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Impact of neem coated urea on phenological development and yield of wheat

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Abstract

In order to study the effects of different nitrogen levels and sources on wheat phenology and productivity, an experiment was conducted during *rabi* season of 2017-18 at Agronomy Research Area of CCS Haryana Agricultural University, Hisar. The experiment was laid out in a split plot design with four nitrogen sources [Ordinary Urea ($\frac{1}{2}$ Basal and $\frac{1}{2}$ at first irrigation), Ordinary Urea ($\frac{1}{2}$ Basal + $\frac{1}{4}$ first irrigation + $\frac{1}{4}$ heading), Neem Coated Urea ($\frac{1}{2}$ Basal + $\frac{1}{2}$ first irrigation) and Neem Coated Urea ($\frac{1}{2}$ Basal + $\frac{1}{4}$ first irrigation + $\frac{1}{4}$ heading)] in main plots and four nitrogen levels (80%, 90%, 100% and 110% RDN) in sub plots replicated thrice. The experimental site is situated in the sub tropical region at 29° 10' N latitude and 75° 46' E longitude with an elevation of 215.2 meter above mean sea level in Haryana State of India. Overall results depicted that application of neem coated urea produced significantly higher yield attributing characters (except test weight) and grain yield of wheat as compared to ordinary urea. However the difference in two and three split application of neem coated urea is not significant. Application of 110 % RDN in wheat resulted in significantly higher growth, yield attributers and yield of wheat than rest two N levels. Days taken to all the phenological stages (except emergence) of wheat were significantly higher with the application of neem coated urea (2-split and 3 split). Days taken to booting, anthesis, milk and dough stage of wheat were significantly less with the application of 80% RDN as compared to 90, 100 and 110 % RDN.

Keywords: Wheat, neem, coated urea, fertilizer, yield, nitrogen

Introduction

About one third of the developing world's wheat (*Triticum aestivum* L.) area is located in environments that are regarded as marginal for wheat production because of drought, heat and edaphic factors. Despite these limitations, the world's dry and difficult cropping environments are increasingly crucial to food security in the developing world. Nitrogen is needed in huge quantity for wheat cultivation and provision of adequate supply of N throughout the growing season is necessary for realizing its potential yields. Fertilizer nitrogen (N) has contributed an estimated 40% to the increase in per capita food production over the past 50 years (Brown, 1999; Smile, 2002) [3, 7]. Nitrogen is often the most deficient of all the plant nutrients in Indian soil. Generally, the agricultural soils are grossly deficient in nitrogen and the wheat crop responds to applied nitrogen. The response of crop to applied nitrogenous fertilizer depends on soil type, soil fertility, soil and crop management practices, crop variety, and also on the method and source of N application. Wheat is very responsive to nitrogen fertilization and very sensitive to insufficient nitrogen dose. Majority of urea is applied at the time of crop sowing when N utilized by the crop is very less so most of the applied urea is wasted whereas at vegetative growth stage when the demand of nutrient is more the crop suffered mostly by nutrient stress. Coating urea with neem (natural oil from *Azadirachta indica*) to produce Neem Coated Urea (NCU) will delay nitrification process or have other slow-release properties that will allow urea to better feed plant demand, thereby increasing N-use efficiency and reducing emission of nitrous oxide. NCU often improves grain yield of wheat (compared with uncoated urea), but does not consistently reduce N₂O emissions or improve N-use efficiency. During the application of slow release fertilizer the loss of nitrogen is reduced (Joshi et al., 2014) [5]. In India, this is the traditional method to mix the urea with neem cake to increase the nitrogen use efficiency (Agostini, 2010) [1]. Split application of neem coated urea may improve the productivity and N use efficiency of crop due to minimizing the release rate. Keeping the above aspects in view, the present investigations "Impact of neem coated urea on phenological

development and yield of wheat" was planned to determine appropriate dose and source of nitrogen for increasing nitrogen use efficiency and grain yield of wheat.

