

SUBSTITUTION OF NITROGEN REQUIREMENT OF MAIZE THROUGH GREEN MANURING

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The studies on maize production as affected by green manuring and fertilization were carried out at the Agronomic Research farm, University of Agriculture, Faisalabad during the year 1988. A quadruplicated experiment was laid out in a randomised complete block design. The treatments comprised control, green manuring only, full fertilizer dose (150-100 kg NP ha⁻¹), green manuring + fertilizer ($\frac{3}{4}$ th N + full P), green manuring + fertilizer ($\frac{1}{2}$ N + full P) and green manuring + full dose of N and P.

Guara was sown as a green manuring crop in the second week of May and buried in the first week of July. Maize variety UM-81 was planted in the second week of August. Various yield components were influenced significantly by green manuring and fertilizer application, alone or in combination and remained superior in performance over control. Whereas the maximum economic returns in the form of net income were recorded in case of treatment where $\frac{1}{2}$ of recommended dose of N fertilizer alongwith full P was applied on a green manured field. This revealed that green manuring can substitute 50% N requirement and can bring increased economic returns in addition to having long term effects on the physical fitness of soil by adding sufficient organic matter into the soil.

INTRODUCTION

Maize (*Zea mays* L.) is not only a food and feed crop but also is an important industrial crop of many countries of the world. It occupies a key place in the existing cropping system of our country because it is a short duration crop which is grown twice a year and hence provides more economic returns to the growers. Among the various yield determining factors, soil fertility status is of prime importance. Our soils are having low nutritional status due to continuous cropping and inadequate use of organic manures and mineral fertilizers.

In order to ensure better crop production, efforts should be made to maintain soil fertility through the use of either organic matter or inorganic material. No doubt,

mineral fertilizers are easy to handle and produce quick results but the fear is being expressed that indiscriminate use of these fertilizers can do more harm than good to the soil and crop unless they are used in combination with organic manures. Moreover, the inorganic fertilizers have gone out of the reach of common farmer because of high prices.

Legumes are considered a good source of organic matter when incorporated into the soil. Muntean (1976) found that maize gave 2.98 t grains ha⁻¹ with no fertilizer, 3.35 t with F.Y.M. and 3.29 t with green manure.

Bhajan and Brar (1985) reported that organic manures and N increased the grain yields of maize crop. The green manure was more effective than F.Y.M. In combination with the organic manures at their lower N

rate were more effective. Organic manures increased the organic C and available N contents in the soil.

Frye *et al.* (1985) reported that winter legume cover crops can be used as a mulch for no-till corn, supplying part of the corn's N requirement and resulting in higher grain yields. Morris *et al.* (1986) maintained that biologically fixed sources of N are being re-examined as alternatives to inorganic N fertilizer. It was reported that rice yield response to green manuring was equal to 80 kg inorganic N ha⁻¹. Reddy *et al.* (1986) noted that maize produced significantly higher dry matter yield when sown after green manure summer legume than after summer fallow.

The present study was, therefore, undertaken to explore the possible role of guara in substituting N requirement of maize grown after green manuring.

MATERIALS AND METHODS

The investigation to study the effect of green manuring and fertilizer use on the growth and yield performance of maize crop was carried out at the Agronomic Research Farm, University of Agriculture, Faisalabad during the year 1988. Guara was used as a green manure crop. The experiment was laid out in Randomized Complete Block Design having four replications with a net plot size 4.8 m x 8 m on a sandy clay loam soil. The experimental soil was analysed for N, P and K before sowing the crop. The N, P and K status of the soil was 0.032%, 5.7 mg kg⁻¹ and 150 mg kg⁻¹, respectively. The treatments comprised of control, green manuring only, fertilizer full dose (150-100 kg NP ha⁻¹), green manuring + fertilizer ($\frac{3}{4}$ th N + full P), green manuring + fertilizer ($\frac{1}{2}$ N + full P) and green manuring + full dose of NP.

Guara was sown in the second week of May and buried in the first week of July. Then a promising variety of maize UM-81 was planted in the second week of August on a well prepared seedbed with the help of single row hand drill in 60 cm apart lines, using 30 kg seed rate ha⁻¹. A recommended dose of fertilizer for poor soils (150-100 NP kg ha⁻¹) was used where whole of P with $\frac{1}{2}$ of N at sowing while remaining N was applied with first irrigation.

The observations were recorded on various parameters like cob bearing plants ha⁻¹, number of cobs plant⁻¹, number of grains cob⁻¹, 1000-grain weight, biomass yield ha⁻¹ and grain yield ha⁻¹. The data were analysed using analysis of variance technique and Duncan's New Multiple Range test at 5% probability level was employed to compare the difference among the treatment means (Steel and Torrie, 1980).

Economic returns in terms of net income was also calculated on hectare basis to see the economic feasibility of green manuring.

RESULTS AND DISCUSSION

The data recorded in Table 1 exhibit that green manuring and fertilizer application influenced significantly cob bearing behaviour and had an edge over control. However, comparison of individual treatment means indicate that green manuring + full dose of NP, green manuring + $\frac{1}{2}$ N and full P and full dose of N and P produced matching results.

