EFFECT OF FOLIAR APPLICATION OF NITROGEN ON GRAIN YIELD OF WHEAT

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A two year field experiment showed that application of ½ N as basal and ½ N as foliar spray at growth stage 3 increased grain yield of wheat by 43.2% compared to that obtained by applying full N (100 kg N ha^{-1}) as basal (normal practice). Foliar spray without starter N reduced the yield by 14.9% (1710.5 kg ha^{-1}) compared to normal practice. Foliar application of ½ N at growth stage 3 along with ½ N as basal was found profitable in terms of gross margin ($ 401.05) and benefit cost ratio (3.60). This treatment gave additional income of US $ 160. 02 ha^{-1}.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important winter cereal crop in Bangladesh ranking second both in acreage and in production. It contributes about 6% to the total food grain production (Anonymous, 1991). Irrigation water is the most vital as well as costly input for crop production. Inadequate facilities and scarcity of irrigation water in wheat growing areas of Bangladesh restricts optimum production of this crop. So, most of the wheat cultivation is done under rainfed condition. In Bangladesh non-irrigated wheat covers about 53% of the total wheat area (Anonymous, 1991).

Czuba (1988), Dekov (1988) and Rozsypal (1989) reported that grain yield and quality of wheat was improved by foliar application of nitrogen and other elements. This study was undertaken to investigate the effect of foliar application of N on yield of rainfed wheat in Bangladesh.

MATERIALS AND METHODS

The study was carried out during winters of 1989-90 and 1990-91 on the Ganges flood plain soils of Regional Agricultural Research Station, Ishurdi, Bangladesh under rainfed condition. The soil was silt loam with pH 7.8. Nitrogen was used @ 100 kg ha^{-1} from urea as basal, foliar spray or both at different growth stages as devised by W. Feekes (Peterson, 1965). As foliar spray, without adjuvant, 2% urea solution was applied @ 10870 l ha^{-1} as the full dose. Full dose of N was partitioned into seven treatments and were adopted in a Randomized Complete Block Design (RCBD) with three replications. The treatments were:

T_1 = Full basal dose of 100 kg N ha^{-1} (normal practice).

T_2 = ½ N as basal and ½ N as foliar spray at growth stage 3.

T_3 = ½ N as basal and ½ N as foliar spray at growth stage 5.

T_4 = ½ N as basal and ½ N as foliar spray at grain filling stage.

T_5 = ½ N as basal, ¼ N at growth stage 3 and ¼ N at growth stage 5 as foliar spray.

T_6 = ¼ N as basal, ¼ N at growth stage 3, ¼ N at growth stage 5 and ¼ N at grain filling stage (10.5) as foliar spray.

T_7 = ½ N at growth stage 3, ¼ N at growth stage 5 and ¼ N at grain filling stage (10.5) as foliar spray.

Unit plot size was 5 m x 4 m. Wheat variety "Kanchan" was sown in rows on the 20th November, 1989 and harvested on the 16th March, 1990, whereas wheat was sown on the 15th November, 1990 and harvested on the 10th March, 1991. A uniform dose of 80 kg P and 60 kg K ha^{-1} was applied in all the treatments at the time of sowing. One hand weeding was done 20 days after emergence.

Ten plants were randomly selected from each plot to collect data pertaining to plant height, spike length, number of grains $spike^{-1}$ and 1000-grain weight. Number of spikes m^{-2} was taken from five randomly selected places. Yield measurements were taken from whole plot. Data were analysed statistically and means were compared by LSD (Steel and Torrie, 1980). Benefit:cost ratio analysis was computed as follows:

Cost of production = Inputs and operational costs

Gross return = Grain yield x Price

Gross margin = Gross return - Cost of production

$$\text{Benefit cost ratio} = \frac{\text{Gross return}}{\text{Cost of production}}$$

RESULTS AND DISCUSSION

The tallest plants, longest spikes and maximum number of grain per spike were obtained from T_2 and those were statis-

Table 1. Effect of foliar application of nitrogen on yield and yield components of wheat

