

EFFECT OF DIFFERENT METHODS OF FERTILIZER APPLICATION TO WHEAT AFTER GERMINATION UNDER RAINFED CONDITIONS

M. Ihsan, A. Mahmood, M. A. Mian and N. M. Cheema*

ABSTRACT

Different methods of application of N and P fertilizer after rainfall were compared with no fertilizer application at the time of wheat sowing (cv. GA-2002). The data regarding flag leaf area, number of grains per spike, 1000-grain weight and grain yield were recorded. The preliminary studies revealed that fertilizer application with rain after germination (45 days after sowing) increased wheat yield by 32.16 percent when only nitrogenous fertilizer was applied (90 kg N/ha) as side dressing. A yield increase of 42.65 percent was recorded when both nitrogenous and phosphatic fertilizers (90-60 kg/ha) were applied by broadcast and 44.05 percent increase in case of same fertilizers applied as side placement as compared to control. The dose of 90 kg N per hectare of nitrogenous fertilizer was found economical in terms of net profit when applied by broadcast method.

KEYWORDS: *Triticum aestivum*; nitrogen fertilizers; phosphate fertilizers; agronomic characters; cost benefit analysis; Pakistan.

INTRODUCTION

The use of chemical fertilizer cannot be overlooked for getting maximum wheat yield under rainfed conditions. Normally the fertilizer is applied to wheat at planting time in rainfed areas but most of the farmers of rainfed areas usually apply less or no fertilizer to avoid losses in case of crop failure due to drought. They are reluctant to apply costly fertilizer due to uncertainty of rains at later stages. A question is frequently asked whether fertilizer could be applied to wheat crop at later stages if rain is available.

The output of fertilizer is very less than actual potential due to inappropriate application practices. It is observed that applied fertilizer may be lost due to run-off and leaching which could be utilized properly through proper method of application (6). Lawton and Davis (5) reported that application of mixed fertilizer in a band below seed appeared to be the most efficient in respect of phosphorous uptake and plant growth. It was also reported that side banding method is superior to broadcast (1). To obtain maximum efficiency of fertilizer, it is essential to use optimum quantities of fertilizer, coupled with proper application time and method.

*Barani Agricultural Research Institute, Chakwal.

These studies were carried out to ascertain effect of nitrogenous and phosphatic fertilizers using various methods of application to wheat crop under rainfed conditions.

MATERIALS AND METHODS

The studies were carried out at Barani Agricultural Research Institute, Chakwal during year 2004-05 in a randomized complete block design with four replications. The plot size was 5 x 1.80 meter keeping row to row distance of 30 cm. Wheat variety GA-2002 was included. The urea was used as source of nitrogen and diammonium phosphate as phosphorus source. The fertilizer was applied after first rainfall (36.6 mm) and germination which occurred 45 days after sowing. In case of side banded, fertilizer was applied with hand drill 5 cm away and 5 cm deep from the plant rows. The following treatments were included in the study:

- T₁ = Control (no fertilizer application)
- T₂ = Urea broadcast @ 90 kg N/ha
- T₃ = Urea + DAP broadcast @ 90-60 kg NP/ha
- T₄ = Urea side placed @ 90 kg N/ha
- T₅ = Urea + DAP side placed @ 90-60 kg NP/ha

The trial was sown on a soil previously exhausted for fertilizer by growing millet crop as fodder. Soil samples from 0-15 cm and 16-30 cm depth were chemically analyzed before sowing of wheat crop. Fertility status of soil at the time of sowing is given in Table 1. As flag leaf matured, the area was recorded using following formula:

$$\text{Flag leaf area} = \text{Maximum length} \times \text{maximum width} \times 0.75 \text{ (constant factor)}$$

Table 1. Physico-chemical properties of experimental soil before sowing.

Depth	Moisture(%)	pH	EC (dS/m)	O.M (%)	P (ppm)	N(%)	Texture
0-15 cm	6.5	8.1	0.53	0.56	4.2	0.028	Sandy loam
16-30 cm	6.8	8.0	0.51	0.47	3.1	0.024	Sandy loam

The crop was harvested and threshed manually to record data regarding grains per spike, 1000-grain weight and grain yield. The data obtained were analyzed statistically by Fisher's method of analysis of variance (3).