The data on cob number plant⁻¹ given in Table 1 indicate highly significant effect of green manuring or fertilization where invariably a higher number of cobs plant⁻¹ were observed in treated plots over control. However, the treatments with full dose of NP, green manuring + $\frac{1}{2}$ N and

Table 1. Yield and yield components of maize as affected by green manuring and fertilization

Treatments	Number of cob bearing plants ha ⁻¹	Number of cobs plant ⁻¹	Number of grains cob ⁻¹	1000-grain weight (g)	Biomass (t ha ⁻¹)	Grain yield (t ha ⁻¹)
Control	61589 c*	0.92 d	472 c	224 c	10.1 e	3.2 e
Green manuring only	64323 b	0.98 c	484 b	244 b	11.8 d	3.9 d
Fertilizer (standard dose)	68880 a	1.10 a	521 a	263 a	14.7 b	6.2 b
Green manuring + fertilizer ($\frac{1}{4}$ N and full P)	65287 b	1.04 b	490 b	250 b	13.2 c	5.3 c
Green manuring + fertilizer ($\frac{1}{2}$ N and full P)	69453 a	1.11 a	502 a	263 a	14.9 ab	6.8 a
Green manuring + fertilizer (full dose of NP)	69792 a	1.12 a	505 a	264 a	16.1 a	6.8 a

*Figures of a column followed by the same letter are statistically alike.

full P and green manuring + full NP produced statistically similar results.

The data pertaining to grains cob⁻¹ presented in Table 1 reveal that in general, green manuring and fertilizer treatments led to produce well filled cobs and statistically remained superior over control. Although, the treatments like fertilizer full dose, green manuring + $\frac{1}{2}$ N and full P and green manuring + full NP did not differ significantly from one another.

The data in Table 1 show that 1000-seed weight was also affected significantly by green manuring practice and fertilizer treatments. Where treatments like green manuring + $\frac{1}{2}$ N and full P, green manuring + full NP and standard dose of NP, though not differing significantly from one another produced heavier grains and statistically remained superior over other treatments including control.

The data on total biomass ha⁻¹ given in Table 1 reveal that all the treatments pro-

duced significantly higher tonnage than control. Maximum biomass (16.1 t ha⁻¹) was produced in case of green manuring + full dose of fertilizer, which however, remained statistically at par with green manuring + $\frac{1}{2}$ N and full P (14.9 t ha⁻¹).

The data regarding grain yield ha⁻¹ given in Table 1 exhibit that all the treatments gave significantly higher yield than the control. The individual comparison of treatments indicates that green manuring + full N and P and green manuring + $\frac{1}{2}$ N with full P, though not differing from each other statistically gave significantly higher yields as compared to other treatments.

Keeping in view overall behaviour of treatments in affecting the plant parameters, it can be derived that three treatments i.e. full dose of N and P, green manuring + full dose of N and P and green manuring + $\frac{1}{2}$ N and full P, though exhibiting matching results remained superior in all respects over other treatments. This could be attributed to

rich soil environments ensuring better supply of essential nutrients to the plants. These results are supported by the findings of earlier researchers like Tiwary *et al.* (1970), Ramirez (1972), Muntean (1976), Saleem and Aly (1979), Bhajan and Brar (1985) and Reddy *et al.* (1986).

instead of full dose of N and P, $\frac{1}{2}$ N can be substituted by green manuring. This practice not only produces quick results in the form of increased crop production but can also go a long way in maintaining the productivity status of soil by adding sufficient quantity of organic matter.

Table 2. Economic returns (net income) from maize crop as affected by various combinations of green manuring and chemical fertilizer

Treatments	Yield (t ha ⁻¹)		Income (Rs. ha ⁻¹)		Total income (Rs. ha ⁻¹)	Cost of production (Rs. ha ⁻¹)	Net income (Rs. ha ⁻¹)
	Grain yield	Stalk yield	Grain yield	Stalk yield			
Control	3.2	6.9	8000	690	8690	3067	5622
Green manuring only	3.9	7.9	9750	790	10540	4214	6325
Fertilizer (standard dose)	6.2	8.5	15500	850	16350	4851	11498
Green manuring + fertilizer ($\frac{1}{4}$ N and full P)	5.3	7.9	13250	790	14040	5348	8691
Green manuring + fertilizer ($\frac{1}{2}$ N and full P)	6.8	8.1	17000	810	17810	5565	12244
Green manuring + fertilizer (full dose)	6.8	9.3	17000	930	17930	5998	11931

Cost of production ha ⁻¹ of maize without fertilizer	= Rs. 3067
Cost of maize production on green manured fields	= Rs. 4215
Cost of fertilizer (full dose 150-100 kg NP ha ⁻¹)	= Rs. 1784
Cost of fertilizer ($\frac{1}{2}$ N with full P)	= Rs. 1350
Cost of fertilizer ($\frac{1}{4}$ N with full P)	= Rs. 1134
Rate of maize grain t ⁻¹	= Rs. 2500
Rate of maize stalks t ⁻¹	= Rs. 100

However, considering the economic aspect of crop production the treatment i.e. green manuring + $\frac{1}{2}$ N and full P seemed to hold more promise which resulted in better economic returns as is clear from Table 2. It can thus be concluded that the existing fertilizer use technology can be modified and

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