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Grain Yield and Economic Effect of NP Fertilizers Application on Dryland Barley

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Abstract: Barley (*Hordeum vulgare* L.) is an important cereal used as feed and forage crop in Pakistan. Information on the economical dose of NP fertilizer application on barley are limited. The objective of this study was to determine the agronomic and economic effects of NP fertilizers on barley production under dryland conditions. The study was conducted at Malakandher Farm of the Agriculture University Peshawar, during 1991-92, in a randomize complete block design with 4 replications. Fertilizer treatments were: 23-0, 46-0, 69-0, 23-23, 46-23, 69-23, 23-46, 46-46, 69-46, 23-69, 46-69, 69-69 of N P_2O_5 kg ha^{-1} respectively vs control (0-0). Barley cultivar Frontier 87 was sown 13, Nov. 1991 in 6 rows 5 m long 30 cm apart. The results on grain yield revealed that maximum grain yield of 2995 kg ha^{-1} was harvested from 69-69 NP_2O_5 kg ha^{-1} treatment and the lowest grain yield of 507 kg ha^{-1} was obtained from control treatment fertilizer applied plots significantly increased grain yield as compared to control. From the economic analysis, a maximum marginal rate of return (MRR) of 5460 percent was obtained from 23-23 NP_2O_5 kg ha^{-1} fertilizer application, followed by 46-46 NP_2O_5 kg ha^{-1} fertilizer treated plot with 5210 percent MRR suggesting their use to farmers under conditions similar to those of this study. More research is needed to conclude valid recommendations for barley growers in different agroecological zones of the Northwest Frontier Province (NWFP) of Pakistan.

Key words: *Hordeum vulgare* L., Marginal rate of return (MRR)

Introduction

Barley *(Hordeum vulgare* L.) is an important crop grown in rainfed areas of Northwest Frontier Porovince (NWFP) and is used for food, feed and forage purposes. In NWFP barley was planted on 59600 ha producing 59700 tonnes grain with average grain yield of 1093 kg ha^{-1} during 1996-97 (Anonymous, 1998). This yield of barley is very low and could be improved considerably, if appropriate agronomic practices were adopted. Fertilizer application, had a significant influence on grain yield in many crops. Sultan *et al*. (1991) conducted from experiment on wheat that the highest grain yield was given by 60 N-20 P kg ha^{-1} application and that the use of fertilizer were profitable with a cost benefit ratio ranged from 1:1.94 to 1:3.96. Becher and Omani found that the grain yield increased up to 100 kg N/ha applied.

Rajput *et al*. (1989) found that 100 N-60 P kg ha^{-1} increased grain yield. Khoso *et al*. (1989) reported that the increased levels of NP combination progressively increased the grain yield. Roy *et al*. (1978) tested four barley cultivars under rainfed conditions at Behar, India and found 40 kg N/ha increased grain yield from 0.94 to 1.55 t ha^{-1}.

Jalil and Ghani (1982) reported that grain yield increased with increased level of nitrogen. Zada and Karim (1982) observed that grain yield increased progressively with increased application of P. Khan *et al*. (1992) concluded from the economic analysis that the use of 56 N- 45 P_2O_5 kg ha^{-1} was best recommendation followed by 56 N-27 P_2O_5 kg ha^{-1} with a marginal rate of return of 1100 percent an 197%, respectively. However, little efforts have been made to optimize the NP application for barley production in the NWFP. Therefore this study was designed to determine the grain yield and economic effects of NP fertilizer application on dryland barley.

Materials and Methods

An experiment was conducted to determine the grain yield and economic effects of NP fertilizers application on barley under dryland conditions at Malakandher Farm of NWFP Agricultural University Peshawar, during 1991-92. Barley cultivar Frontier 87 was sown at a seeding rate of 100 kg ha^{-1} on 13 Nov. 1991. A randomized complete design was used with four replication. Each treatment plot size was 6 row, 5m long 30cm apart. Fertilizer treatments used were: F0(0-0), F1(23-0), F2(46-0), F3(69-0), F4(23-23), F5(46-23), F6(69-23), F7(23-46), F8(46-46), F9(6946), F10(23-69), F11(46-69) and F12(69-69) NP,O, kg ha^{-1}. Source of fertilizers used were urea (46 % N) and diammonium phosphate (18-46-0). A basal dose of 50 k/hs K_20 in the form of K_2SO_4 was used. Four central rows were harvested for recording grain yield data, in kg ha^{-1}. Economic analysis was calculated as prescribed by CIMMYT (1998), using market prices prevailed at the time of harvest of the experiment.