Materials and Methods

The field experiments were conducted at Agronomy Research Area of CCS Haryana Agricultural University, Hisar which has a semi-arid and sub-tropical climate with hot, dry and desiccating winds during summer and severe cold during winter season. The mean monthly maximum temperature during summer months of May to June is around 42 °C to 45 °C while the minimum temperature during winter months of December and January sometimes goes as low as 0 °C or less than this. The average annual rainfall is about 400 mm which is mainly received during monsoon months of July to September with a few showers of cyclonic rains received during winter months of December and January or early spring. The experiment was laid out in a split plot design with four nitrogen sources [Ordinary Urea ($\frac{1}{2}$ Basal and $\frac{1}{2}$ at first irrigation), Ordinary Urea ($\frac{1}{2}$ Basal + $\frac{1}{4}$ first irrigation + $\frac{1}{4}$ heading), Neem Coated Urea ($\frac{1}{2}$ Basal + $\frac{1}{2}$ first irrigation) and Neem Coated Urea ($\frac{1}{2}$ Basal + $\frac{1}{4}$ first irrigation + $\frac{1}{4}$ heading)] in main plots and four nitrogen levels (80%, 90 %, 100 % RDN and 110 % RDN) in sub plots replicated thrice. Land was prepared by ploughing twice and planking once, followed by pre-sowing irrigation. A basal dose consisting of 60 kg P_2O_5 /ha was applied to all the plots at sowing as single superphosphate through seed-cum-fertilizer drill. Wheat seed was sown during first fortnight of December and harvested in between 15 and 20 April. Wheat variety WH 1105 was sown with row-to-row spacing of 20 cm. The other agronomic practices like irrigation, weed control measures and insect-pests control were done as per recommended package of practices of CCSHAU, Hisar. Harvesting and threshing of wheat was done manually to minimize yield losses. For recording test weight of wheat, grain samples were taken from the produce of each treatment and 1000 grains were counted and were dried in oven at 60°C for 48 hours. After drying, they were weighed and mean weight of 1000 grains was noted as test weight. Total tillers per metre row length at five randomly fixed sites from each plot counted starting 30 days after sowing at 30 days interval up to maturity using one square meter quadrat and then number tillers m^{-2} counted and worked out. The sun dried produce of each treatment was tied in bundles and weighed to determine the dry matter produce (grains + straw). The grain obtained after threshing and winnowing from each treatment was weighed and noted. The straw weight was obtained by subtracting the grain weight from the total weight of the bundle.

Result and Discussion

Yields attributes and yield of wheat

The data pertaining to yield attributes and yield of wheat as influenced by sources and levels of nitrogen application is presented in Table 1. A perusal of data revealed that yield attribute and yield of wheat showed significant relation with the different nitrogen source and levels. Three split application of neem coated urea recorded significantly higher no of tillers/ m^2 and no of grains per spike of wheat (Table1). The improvement in the formation of tillers with neem coated urea application in the present experiment might be due to increase in nitrogen availability which enhanced tillering of wheat. Higher number of grains per spike of wheat due to application of neem coated urea might be due to better growth parameters with the increasing and steady supply of nitrogen

which results in higher number of tillers and number of grains per spike of wheat. Singh et al., (2006) ^[6] at Ludhiana also studied that the modifications in fertilizer source and/or management can lead to reduced losses of N, high wheat yields and increased fertilizer N-use efficiency. Performance of neem coated urea @ 96 kg N ha^{-1} drilled during sowing of wheat was better than neem-coated urea applied @ 120 kg N ha^{-1} in 2 split doses. Neem coating of urea did not significantly influence test weight of wheat. Among different nitrogen sources application of three split of neem coated urea ($\frac{1}{2}$ Basal + $\frac{1}{4}$ first irrigation + $\frac{1}{4}$ heading) resulted in significantly higher grain yield of wheat as compared to other treatments. This might be due higher yield attributing characters like no of tillers/ m^2 and no of grains per spike of wheat. Datt et al. (2007) ^[4] while studying nitrogen mineralization and relative efficiency of neem and neem coated urea for wheat and rice reported that 100% neem coated urea produce more grain and straw yield both in rice and wheat crop. Varying nitrogen sources did not significantly influenced straw yield of wheat.

Among all the four nitrogen levels, application of 110 % RDN, being at par with 100 % RDN resulted in higher number of tillers/ m^2 and grains per spike of wheat. This might be due to the better vegetative growth and development resulting in higher number of tillers per plant and number of grains per spike of wheat by more nutrients application. Similarly application of 110 % RDN produced significantly higher test weight of wheat than rest three treatments (80, 90 and 100 % RDN). Increase in nitrogen level significantly increased the grain and straw yield of wheat, being lowest with the application of 80% RDN (4592 and 6859 kg/ha grain and straw yield) and highest with the application of 110% RDN (5438 and 7298 kg/ha grain and straw yield). It might be due better yield attributing characters of wheat which were also significantly higher with higher levels of nitrogen application. Varying nitrogen levels fail to influence test weight of wheat. Neem coating has shown its superiority in enhancing the N use efficiency, grain yield, N concentration in grain of wheat crop in all tested soils (Suganya et al., 2007) ^[8].

