigation)-urea and 100% RDN (Basal + 1st irrigation)-Neem coated urea produced maximum straw yield as compared to other treatments due to the beneficial effect of nitrogen application in two equal splits on plant height, dry matter accumulation and other physiological growth parameters of wheat due to balanced nutrition which finally improved grain and straw yield. These results are in conformity with earlier findings when nitrogen is applied @ 120 kg ha^{-1} increased the wheat straw yield by 115.0 as compared with the control plots [8]. The data presented in [Table-3] showed that the highest percentage of harvest index (44.87 %) was recorded with the application of 50 % RDN through FYM @ 13 q ha^{-1}, vermicompost @ 9.5 q ha^{-1} and mustard cake @ 4.8 q ha^{-1} and 50 % RDN through neem coated urea @ 130.2 kg ha^{-1}. The higher percentage of harvest index was observed mainly due to conjunctive use of FYM and chemical fertilizers [1,2].

Conclusion

A perusal of the data revealed that the growth parameters, yield attributes and yields of wheat were found significantly superior with application of 100% RDN (Basal + 1st irrigation)-neem coated urea as compared to other nitrogen sources.

Application of research: Application of neem coated urea was found promising and can be utilized in integrated and organic management fields by lowering the nutrient losses.

Research Category: Agronomy

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Study area / Sample Collection: Campus for Research and Advanced Studies, Dhablan, Patiala, Punjab, India.
Cultivar / Variety / Breed name: Wheat (*Triticum aestivum* L.)- PBW 725

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References

[1] Gopakkali P., Channanaik D., Rajanna G.A., Sannathimmappa, Ramesha Y.M. and Veeresha (2012) *Crop Res*., 43(1, 2&3), 10-14.
[2] Rajanna G.A, Murali K., Gopakkali P., Nayak P., Sudakara T.M. and Lakshmipathy R.N. (2012) *Crop Res*., 43(1,2&3),5-9.
[3] Rana D.S., Dass A., Rajanna G.A. and Choudhary A.K. (2018) *Agronomy J.,* 110(6), 2608-2618.
[4] Guo M., Liu M., Zhan F. and Wu L. (2005) *Ind. and Eng. Chem. Res*., 44(12), 4206-4211.
[5] Rana D.S., Dass A., Rajanna G.A. and Kaur R. (2016) *Indian J. of Agro*., 61 (4), 238-248.
[6] Rajanna G.A., Dhindwal A.S. and Nanwal R.K. (2017) *Cereal Res. Comm*., 45(1), 166-177.
[7] Rajanna G.A., Murali K., Nayak P., Lakshmipathy R.N., Gopakkali P. and Paramesh V. (2011) *International J. of Agri. Sci*., 7(1), 193-196.
[8] Kumar R., Aggarwal S.K. and Nanwal R.K. (2007) *Indian J. of Agri. Sci*., 77(10), 669-671.
[9] Naresh R.K., Singh S.P., Kumar P., Singh B., Singh P.K., Chauhan P. and Rathore R.S. (2014) *Indian J. of Agri. Sci*., 84(6), 695-701.
[10] Rajanna G.A. and Dhindwal A.S. (2019) *Indian J. of Agri. Sci*., 89(6), 912-9.
[11] Meena B.S. (2010) *Indian J. of Agri. Sci*., 80(6), 538-540.
[12] Singh V., Singh S.P. Singh S. and Shivay Y.S. (2013) *Indian J. of Agri. Sci*., 83(3), 331-334.