Results and Discussion

The data measured on grain yield (Table 1) reveled that grain yield was significantly affected by N Pfertilizer application. Maximum grain yield of 2995 kg ha^{-1} was harvested from a plot of 69 N-69 P_2O_5 kg ha^{-1} fertilizer applied. Whereas, lowest grain yield of 507 kg ha^{-1} was obtained from control (0 N-OP_2O_5) treatment. These result are in agreement with other researchers Khan *et al*. (1992), Khoso *et al*. (1989) and Rajput *et al*. (1989), who reported similar response in grain yield of wheat or barley to nitrogen and phosphorus fertilizer application. They observed progressive increase in grain yield with NP fertilizer application as compared to control in their studies. From the partial budget analysis (Table 1) it is observed that treatments dominated F3,' F10 and F11, which mean that these have higher variable costs and lower net benefit as compared with non dominated treatments (Table 2). From the marginal analysis of non-dominated treatments (Table 3) the maximum marginal rate of return (MRR) of 5460 percent was obtained from treatment recieved 23N-23 P_2O_5 kg ha^{-1} of fertilizer, followed by 46N-46 P_2O_5 kg ha^{-1} fertilizer application with 5210 percent MRR, giving a choice to farmers depending on their financial conditions. Khan *et al*. (1992) also recommended NP fertilizer application treatments with maximum marginal rate of return in their study on wheat which were not essentially:

$$*MRR = \frac{\text{Marginal net benefit}}{\text{Marginal cost}} \times 100$$

Table 1: Partial budget of average data from fertilizer trials on (per hectare basis)

ItemNo.	Fertilizer treatents (kg ha^{-1})												
	No.	23	46	69	23	46	69	23	46	69	23	46	69
	P_2O_5	0	0	0	23	23	23	46	46	46	69	69	69
Average grain yield (Kg ha^{-1})	507	1067	1693	1914	1419	2857	2396	2057	2116	2812	2148	2434	2995
Net Yield (Kg ha^{-1}) field benefit (Rs/ha at Rs. 4/Kg)	457	961	1523	1722	1277	1851	2156	1851	1945	2531	1933	2192	2695
	1927	3842	6093	6889	5107	7405	8623	7405	7780	10122	7732	8763	18780
Average Straw Yield (Kg ha^{-1})	2670	5495	6535	7616	6053	7663	9062	6430	8251	9840	7067	8998	10598
Net straw yield (Kg ha^{-1})	2403	4945	5881	6854	5447	6896	8155	5787	7425	8856	6360	8098	9538
Field benefit (Rs/ha at Rs. 3/kg)	720	1483	1764	2056	1634	2068	2446	1736	2227	2656	1908	2429	2861
Gross benefit (Rs/ha)	2547	5325	7857	8945	6741	9473	11069	9141	10007	12778	9640	11192	13641
Variable money cost N (Rs. 9.13/kg N) and P (Rs. 8.25Kg)	0	210	420	630	210	420	630	210	420	630	210	420	630
	0	0	0	0	190	190	190	380_	380	380	570	570	570
Variable money cost	0	210	420	630	400	610	820	590	800	1010	780	990	1200
Cost for application 11 day 50 Rs.)	0	50	50	50	50	50	50	50	50	50	50	50	
Total variable cost (Rs/ha)	0	260	470	680	450	660	870	640	850	1060	830	1640	1250
Net benefit (Rs/ha)	2547	5065	7387	8265	6291	8813	10199	8501	9157	11718	8810	10152	12391

Table 2: Dominance analysis fo NP fertilizers response

Net benefit (Rs ha^{-1})	Treatments (kg ha^{-1})		
	N	P_2O_5	Variable cost (Rs. ha^{-1})
2547	0	0	0
5065	23	0	260
6291	23	23	450
7387	46	0	470
8501	23	46	640
8813	46	23	660
8265	69	0	680
8810	23	69	830
9157	46	46	850
10199	29	23	870
10152*	46	69	1040
11718	69	46	1060
12391	69	69	1250

*Dominated Treatment

Table 3: Marginal analysis of the undominated NP fertilizers response data

Fertilizer Treatment (Kg ha^{-1})		Net benefit Rs. ha^{-1}	variable Cost	Marginal increase in net Benefit	Marginal increase in cost (MRR)*	Marginal rate of return	NP_2O_5
0	0	2547	0	2518	260	968.00 %	
23	0	5065	260	1226	190	645.00 %	
23	23	6291	450	1092	20	5460.00 %	
46	0	7387	470	1118	170	657.00 %	
23	46	8501	640	312	20	1560.00 %	
46	23	8813	660	314	190	181.00 %	
46	46	9157	850	1042	20	5210.00 %	
69	23	10199	870	1519	190	799.00 %	
69	46	11718	1080	673	190	354.00 %	
69	69	12391	1250	-	-	-	

The highest levels of N P_2O_5 fertilizers used, with increased grain yield. However, soil, rainfall and transport costs vary widely from location to location, reseach efforts are needed to optimize the NP fertilizer application in different agro-ecological zones of the NWFP for enhancing barley production.

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