

Agronomic Efficiency of Different N:P Ratios in Rain Fed Wheat

ZAHID PERVAIZ, †KHADIM HUSSAIN, S.S.H. KAZMI AND ‡K.H. GILL

Soil and Water Testing Laboratory, Gujrat, Pakistan

†Soil and Water Conservation Research Institute, Chakwal, Pakistan

‡Soil Fertility Survey and Soil Testing Institute Punjab, Lahore, Pakistan

ABSTRACT

Different N: P ratios were tried in rain fed wheat on farmer field in order to find out the best economical N: P ratio. The N: P ratio 1:1 gave the highest straw yield (7984 kg ha⁻¹), grain yield (4518 kg ha⁻¹), straw nutrient ratio (18.8), grain nutrient ratio (11.3) and VCR (Value Cost Ratio) value (4.1) and proved to be the best N: P ratio in rain fed wheat. VCR for all treatments was more than 2.0, showing satisfactory risk coverage against investment in fertilizer use. Potassium application in rain fed wheat seems to be uneconomical due to the least VCR (2.4) as compared to the other ratios. Further studies on larger scale are suggested on this aspect.

Key Words: N:P ratios; Wheat; Agronomic efficiency; VCR

INTRODUCTION

Rain fed area plays an important role in wheat production in Pakistan. Rain fed wheat in Pakistan is grown on 1.3 mha⁻¹ and its yield is discouragingly low being only 1.13 t ha⁻¹ (MINFAL, 1995). Wheat is the staple food in Pakistan and occupies about 48% of the total cropped area and consumes more than 48% of the total fertilizers. Yet the per acre yield is not only low, compared to other wheat growing countries of the world but has remained stagnant at about 2 t ha⁻¹ for the last many years (Anonymous, 1998). Although the overall fertilizer use has grown by 40% over the past decade, major increase has been in nitrogen use, resulting in a wider N: P ratio. The causes of low yield may be attributed, besides other factors (low moisture due to low and uneven rainfall, deficiency of N and P in the field) largely to inadequate and imbalance use of fertilizer.

Application of N and P fertilizer to wheat increased the straw and grain yield of wheat (Alam *et al.*, 1992; Alam, 1995). Phosphatic fertilizers increased the efficiency of nitrogen fertilizers and also increase the total uptake of N and P (Rashid & Salim, 1991). Timely application of nitrogen or occurrence of rain along with fertilizers gave a good response to improve the yield components of wheat (Saeed & Yousaf, 1994). At the same time, nitrogen application not only increase the uptake of nitrogen by the crop but also increase the protein content of straw and grain (Azam, 1992) which is an ultimate source of food. The agriculture department is advocating the use of N: P in 1:1 or at least 2:1 ratio, while the fertilizer use in Punjab remained 3.6:1 during the year 1999-2000 (NFDC. 2000). So a study was conducted to compare the yield performance and to find out an optimum level of fertilizers for wheat under rainfed conditions.

MATERIALS AND METHODS

The study was carried out on farmer field on Mangla road near Jhelum in Rawalpindi division under barani condition. Eight fertilizer levels i.e. 0-0-0, 100-0-0, 100-100-0, 133-67-0, 150-50-0, 160-40-0, 120-80-0 and 120-80-60 Kg N-P₂O₅-K₂O ha⁻¹ were applied at sowing. Soil sample was collected from the field before sowing of crop and was analysed in the laboratory for physical and chemical characteristics by standards methods. The soil characteristics of the experimental site were, EC (0.071 dSm⁻¹), pH (7.8) organic matter (0.40%), available P and K (6.0 and 125 mg kg⁻¹), respectively and textural class was loam. N, P and K were applied in the form of Urea, SSP and SOP, respectively. The wheat variety Pothohar-93 was sown on 10th November, 96 using RCBD with three replicates. A total of 10 rains (68 mm) were received by the experiment from 18th January to 28th April, 97. The yield data were recorded on 16th May, 97 by harvesting randomly selected 3x3 m from each treatment on 1st May, 97 and were statistically analyzed by using analysis of variance techniques. The differences among treatments were compared by LSD at P_{0.05} (Steel & Torrie, 1980). The VCR and agronomic efficiency were calculated by the following formulae.

$$\text{Value Cost Ratio (VCR)} = \frac{\text{Value of increased yield obtained}}{\text{Cost of fertilizer used}}$$

Agronomic Efficiency

$$\text{Straw or Grain Nutrient Ratio (SNR or GNR)} = \frac{\text{Increase in yield}}{\text{Nutrient applied}}$$

RESULTS AND DISCUSSION

Wheat yield as affected by different N: P ratios. The yield data in Table I indicates that N: P ratio 1:1 gave the highest straw yield of 7984 kg ha⁻¹ which is at par with N: P ratio 1.5:1+K and followed by N: P ratios of 4:1, 2:1, 3:1, 1.5:1 and 1:0. As concerned grain yield, again N: P ratio 1:1 gave the highest yield of 4518 kg ha⁻¹ which is highly significant and was followed by N: P ratios 1.5:1+K, 1.5:1, 2:1 3:1 4:1 and 1:0. There was significant reduction in grain yield due to the application of K along with N: P (1.5: 1) as compared to N: P (1:1). Application of N and P fertilizer to wheat increased the straw and grain yield of wheat which is in agreement with those of Alam *et al.* (1992), Alam (1995) and Bakhsh *et al.* (2001). Further Phosphatic fertilizers increased the efficiency of nitrogen fertilizers and similar results had been reported by Rashid and Salim (1991). Gradual increase in the level of N from 100-kg h⁻¹ to 160 kg

h⁻¹ and decrease in the P level from 100 kg h⁻¹ to 40 kg h⁻¹, gradually decreased the grain yield. It indicated that low grain might be attributed, besides other factors, largely to inadequate and imbalance use of fertilizer (wider N: P ratio). Hence, it is necessary that N and P fertilizer should proportionally be applied which is proved 1:1 in this study.