Treatment	Plant height (cm)		Number of spikes (m^{-2})		Spike length (cm)		Number of grains $spike^{-1}$		1000-grain weight (g)		Grain yield (kg ha^{-1})		Mean	Yield increase over T_1 (%)
	1989-90	1990-91	1989-90	1990-91	1989-90	1990-91	1989-90	1990-91	1989-90	1990-91	1989-90	1990-91		
T_1	90.0	88.9	240	235	8.8	8.1	35.5	34.9	49.7	49.2	2026	1995	2010	-
T_2	92.1	91.5	247	241	9.0	8.9	36.9	35.5	51.2	50.4	2957	2800	2878	43.2
T_3	88.4	86.1	235	229	8.6	8.7	35.2	34.0	46.1	46.0	1885	1810	1847	-8.1
T_4	86.2	85.0	236	230	8.4	7.9	34.5	34.0	48.4	47.2	1805	1795	1800	-10.5
T_5	89.3	89.4	238	239	8.8	8.7	35.4	35.0	48.9	49.0	1900	1920	1910	-5.0
T_6	83.4	84.4	220	218	8.0	8.0	31.9	32.3	44.1	46.1	1750	1741	1745	-13.2
T_7	78.8	76.8	200	210	7.3	7.4	28.8	29.6	41.0	42.1	1690	1731	1710	-14.9
LSD (0.05%)	12.9	13.0	NS	NS	1.4	1.5	6.8	5.3	3.9	4.2	4.4	418	-	-
CV (%)	8.36	9.00	16	15	9.25	10.31	11.28	8.82	4.68	4.95	12.6	11.9	-	

tically at par with other treatments except T_7 where no basal nitrogen was used (Table 1). Likewise, significantly the highest 1000-grain weight was recorded for T_2 and those were statistically similar to T_1, T_4 and T_5. Due to beneficial effect of foliar spray at grain filling stage (10.5), T_4 produced 1000-grain weight statistically at par with T_1. Dekov (1988) similarly mentioned that foliar application of nitrogen after heading had no significant effect on yield but increased 1000-grain weight of wheat. The lowest 1000-grain weight was found for T_7. Significantly the highest grain yield was obtained from T_2 and the yield increment over normal practice was 43.2%. Bhati and Rathore (1988) and Rozsypal (1989) also reported similar effects of agro-chemicals and nitrogen on wheat. The highest yield for T_2 could be contributed by higher number of spikes unit^{-1} area, length of spike, grain spike^{-1} and 1000- grain weight. It could be expected that foliar application of N increased N use-efficiency for wheat and ultimately increased yield (Czuba, 1988).

The cost of production was directly related to number of sprays given (Table 2). The highest costs were involved for T_6 and T_7 where 3 sprays were given and that of minimum in T_1 (normal practice). The highest gross return, gross margin (US $ 401) and benefit cost ratio (3.60) were obtained for T_2 during both the years. This treatment produced an additional income of US $ 160 ha^{-1}.

From the results, it could be inferred that foliar application of ½ N at growth stage 3 along with ½ N as basal will be profitable over normal practice under rainfed conditions of the Bangladesh.

Table 2. Cost and return analysis as affected by foliar application of nitrogen on wheat

Treatment	Cost of production (US $ ha^{-1})		Gross return (US $ ha^{-1})		Gross margin (US $ ha^{-1})			Benefit cost ratio			Additional income over T1 (US $ ha^{-1})
	1989-90	1990-91	1989-90	1990-91	1989-90	1990-91	Average	1989-90	1990-91	Mean	
T_1	146	148	391	385	245	237	241	2.68	2.60	2.64	-
T_2	153	156	571	540	418	384	401	3.73	3.46	3.60	160.02
T_3	153	156	364	349	211	193	202	2.38	2.24	2.31	-38.96
T_4	153	156	348	346	195	190	193	2.28	2.22	2.25	-48.12
T_5	161	165	367	371	206	206	206	2.28	2.25	2.27	-35.40
T_6	169	173	338	336	169	163	166	2.00	1.94	1.97	-75.15
T_7	169	173	326	334	157	161	159	1.93	1.93	1.93	-81.90

Assuming market price of wheat US $ 0.193 kg^{-1}.

REFERENCES

Anonymous. 1991. Yearbook of Agricultural Statistics of Bangladesh. Bangladesh Bureau of Statistics. Govt. of Bangladesh, Dhakka.

Bhati, D.S. and S.S. Rathore. 1988. Effect of agro-chemicals as seed soaking treatment and foliar spray on nutrient content and uptake in late sown wheat. Madras Agri. J. 75: 363-364.

Czuba, R. 1988. Foliar application of nitrogen and trace elements to winter wheat. Internationale Zeitschnift der Landwirtschft. 4: 290-292.

Dekov, D. 1988. Effect of late foliar application of nitrogen on grain yield and quality of soft and durum wheat. Resteniev dni Nauki. 25: 17-23.

Peterson, R.F. 1965. The wheat plant and its morphological development. pp: 17-33. In: Wheat. Intersci. Pub. Inc., NY, USA.

Rozsypal, R.F. 1989. Foliar application of nitrogen and phosphorus to winter wheat. Rostlina Vyroba. 35: 29-36.

Steel, R.G.D. and J.H. Torrie. 1980. Principles and Procedures of Statistics. McGraw Hill Book Co. Inc., NY, USA.