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Impact of Nitrogen Fertilizer, Their Levels, Application Time and Weeding Methods on Yield and Yield Components of Wheat

[1]Mujtaba Masood, [1]Muhammad Tariq Jan and [2]Imran Haider Shamsi
[1]Department of Agronomy, [2]Department of Weed Science,
NWFP Agricultural University, Peshawar, Pakistan

Abstract: Field experiment was conducted to study the impact of nitrogen fertilizer (80, 100 and 120 kg N ha^{-1} to wheat (*Triticum aestivum* L.) applied at sowing, early and boot stage and weed control methods (no weeding, hand weeding, chemical applied once and twice). A basal dose of 40 kg N ha^{-1} was given to all treatments at sowing. Grain weight showed no response to fertilizer, Spike population and number of grains per spike had a positive linear relationship with fertilizer levels. Weed control methods significantly influenced grain weight and number of grains $spike^{-1}$. Highest grain yield was achieved from single application of Isoproturon and fertilizer applied at the rate of 120 kg N ha^{-1} in three equal split doses.

Key words: N-fertilizer, time, levels, weeding methods, yield and yield components, wheat

Introduction

Among the several factors responsible for low yield, balanced fertilizer and weed management is the important factors for obtaining high yield. Nitrogen is considered a major element of fertilizer for a good yield. Nitrogen is closely linked to control the vegetative growth of plant and hence determine the fate of reproductive cycle. Besides N-fertilizer, its application times are also considered a key to high production. Synchronization of fertilizer N supply with plant-N demand reduces the potential for N loss to atmosphere. Similarly the N use efficiency increases with matching the N supply and demand. The split application of N-fertilizer has been found effective in increasing crop yield compared with the full application of N-fertilizer at sowing time (Ragheb *et al.*, 1993). Weeds are generally injurious, harmful, poisonous and constant source of trouble for successful growth and development of economic crops. There occur a loss of 30% of wheat yield due to weeds (Khan and Haq, 1995). Weeds compete with crops for light, moisture, space and plant nutrients and thus indirectly rob the plant food and interfere with the normal growth of the crops.

The purpose of the present study was to determine the optimum dose and application time of N-fertilizer, weeding methods and its interaction with fertilizer on yield and yield components of wheat.

Materials and Methods

The experiment was conducted on wheat variety Inqilab-91 at Agronomy and Malakandher Research Farm of NWFP Agricultural University, Peshawar, Pakistan during the year 1999-2000. Weeding treatments were consist of control (W_1), hand hoeing (W_1), chemical spray once (W_2) and spray twice (W_3). Seven nitrogen levels were used in the study (Table 1).

Table 1: Details of weeding methods and amount of nitrogen (kg ha^{-1}) and their application time

Weeding methods				
Control	(W_0)	No weeding.		
Hand hoeing	(W_1)	Hand hoe was done once.		
Spray once	(W_2)	Isoproturon (1.3 kg ha^{-1}) was applied once at 4-5 leaves stage.		
Spray twice stage and	(W_3)	Isoproturon applied at 4-5 leaves boot stage		
Amount of nitrogen (kg ha^{-1}) and their application time				
Treatments	Pre-sowing	Early stage	Boot stage	Total amount
F_1	40	---	---	40
F_2	40	40	---	80
F_3	40	60	---	100
F_4	40	80	---	120
F_5	40	20	20	80
F_6	40	30	30	100
F_7	40	40	40	120

Experiment was laid out in Randomized Complete Block (RCB) design with split plot arrangement. Nitrogen treatments were allotted to the main plots, while weeding treatments were randomized in sub-plots. Each sub-plot was consist of 5x2 m^2. Crop was sown on 25th Nov. with a row spacing of 25 cm. A basal dose (90 and 60 kg ha^{-1}) of PK was applied before sowing. All the standard agronomic practices were adopted during the course of experiment. The number of productive spikes were counted in one meter long row at three different points at each plot and average number of spikes m^{-2} was calculated. The number of grains per spike was calculated by counting the number of grains of five randomly selected spikes from each plot. Grain weight was recorded by weighing thousand grains from each treatment. Grain yield was recorded after threshing the harvested material and weighing the cleaned grains for each treatment. The data collected were analyzed statistically (Sher, 1996) by using F- test to detect the significance of treatment effect and LSD was used as a test of significance. ANOVA was further split to understand and compare the means in detail, for which contrast were done.