RESULTS AND DISCUSSION

The data showed significant differences of various treatments for flag leaf area, number of grains per spike, 1000-grain weight and grain yield (Table 2). The flag leaf area was found positively correlated with grain yield and was significantly affected by using various fertilizer application methods. The data

(Table 3) showed that flag leaf area was increased by 21.9 and 28.26 percent over control when only urea was applied through broadcasting and side placement, respectively. An increase of 36.39 and 54.41 percent over no fertilizer treatment (control) was observed when both nitrogen and phosphorus were applied through broadcast and side placement, respectively. Maximum increase in flag leaf area (54.41%) was found when both fertilizers were side placed.

Table 2. Mean squares of flag leaf area, grains per spike, 1000-grain weight and yield.

SOV	df	Mean squares			
		Flag leaf area	Grains/spike	1000-grain weight	Grain yield
Replications	3	2.56	3.257	3.142	41986
Treatments	4	127.3**	112.988**	56.490**	258280**
Error	12	1.83	1.511	2.301	37753

**Significant at 0.01 level.

Table 3. Effects of N and P fertilizer on flag leaf area, grains per spike, 1000-grain weight and yield of rainfed wheat.

Treatments	Flag leaf area		No. of grains/spike		1000-grain weight		Grain yield	
	Flag leaf area (cm ²)	Percent increase over control	No. of grains/spike	Percent increase over control	1000-grain wt. (g)	Percent increase over control	Grain yield (kg/ha)	Percent increase over control
No fertilizer (control)	28.30d	-	26.70c	-	34.12b	-	1430b	-
Urea broadcast @ 90 kg N/ha	34.50c	21.90	32.10b	20.22	35.35b	3.60	1870a	30.76
Urea + DAP broadcast @ 90-60 kg NP/ha	38.60b	36.39	33.20d	24.34	36.10b	5.80	2040a	42.65
Urea side placed @ 90 kg N/ha	36.30c	28.26	32.40b	21.34	41.40a	21.33	1890a	32.16
Urea + DAP side placed @ 90-60 kg NP/ha	43.70a	54.41	41.50a	55.43	42.40a	24.26	2060a	44.05
LSD (0.05)	2.08	-	1.89	-	2.34	-	299.4	-
LSD (0.01)	2.91	-	2.65	-	3.28	-	419.7	-
Cv%	3.72	-	3.70	-	4.01	-	10.46	-

The number of grains per spike were increased by 20.22 and 21.34 percent with N application through broadcast and side band placement, respectively while both N and P by broadcast and side placement increased grains per spike by 24.34 and 55.43 percent over control, respectively. These results are confirmed by earlier findings (4, 7).

The improvement in grain weight was significant as it is one of main yield components in wheat. It has also been reported that varieties with high grain weight can better withstand heat and drought stresses during grain filling

stage (13). Increase in 1000-grain weight due to fertilizer application over control ranged from 3.6 to 24.26 percent. Maximum increase (24.26%) was obtained when nitrogen and phosphorus were side placed followed by side placement of urea alone (21.33%) over control. These results are confirmed by earlier reports (2, 4).

The data further revealed that N application through broadcast after 45 days of sowing increased grain yield significantly (30.76%). However, both nitrogen and phosphorus application through broadcast and side placement gave 42.65 to 44.05 percent increase, respectively over control. Side placement of both nitrogenous and phosphatic fertilizers showed yield improvement over broadcast (7, 8, 9).

With regards to profit and cost benefit ratio (Table 4) maximum profit of Rs. 8204.00 per hectare was obtained when only nitrogen (90 kg/ha) was applied by broadcast in the form of urea. Higher cost benefit ratio (1:1.63) was also recorded from the same treatment.

Table 4. Cost of production, net profit and cost benefit ratio of various treatments.

Treatments	Total cost/ha (Rs.)	Total income/ha (Rs.)	Net profit (Rs.)	Cost benefit ratio
No fertilizer (control)	10654	16088	5434	1:1.51
Urea broadcast @ 90 kg N/ha	12834	21038	8204	1:1.63
Urea + DAP broadcast @ 90-60 kg NP/ha	15064	22950	7886	1:1.52
Urea side placed @ 90 kg N/ha	13234	21263	8029	1:1.60
Urea + DAP side placed @ 90-60 kg NP/ha	14464	23175	7711	1:1.60

Calculation based on urea @ Rs. 520/50 kg, DAP @ Rs. 1100/50 kg, wheat @ Rs. 10/kg and wheat bhoosa @ Rs. 50/40 kg.

CONCLUSION

In rainfed areas fertilizer application at sowing with first rainfall showed significant effect on wheat yield over control (o fertilizer). Broadcast of urea @ 90 kg N per hectare was most profitable and economical. Further studies in this respect are underway for comprehensive findings.

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