Phenological studies of wheat

The data pertaining to days taken for seven phenological stages i.e. days taken to emergence, crown root initiation, booting, anthesis, milk, dough and physiological maturity under different treatments is presented in Table 2. Perusal of data reveals that various sources and levels of nitrogen have significant effect on duration for phenological stages of wheat. However, days taken to emergence were not significantly affected by various sources and levels of nitrogen application. Similarly varying nitrogen levels fail to influence days taken to crown root Initiation. Days taken to all the phenological stages of wheat were significantly higher with the application of neem coated urea (2-split and 3 split). Application of ordinary urea in wheat results in rapid phenophasic development as compared to neem coated urea. Increasing levels of nitrogen application results in more number of days taken to various phenological stages of wheat. Days taken to booting, anthesis, milk and dough stage of wheat were significantly less with the application of 80% RDN as compared to 90,100 and 110 % RDN. Days taken for physiological maturity also increased with increasing nitrogen levels. The treatments having 110 % RDN had taken numerically more number of days for the different phenological stages of wheat as compared to 80% RDN.

Further, days taken to physiological maturity were reduced by ten days under treatment 80 % RDN as compared to 110 % RDN. Similar results of delayed senescence of wheat which

lead to lengthen the duration of reproductive phase with increasing in fertilizer dose of N were reported by Amanullah *et al.*, 2013^[2].

Table 1: Effect of sources and levels of nitrogen application on yield and yield attributes of wheat

Treatments	No. of tillers/m ²	No of grains per spike	Test wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Nitrogen sources					
Ordinary Urea (2-split)	341.7	40.2	40.20	4752	7081
Ordinary Urea (3-split)	346.6	41.3	40.65	5078	7109
Neem Coated Urea (2-split)	348.8	42.6	40.46	5216	7112
Neem Coated Urea (3-split)	350.4	43.0	40.78	5259	7197
CD at 5%	3.75	1.20	NS	98	NS
Nitrogen levels					
80% RDN (120 kg N/ha)	339.6	39.6	39.93	4592	6859
90 % RDN (135 kg N/ha)	343.5	41.6	40.42	4893	7108
100 % RDN (150 kg N/ha)	351.1	42.7	40.81	5382	7234
110 % RDN (165 kg N/ha)	353.3	43.2	40.93	5438	7298
CD at 5%	4.71	1.11	NS	76	114

Table 2: Phenological stages of wheat as affected by sources and levels of nitrogen application

Treatments	Phenological stages (DAS)						
	Emergence	Crown root Initiation	Booting	Anthesis	Milk	Dough	Physiological maturity
Nitrogen sources							
Ordinary Urea (2-split)	8.33	23.33	96.3	108	116	127	134
Ordinary Urea (3-split)	8.33	23.33	97.6	113	121	130	137
Neem Coated Urea (2-split)	8.66	23.66	98.3	114	122	132	139
Neem Coated Urea (3-split)	8.66	24.00	99	117	125	134	140
CD at 5%	N.S.	0.29	0.87	5.90	7.12	2.49	3.60
Nitrogen levels							
80% RDN (120 kg N)	8.33	22.66	96.6	109	117	126	132
90 % RDN (135 kg N)	8.66	23.00	97.3	112	120	130	136
100 % RDN (150 kg N)	8.66	24.00	97.6	115	123	132	140
110 % RDN (165 kg N)	8.33	24.66	99.3	116	124	135	142
CD at 5%	N.S.	N.S.	0.66	5.90	6.98	2.33	3.76

Conclusions

Significantly higher yield attributes and grain yield of wheat were obtained with application of neem coated urea as compared with ordinary urea. Among the four nitrogen levels, application of 110 % RDN, being at par with 100 % RDN resulted in better yield attributes and higher grain and straw yield of wheat. Application of neem coated urea results in slow phenophasic development as compared to ordinary urea. Increasing levels of nitrogen application results in more number of days taken to various phenological stages of wheat except emergence and crown root initiation.

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