Results

All the fertilizer levels and weeding methods had no effect on number of spikes per unit area. Planned means comparison was able to detect only significant positive linear increase in spike m^{-2} by fertilizer levels and interaction among fertilizer trend and split application of N fertilizer (Table 2). On average basis 80, 100 and 120 kg N ha^{-1} produced 113, 114 and 115 spikes m^{-2}, respectively.

Number of grains $spike^{-1}$ (Table 3) was significantly affected by fertilizer levels and weed control methods. However the interaction among fertilizer levels and weeding methods were non-significant for number of grains $spike^{-1}$. The highest number of grains $spike^{-1}$ (46) were observed from those plots, where the highest dose of fertilizer 120 kg N ha^{-1} was applied in three equal split doses, while the lowest number of grains $spike^{-1}$ (39) were recorded from those plots where basal dose of 40 kg N ha^{-1} was applied. The basal dose produced significantly lower number of grains $spike^{-1}$ than the rest of the fertilizer levels. The number of grains $spike^{-1}$ increased with increase in fertilizer level 80 to 120 kg N ha^{-1} (Table 3). Fertilizer applied in two or three split doses at various growth stages had no significant effect on number of grain $spike^{-1}$. The control plots (no weedicide or hand hoeing) produced significantly lower number of (39) grains $spike^{-1}$ compared to other treatments. The plots that received chemicals produced significantly higher number of grains $spike^{-1}$ than hand hoeing, while the levels of Isoproturon (1.3kg ha^{-1}) produced the same number (44) of grains $spike^{-1}$.

Grain weight is an important trait that contributes to overall yield of wheat. There was no significant effect of fertilizer levels on

Table 2: Number of spikes m^{-2} of wheat as affected by nitrogen levels and different weed control methods

	Weeding				
Fertilizer	W_0	W_1	W_2	W_3	Mean
F_1	110	114	112	111	112
F_2	114	110	110	112	111
F_3	112	111	117	113	114
F_4	118	113	115	118	116
F_5	110	116	112	117	114
F_6	113	115	117	113	114
F_7	113	116	111	114	114
Mean	113	113	113	114	

Means of planned comparison with statistical significance

Kg N ha^{-1}	No. of spikes m^{-2}	Contrast
Treatment		
Basal	112	Basal vs. Rest ns
Rest	114	
80	113	N-Linear*
100	114	N-quadratic
120	115	
Two split	114	Two vs. three ns
Three split	114	
N-1 (2 vs. 3 split)*		
N-q x (2 vs. 3 split) ns		

ns = Non-significant
* = Significant at 0.05 level of probability

Table 3: Number of grains $spike^{-1}$ of wheat as affected by nitrogen levels and different weed control methods

	Weeding				
Fertilizer	W_0	W_1	W_2	W_3	Mean
F_1	36	38	41	42	39
F_2	37	40	42	44	41
F_3	39	40	43	44	42
F_4	40	42	46	47	44
F_5	38	41	44	45	42
F_6	39	41	44	47	43
F_7	41	45	47	49	46
Mean	39	41	44	44	
LSD (0.05) value for Fertilizer = 1.39					
LSD (0.05) value for Weeding = 0.62					

