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Contribution of Some Maize Production Factors Towards Grain Yield and Economic Return under the Agro-climatic Conditions of Dera Ismail Khan

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Abstract: Contribution of different factors responsible for the increase of Maize production viz: weeds control, insect/pest control and fertilizer were determined in Kharif, 1996 and 1997 under the agro-climatic conditions of Dera Ismail Khan, Pakistan. The investigations measured the average maximum yield gap between the improved practices and that of farmer's practices as 2443 kg/ha, showing an increase of 193.88 % over that of farmer's practices. The highest share contributed by improved fertilizer dose, was 38.48 %; followed by insect/pest control, that was 26 %. The lowest share was contributed by weeds control, 22 %. The highest net return and Value Cost Ratio (VCR) of Rs. 3974.65 and (1:2.2) respectively, were found for fertilizer. The minimum net return of Rs. 1576.20 with VCR (1:1.47) was obtained for insect/pest control.

Key words: Maize, weeds, insects/pests, fertilizer, grain yield, yield gap, cost analysis, Pakistan

Introduction

The ultimate yields of field crops are controlled by a number of genetic and external factors. A single factor at an optimum level will not cause an appreciable increase in the yield itself. In fact a combination of factors contribute to the ultimate yield of field crops.

By now it is well recognized that inputs like improved variety, balanced use of fertilizer, plant protection measures and weed control etc, each has an effective role in increasing the yield of crops.

Maize is important cereal crop. The efforts are being made by the researchers to narrow the yield gap between potential yield and actual farm yield in maize crop.

According to Ansar *et al.* (1996) maize plots with higher (12m^{-2}) density of trianthema monogyna gave lower maize yield (3544 kg/ha^{-1}) than weed free plots (3891 kg/ha^{-1}). Spitters *et al.* (1989) concluded weeds reduce the maize yield by 82 %. Shad *et al.* (1993) reported that critical period for weeds competition in maize was from 3-6 weeks after planting. Ferrero *et al.* (1991) observed the critical period for weeds competition in maize to be from 2nd to 3rd weeks after crop emergence, when heavy infestation reduced maize yields by upto 23%. PARC conducted trials on weeds control in maize during 1983-84 and observed that for the control of weeds, premextra herbicide @ 1.5 kg (a.i)/ha^{-1} gave 4920 kg/ha^{-1} grain as against 2055 kg/ha^{-1} from the non weeded control. Economically Rs. 5659.00 were obtained as compared to Rs. 2544/ ha^{-1} from non-weeded plots (Anonymous 1985).

A trial conducted at Agricultural Research Institute, D.I.Khan during 1999 on efficacy of insecticides for the control of maize stem borer (chilo partellus). Results of the trial revealed that insecticides used for seed treatment had significantly lowered the infested plants than untreated check (Anonymous 1999). Neil *et al.* (1997) reported that high mortality of English grain aphid and oat-birdchery aphid was observed when treated with dimethoate and carbaryl.

Insecticide trails were conducted at Bagh, Danna and Garhi Dopatta, Muzaffarabad (Azad Kashmir) during 1984, to see the effectiveness of different insecticides against maize stem-borer and reported that treatment 0.6 gm advantage (seed treatment) plus 22.5 gm Furadan (30-35 days after sowing) gave the maximum grain yield (6750 kg/ha^{-1}) (Anonymous 1984-85). Wahla, 1982 controlled maize borer and shootfly in spring season with the use of synthetic pyrethroid and reported significant increase in yield as compared with check.

A trial conducted at Agricultural Research Institute, D.I.Khan during 1998-99 to see the response of maize to NPK application and concluded that the NPK levels affected the yield of maize crop significantly, the highest yield of 5.6 t/ha^{-1} was obtained from NPK level of 120-120-100 kg NPK/ha^{-1} fatching the highest net return of Rs. 4444.00/ha^{-1} (Anonymous 1999). Chaudhry (1994) reported that higher yield of maize is associated with fertilizer dose of 120-50 NP kg/ha^{-1}.

A series of trials on fertilizer requirements, on maize were carried out on farmer's fields by PARC Islamabad (1983-84) and indicated that a dose of 180-90 kg NP/ha^{-1} yielded 3830 kg/ha^{-1} with net return of Rs. 4418/ha^{-1}.