Agronomic efficiency of different N: P ratios in wheat.

The agronomic efficiency in Table II indicates that the highest straw nutrient ratio (SNR) of 18.8 was calculated in wheat against the 1:1 NP ratio and lowest SNR of 12.4 in NP ratio 1.5:1. The grain nutrient ratio of 1:1 NP ratio was also highest (11.3) as compared to the other ratios and was followed by NP ratios, 1.5:1, 2:1, 3:1, 4:1, 1.5:1+K and 1:0. This indicates that NP ratio of 1:1 is the best one amongst the other ratio.

Economic analysis of different N: P ratios in wheat. The value cost ratio (VCR) of different N: P ratio in rain fed wheat (Table-III) revealed that it ranged from 2.4 to 4.1.

Table I. Wheat yield as affected by different N: P ratios in rain fed wheat

Sr.No	Fertilizer rates kg ha ⁻¹			N:P	Straw yield kg ha ⁻¹		Grain yield kg ha ⁻¹	
	N	P ₂ O ₅	K ₂ O		Yield	Increased yield (%)	Yield	Increased yield (%)
1	0	0	0	-	4221 e	-	2253 f	-
2	100	0	0	1 : 0	5763 d	1542 (37)	2932 e	679 (30)
3	100	100	0	1 : 1	7984 a	3763 (89)	4518 a	2265 (101)
4	133	67	0	2 : 1	7007 bc	2786 (66)	4073 bc	1820 (81)
5	150	50	0	3 : 1	6742 c	2521 (60)	3925 cd	1672 (74)
6	160	40	0	4 : 1	7273 bc	3052 (72)	3895 d	1642 (73)
7	120	80	0	1.5: 1	6696 c	2475 (59)	4147 b	1894 (84)
8	120	80	60	1.5: 1+ K	7495 ab	3274 (78)	4206 b	1953 (87)

Figures in parenthesis are percentage of their respective control.

Table II. Agronomic efficiency of different N: P ratios in rain fed wheat

Sr.No	Fertilizer rates kg ha ⁻¹			N:P	Straw yield kg ha ⁻¹		Grain yield kg ha ⁻¹	
	N	P ₂ O ₅	K ₂ O		Increased yield	Straw nutrient ratio (SNR)	Increased yield	Grain nutrient ratio (GNR)
1	0	0	0	-	-	-	-	-
2	100	0	0	1 : 0	1542	15.4	679	6.8
3	100	100	0	1 : 1	3763	18.8	2265	11.3
4	133	67	0	2 : 1	2786	13.9	1820	9.1
5	150	50	0	3 : 1	2521	12.6	1672	8.4
6	160	40	0	4 : 1	3052	15.3	1642	8.2
7	120	80	0	1.5: 1	2475	12.4	1894	9.5
8	120	80	60	1.5: 1+ K	3274	12.6	1953	7.5

Table III. Economic analysis of different N: P ratios in wheat in rain fed wheat

Sr.No	Fertilizer rates kg ha ⁻¹			N:P	Gross return (Rs)	Expenditure on fertilizer (Rs)	Net return (Rs)	VCR
	N	P ₂ O ₅	K ₂ O					
1	0	0	0	-	16898	-	16898	-
2	100	0	0	1 : 0	21990	1784	20206	2.9
3	100	100	0	1 : 1	33885	4184	29701	4.1
4	133	67	0	2 : 1	30548	3978	26570	3.4
5	150	50	0	3 : 1	29438	3873	25565	3.2
6	160	40	0	4 : 1	29213	3814	25399	3.2
7	120	80	0	1.5: 1	31103	4060	27043	3.5
8	120	80	60	1.5: 1+ K	31545	6004	25541	2.4

Price of wheat = Rs. 7.5 / Kg, Price of urea, SSP and SOP = Rs. 410, 240 and 810 / bag, respectively

The highest VCR of 4.1 was obtained from N: P ratio 1:1 followed by 1.5:1 ratio (3.5). VCR (Value Cost Ratio) for all treatment was more than 2.0, showing satisfactory risk coverage against investment in fertilizer use. The data also indicated that N: P application in 1:1 ratio proved better. Application of K with 1.5:1 N: P showed the least VCR and indicated its application uneconomical.

CONCLUSIONS

The following conclusions were drawn from this study:

1. In rain fed wheat N: P application in 1:1 ratio gave highest and significant results.
2. VCR (Value Cost Ratio) for all treatment was more than 2.0, showing satisfactory risk coverage against investment in fertilizer use.
3. Potassium application is uneconomical due to least VCR (2.4).

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