Planned means comparison with statistical significance

Kg N ha^{-1}	No. of grains $spike^{-1}$	Contrast
Treatment		
Basal	39	Basal vs. Rest**
Rest	43	
80	41	N-Linear**
100	42	N-quadratic ns
120	45	
Two split	42	Two vs. three ns
Three split	44	
N-1 (2 vs. 3split) ns		
N-q x (2 vs.3 split) ns		

ns = Non-significant
** = Significant at 0.01 level of probability

Table 4: Thousand grain weight (g) of wheat as affected by nitrogen levels and different weed control methods

	Weeding				
Fertilizer	W_0	W_1	W_2	W_3	Mean
F_1	32.27	35.60	38.33	40.80	36.75
F_2	34.13	35.93	39.77	57.17	41.75
F_3	36.23	37.67	40.87	42.53	39.33
F_4	38.17	39.57	43.33	44.40	41.37
F_5	34.67	37.13	40.40	40.53	38.18
F_6	37.37	39.13	42.93	44.00	40.86
F_7	38.97	40.50	44.30	45.23	42.25
Mean	35.97	37.93	41.42	42.51	--
LSD (0.05) value for Weeding = 3.29					

Planned means comparison with statistical significance

Kg N ha^{-1}	Thousand grain wt.	Contrast
Treatment		
Basal	37	Basal vs. Rest*
Rest	41	
80	40	N-Linear ns
100	40	N-quadratic ns
120	42	
Two split	41	Two vs. three ns
Three split	40	
N-1 (2 vs. 3split) ns		
N-q x (2 vs. 3 split) ns		

ns, Non-significant *, Significant at 0.05 level of probability

Table 5: Grain yield ha^{-1} (kg) of wheat as affected by nitrogen levels and different weed control methods

	Weeding				
Fertilizer	W_0	W_1	W_2	W_3	Mean
F_1	3010.33	3204.67	3409.33	3454.67	3269.75
F_2	3157.33	3322.00	3532.00	3475.67	3371.75
F_3	3227.00	3411.67	3664.33	3692.00	3498.75
F_4	3422.00	3540.00	3764.67	3842.00	3642.17
F_5	3178.67	3375.00	3663.33	3688.67	3476.42
F_6	3292.67	3449.33	3708.00	3740.67	3547.67
F_7	3435.33	3602.33	3819.00	3925.00	3695.42
Mean	3246.19	3415.00	3651.52	3594.33	
LSD (0.05) value for fertilizer = 31.66					
LSD (0.05) value for weeding = 18.97					
LSD (0.05) value for interaction = 50.19					

Planned means comparison with statistical significance

Kg N ha^{-1}	Grain yield ha^{-1} (kg)	Contrast
Treatment		
Basal	3269.75	Basal vs. Rest **
Rest	3538.69	
80	3424.08	N-Linear **
100	3523.21	N-quadratic *
120	3668.79	
Two split	3504.22	Two vs. Three **
Three split	3573.17	
N-1 x (2 vs. 3 split)*		
N-q x (2 vs. 3 split) ns		

ns = Non-significant
*, ** = Significant at 0.05 and 0.01 level of probability, respectively

thousand grain weight (Table 4), while weed control methods had significant effect on this trait. A planned means comparison among basal dose and average of rest of fertilizer treatments showed significant difference for grain weight at 5% level of probability only. The basal dose of 40 kg N ha^{-1} at sowing produced the lowest thousand grains of (36.75g). No significant linear or quadratic trend was observed for grain weight in response to fertilizer application. Generally thousand-grain weight was increased with increase in fertilizer level from 80 to 120 kg N ha^{-1} (Table 4). The split application of fertilizer at different growth stages did not effect grain weight. The lowest average grain weight (35.97g) were obtained from the control plots, followed by hand hoeing treatments, (39.93g). Chemical herbicide application gave significantly heavier grains than hand hoeing and control treatments. Although the differences for thousand-grain weight among chemical application levels were not significant, Isoproturon applied twice had the heaviest thousand-grain weight.