Nazeer *et al.* (1999) reported that grain yield was higher from improved cv-kissan, 100-50 kg NP/ha^{-1} and insecticide application than local cultivar and reduced fertilizer rates 50-25 kg NP/ha^{-1}. Riedell *et al.* (1998) grown maize and concluded that level of inputs (tillage, herbicide, insecticide and fertilizer rates) provided for maize can affect the crop rotation response. They further reported that maize yield following soyabean was 32 % greater than for continuous maize with intermediate inputs, but with high input levels, there was no difference between rotation treatments.

Materials and Methods

In order to assess the gap between farmer's yields and yields due to improved practices, studies on relative effects of weeds control, insect/pest control and fertilizer levels on grain yield of maize were carried out at Agricultural Research Institute, D.I.Khan during Kharif, 1996 and 1997.

In first test factor, which was weeds control, No weeds control was done in case of farmer's practice (FP), while weeds were controlled with Khurpa after 20 and 40 days after emergence of crop in improved practice (IP). In the second test factor, which was insect/pest control, no insecticide was either sprayed or applied in case of farmer's practice, while curator granules @ 20 kg/ha was applied two times at 20 days interval in case of improved practice. The insecticide was applied into the whorl of the plant when the plant was in 5-6 leaf stage (i.e. 10-15 days after planting, and the second dose of insecticide at 20 days interval of 1st dose application. Regarding the third test factor, which was fertilizer 60-60 kg NP/ha^{-1} was applied in case of farmer's practice, while 120-

Table1: Average Grain Yield of Maize (Kg/ha) as Affected by Various Factors of Maize Trial at A.R.I., D.I.Khan During Kharif, 1996 and 1997

Treatment S.No.	FACTORS			Average grain Yield of both The years (kg/ha)
	Weeding	Pests control	Fertilizer	
T1	FP	FP	FP	1260
T2	IP	FP	FP	2033.500
T3	FP	IP	FP	2367
T4	FP	FP	IP	2320
T5	IP	IP	FP	2216
T6	IP	FP	IP	2880
T7	FP	IP	IP	2734
T8	IP	IP	IP	3703

Input factor F.P = Farmer's practice, IP = Improved practice

Weeding	Nil	Two manual weeding with Khurpa or Khudal
Insects/pest control	Nil	Two times application of curator granules
Fertilizer	60-60 kg NP/ha	120-120 kg NP/ha

Table2: Average Yield Gap and Factor Contribution for Maize Trial at A.R.I. D.I.khan During Kharif, 1996 and 1997

Improved practice	Farmer's practice	Yield gap	Per hectare in kg		
			Yield contribution of each factor		
			Weeds control (1)	Insects/pest control (2)	Fertilizer (3)
			* *	* *	* *
3703	1260	2443	537.875	631.625	940.125
Average %age of each factor			22%	26%	38.48%

* * Significant at 1%

1) Two manual weedings with Khurpa or khudal.

2) Two applications of curator granules @ 20 kg/ha

3) 120 – 120 kg NP/ha.

Table3: Economics of Average Individual Test Factor for Maize at A.R.I. D.I.Khan During 1996-97

Test factor	Input cost		Added cost including interest cost 10%	1/6th of factor contribution i.e. harvesting, theshing etc. cost plus Rs. 10.00 per 100 kg	Total added cost	Contribution of test factor in kg/ha	Per hectare in Rupees		
	Farmer's practice	Improved practice					Value of the contribution in Rs. (I) Rs. 7.75/kg	Net return	Value Cost Ratio (VCR)
Weeds control	-	(a)1000.00	1100.00	744.50	1844.50	537.875	4168.50	2324.00	2.26:1
Insects/pests control	-	(b)2220.00	2442.00	875.50	3317.50	631.625	4895.00	1577.50	1.47:1
Fertilizer	(c)1820.00	(d)3640.00	2002.00	1309.00	3311.00	940.125	7286.00	3975.00	2.2:1

(i) per kg market price

(a) Cost of two manual weedings @ Rs. 50.00/manday (10 manday per each weeding).