There was significant effect of fertilizer levels and weeding methods on the grain yield ha^{-1} (Table 5). Interaction among fertilizer levels and weed control methods was also significant for grain yield ha^{-1}. The highest grain yield (3695 kg ha^{-1}) was in plots, with the highest dose of 120 kg N^{-1} ha applied in three equal split doses. The lowest grain yield ha^{-1} (3668.75 kg ha^{-1}) was recorded from plots with basal dose of 40 kg N ha^{-1}. Splitting ANOVA gave some more useful information and means comparison. Compared with the rest of fertilizer levels, basal dose of 40 kg N ha^{-1} had significantly lower grain yield (3270 kg ha^{-1}). On the average, the rest of fertilizer levels produced (3539 kg ha^{-1}) of grain yield ha^{-1} (Table 5). Fertilizer levels had significant linear and quadratic effect on grain yield ha^{-1}. The grain yield increased with increase in fertilizer levels from 80 to 120 kg N ha^{-1}. Fertilizer applied in two or three split doses at various growth stages had significant effect on grain yield $ha^{-1.}$ On average basis, three split doses of fertilizer produced significantly greater (3573 kg ha^{-1}) grain yield ha^{-1} compared to two split doses (3504 kg ha^{-1}). Weeding methods had also significant effect on grain yield. Control treatments (where no chemicals or manual weeding was done) had the lowest grain yield (3246 kg ha^{-1}). The highest grain yield (3652 kg ha^{-1}) was recorded from those plots, where Isoproturon was applied once, followed by the twice application of Isoproturon (3594 kg ha^{-1}). Hand hoeing produced significantly higher grain yield (3415 kg ha^{-1}) than control plots (3246 kg ha^{-1}), but this yield was lower than chemical control (3652 and 3594 kg ha^{-1} in once and twice application of Isoproturon, respectively).

Discussion

Number of spikes per unit area is a major key yield component of wheat. Fertilizer levels, weeds control methods and interaction among them did not significantly effect this trait. In the planned means comparison only significant positives linear increase in spike m^{-2} with fertilizer were observed (Table 2). The superior spike population from split application can be attributed to the balance nitrogen availability to crop according to the demand. Fertilizers and weeds control methods had a significant influence on grains $spike^{-1}$. The number of grains $spike^{-1}$ significantly increased with increase in fertilizer levels and are directly proportional to the number of spikelets $spike^{-1}$. It seems that higher dose of nitrogen decreases the mortality of grains formation and increases grain fertility. The results are in agreement with Galeto *et al.* (1995) and Ayub *et al.* (1994). The lowest grains $spike^{-1}$ were observed in no weeding the highest were observed in chemically control plots. The logical reason for such finding is that weed free plots had less competition for nutrients and other basic requirements resulting in more grains production. The results are in agreement with Rajput *et al.* (1993).

Thousand grain weight is one of the most important yield components that contributes to the overall grain yield of wheat. Fertilizer had no affect while weeds control methods had a significant effect on grain weight. A planned means comparison among basal dose and the average of the rest of the fertilizer levels showed significant difference for grain weight at 5% level of probability only. The results suggest that probably a basal dose is not enough to heavier grains compared to the N level 80 −120 kg ha^{-1}. Similar results are obtained by Banziger *et al.* (1992). The lowest grain weight was obtained from plots where no weeding was done, while the heaviest grains were observed in plots where Isoproturon was applied twice. It seems that chemicals effectively controlled the weed leaving abundant of nitrogen to be utilized by the wheat crop. The results are in agreement with Rajput *et al.* (1993).