(b) Cost of 40 kg curator granule @ Rs. 444.00 per 8 kg.

(c) Cost of 2.5 bags DAP plus 1.5 bags urea @ Rs. 530.00/bag and Rs. 330.00/bag respectively.

(d) Cost of 5 bags DAP plus 3 bags urea @ Rs. 530.00/bag and Rs. 330.00/bag respectively.

120 kg NP/ha^{-1} in case of improved practice. All P was applied at sowing time in both the practices while half N at sowing time and remaining half N at 35 days after sowing.

During the consecutive years, the experimental design was factorial with four replications. The data were analysed statistically by method as prescribed by Leclerg *et al.* (1972). The L.S.D was tested at 5% and 1% level of significance.

The data on grain yield in kg/plot was recorded and was then converted to kg/ha. Combined two year data have been analysed and are presented in the Tables.

The % contribution was calculated by dividing grain yield gap, factor contribution and yield level of various treatment. The 2^3 complete factorial component was applied. The factorial component consisted of factors (production inputs) at two levels, i.e. (a) farmer's level and (b) improved level.

The size of the experimental plots were kept smaller so that it could easily be controlled. There were eight treatments and each treatment had four replications.

The layout plan was based upon randomized complete block design. The dimension of each sub-plot was 8 x 3 = 24 square meter. Random sampling technique was applied for assigning a given treatment to cover heterogeneity of the soil, if any.

The complete factorial design was applied because it generate data for estimation of yield gap, contribution of individual test factor. The traditional statistical analysis of variance was applied on the yield data to determine whether the contribution of test factors was statistically significant. The benefit cost ratios have been calculated for the test factors in order to determine their relative profitability.

Results and Discussion

The results of this study showed that weeds control, insects/pests control and fertilizer in terms of improved practices have significantly increased the maize grain yield (Table1) during both the years. These findings are in the agreement with the results reported by Nazeer *et al.* (1999) and Riedell *et al.* (1998). The per hectare yield gap was determined as the difference between the yield obtained with all test factors at improved level (T-8) and the yield obtained

at farmer's level (T-1). In Table2, yield gap and contribution of individual test factor is represented which indicates that there was 2443 kg/ha average yield gap for both the years, showing an increase of 196.88 % over that of farmer's practice. It means that there is a great scope for enhancing maize productivity.

The contribution of individual test factor was calculated by yate's method which was essentially the source of IRRI methodology. The contribution of individual test factors was calculated as the difference between averaging the yield over all treatments obtained with that test factor at the farmer's level and the average of yield over all treatments given by test factor at the improved level. Table2 shows that fertilizer, insects/pests control and weeds control were prominent constraints in this study. Their contribution towards average grain yield increase was 38.48, 26 and 22 respectively during both the years (Table2).

A large potential yield gap and the significant contribution of individual test factor are not likely to provide sufficient incentive for an average Pakistani farmer to adopt improved practices, unless he perceives the physical return in his subjective perspective. The farmer would also like to relate it to himself, interpret it meaningfully and get signals for his farm production behaviour aimed at profitability of the improved input. The basic premises behind the economic analysis is that the typical farmer is more likely to adopt the improved technology package when he is convinced of better monetary returns over his additional investment.

Table3 presents economics of average contribution of individual test factor for maize. The cost of individual input were worked out separately at farmer's and improved levels in rupees on per hectare basis. The difference between farmer's and improved practices was taken as additional input cost for the given test factor. A 10 % interest rate was added on the additional input cost to accommodate farmer's opportunity cost for his investment. Additionally, about 17 % of the total output value of the test factor was added to total input cost to cover the harvesting, threshing, cleaning and weighing charges. Lastly, Rs. 10.00 per 100 kg was included as average transport cost from farm to threshing floor and from there to the nearest procurement center.

The benefit cost ratio were calculated by dividing additional output value by additional input cost. Table3 shows the economies of average contribution of individual test factor. The Table shows that fertilizer, weeds control and insects/pests control at improved level gave the highest net return of Rs. 3975.00, Rs. 2324.00 and Rs. 1577.50 with VCR of 2.2, 2.26 and 1.47 respectively.

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