Fertilizer and weeding methods had significant effect on grain yield of wheat and the interaction among both treatments. The highest grain yield was observed from high fertilizer level (120 kg N ha^{-1}) when applied in a three equal split doses. The lowest grain yield was recorded from those plots where the basal dose of fertilizer was applied. Similarly, the grain yield linearly increased with fertilizer level. Three equal split doses also produced higher grain yield compared to two split doses. Most of the increased in grain yield with increase in fertilizer level is attributed to the higher availability of nitrogen. Similarly, effect of split application fertilizer on yield indicated that timely availability of nitrogen at various growth stages and its efficient utilization resulted in higher grain yield. The grain yield is the product of spike population, grains $spike^{-1}$ and grain weight. Higher doses of nitrogen resulted in higher spike numbers per unit area, grains $spike^{-1}$ and grain weight (Table 2, 3 and 4) and consequently higher grain yield. The results are in agreement with many researchers. They observed that number of spike, grain weight (Ragheb *et al.*, 1993; Jan and Khan, 2000) and grain yield (Singh *et al.*, 1992; Verma *et al.*, 1993) with increased level of fertilizer. Similarly time of fertilizer application has been shown to the N utilization efficiency by cereals (Ragheb *et al.*, 1993; Banziger *et al.*, 1994). The highest grain yield was recorded from Isoproturon treated plots (Table 5). The probable reason is that in Isoproturon treated plots weed competition with wheat for nutrients and other basic requirements has been significantly reduced. The application of Isoproturon at early stage of weeds seems very effective in control measurement than other. The results are in agreement with Nayyar *et al.* (1994).

Field experiment was conducted to determine the best dose and weeding method for wheat crop. However the grain yield of wheat was significantly increased with three split doses of N-fertilizer. On the basis of this study it is concluded that 120 kg N ha^{-1} with three split doses (40 kg each at sowing, early and boot stage) and weedicide (Isoproturon) @ 1.3 kg ha^{-1} can be used for achieving maximum grain yield of wheat.

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References

Ayub, M., S. Guertin, S. Lussier and D.L. Smith, 1994. Timing and level of nitrogen fertility effect on spring wheat. Crop Sci., 34: 748-756.

Banziger, M., B. Feil and P. Stamp, 1994. Competition between nitrogen accumulation and grain growth for carbohydrates during grain filling of wheat. Crop Sci., 34: 440-446.

Geleto, T., D.G. Tanner, T. Tamo, G. Gebeyehu, G. Tilahun, M. Tekalign and G. Getinet, 1995. Response of rainfed bread durum wheat to source, level and timing of nitrogen fertilizer on two Ethiopian Vertisols. Yield and yield components. Comm. in Soil Sci. and Plant Anal., 26: 1773-1794.

Khan, M. and H. Noor, 1995. Weeds of wheat crop and their control. Div. com. Services NWFP Agric. Univ. Peshawar, Pakistan.

Nayyar, M., M.M. Shafi, T. Mehmood and A.M. Randhawa, 1994. Effect of Herbicides on monocot weed in wheat. J. Agric. Res., 32: 149-155.

Ragheb, H.M., R.A. Dawood and K.A. Kheiralla, 1993. Nitrogen uptake and utilization by wheat cultivars grown under saline stresses. Assiut J. Agric. Sci., 24: 97-117.

Rajput, M.T.S., M. Alam and M.S. Rajput, 1993. Effect of weed control and nitrogen application on the growth of wheat. Pak. J. Agric. Res., 3: 131-135.

Sher, M.C., 1996. The analysis of variance. Introduction to statistical theory, 2: 295-296. Publisher: Markazi Kutub Khana, Urdu Bazar Lahore, Pakistan.

Singh, R.V., V.K. Dubey and M.D. Vyas, 1992. Effect of seed rate, nitrogen level and method of fertilizer placement on wh-eat (*Triticum aestivum*) under late sown condition. Indian J. Agron., 37: 43-46.

Verma, V.K., R.K. Mishra and R.K. Yadav, 1993. Response of drawf wheat varieties to varying levels of nitrogen under irrigated condition at Raigarh District of Chhattisgarhregion of Madhya Pardesh. Advances in Plant Sci., 6: 1-9.