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EFFECT OF SIZE OF NUTRITIONAL AREA ON THE GROWTH AND YIELD OF MAIZE GROWN AT DIFFERENT FERTILITY LEVELS

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Studies investigating the effect of varying nutritional area on the growth and yield of maize grown at different fertility levels were carried out on a sandy loam soil. The fertilizer treatments comprised of 0, 150 kg N, 150 kg N + 75 kg P_2O_5, 150 kg N + 75 kg P_2O_5 + 75 kg K_2O/ha, while the size of nutritional area varied as 60 x 20 cm, 60 x 25 cm and 60 x 30 cm giving rise to crop stand of 83, 67 and 56 thousand plants/ha, respectively. The various yield components like number of cob bearing plants/plot, number of grains/cob, 1000-grain weight were significantly affected with the application of 150 kg N + 75 kg P_2O_5/ha. It was also observed that the application of K in addition to N and P did not help in increasing the grain yield of maize to a considerable extent because of already high K level in the experimental soil (500 ppm). A plant population of 67 thousand/ha as maintained in the planting pattern of 60 x 25 cm appeared to be the best for obtaining the highest grain yield of maize.

Key words: Nutritional area, Fertility level, Maize yield.

INTRODUCTION

Maize (*Zea mays* L.) ranks third amongst the food grains after wheat and rice in Pakistan and is being utilized equally for food and feed purposes. It is grown on an area of about 789.8 thousand hectares with an annual production of 1005.4 thousand tonnes(4). The expanded use of maize starch in textile industry, preparation of liquid glucose and extraction of edible oil gives this crop a prominent place in agricultural economy.

Amongst the various factors of crop production, fertilizer plays a pivotal role which increase the yield by 40-50 percent [3]. The use of fertilizer and size of nutritional area has become rather more important as the soils are running short of inherent potentials due to continuous load of high cropping intensity.

The latest production technology which gives emphasis on the use of fertilizer responsive maize varieties capable of superior performance alongwith essential agronomic practices need to be applied resourcefully. Many researchers [2,6,11,14,15] have advocated in favour of optimum use of fertilizer particularly in combination with other agronomic variables of which size of nutritional area seems to be the most important contributing factor under irrigated conditions [1,9,10,12,13]. This is, why, a dose of 120 kg N and 60 kg P_2O_5/ha is recommended to be used under the prevailing planting pattern of maize i.e. 60 x 25 cm. With the changing conditions like, introduction of new strains with a different behaviour, it becomes imperative to ascertain their needs. Consequently, the present study was conducted to determine the optimum level of fertilizer and proper spacing for ensuring a good crop harvest of Maize under irrigated conditions.

MATERIALS AND METHODS

The studies were undertaken to determine the impact of varying nutritional area on the growth and yield of Maize grown at different fertility levels at the University of Agriculture, Faisalabad during 1983-84 on a sandy loam soil having 0.31 % organic matter, 268 ppm available phosphorus, 500 ppm available potash and 8.7 PH.

The experiment was quadruplicated using split plot design with a net plot size measuring 1.20 x 6.0 m. The main and sub plots comprised of fertilizer treatments and size of nutritional area, respectively.

The following treatments were included in the studies:

A. *Fertilizer Levels:*

kg NPK/ha

1. 0 – 0 – 0
2. 150 – 0 – 0
3. 150 – 75 – 0
4. 150 – 75 – 75

B. *Nutritional Area:*

1. 60 x 20 cm – (83,000 plants/ha)
2. 60 x 25 cm – (67,000 " ")
3. 60 x 30 cm – (56,000 " ")

The crop was sown in the first week of August with the help of single row hand drill using seed rate of 30 Kg/ha. Whole of Phosphorus and potash and half of nitrogen were applied at sowing while remaining nitrogen was applied when the plants attained a height of 75 cm. All other practices were exercised uniformly for all the treatments.

For the collection of data on various plant growth and yield parameters, 10 plants were selected at random in each sub plot. Cobs were removed, sun dried and weighed after about fifteen days of harvesting. Plant height of the selected plants was measured with the help of meter rod while the grain yield was recorded on net plot basis and then converted into hectare. The collected data were analysed statistically by using the analysis of variance technique and Duncan's New Multiple Range Test at 5 percent probability was employed to test the significance of treatment means [16].

RESULTS AND DISCUSSIONS

The results pertaining to different growth and yield parameters of maize as affected by size of nutritional area at different fertility levels as presentedin (Table I) revealed that all the fertilizer levels significantly increased plant height over control but were at par with each others. Similarly size of nutritional area significantly affected plant height. The highest plants were found with 60 x 30 cm nutritional area but there was no difference in plant height in the treatments 60 x 20 cm and 60 x 25 cm. These results indicate that nitrogen enhanced plant growth resulting in increased plant height. The tallness attained by plants as found under wider nutritional area of 60 x 30 cm seems to be interesting because generally it is observed that with lesser spacings plants tend to grow taller though remain weak. But here it seems that nitrogen coupled with more sunlight might have accelerated the photosynthetic activities resulting in better plant growth and development. These results are contradictory to most of the findings which either report non-significant effect on plant or their stand show increased plant height [7,8].

Results regarding the number of cob bearing plants/ plot (Table 1 & 2) demonstrate that various fertilizer treatments and size of nutritional area have significant differences. Amongst the fertilizer treatments the highest (44.25) number of cob bearing plants were found with NPK (150 + 75 + 75 kg/ha). This is significantly at par with NP (150 + 75 kg/ha) but is significantly higher than N(150 kg/ha) and control treatments. This indicate that a suitable combination of N,P. and K contributes to enhance reproductive growth of plant. The analysis of soil has shown that sufficient quantities of available K(500 ppm) were present in the field that is the reason the plots with NP(150 + 75 kg/ha) equaled with NPK. This suggest that there is

Table 1. Effect of size of nutritional area on the grwoth and yield of maize grown at different fertility levels

Treatment	Plant height (cm)	Number of cob bearing plants per unit area (1.20 x 6.0 m)	Number of cobs per plant	Number of grains per cob	1000-grain weight (gm)	Grain yield (q/ha)
A. *Fertilizer levels (kg NPK/ha)*						
1. 0-0-0	224.71 b*	37.08 c	1.008 N.S.	301.91 C	189.83 C	17.18 C
2. 150-0-0	240.36 a	40.58 b	1.015	384.83 b	219.77 b	28.93 b
3. 150-75-0	243.96 a	43.35 a	1.018	429.81 a	241.93 a	41.84 a
4. 150-75-75	243.30 a	44.25 a	1.020	436.08 a	243.52 a	42.59 a
B. *Nutritional area*						
1. 60 x 20 cm	231.20 b	49.50 a	1.012	376.25 b	217.58 b	31.29 b
2. 60 x 25 cm	237.71 b	40.06 b	1.016	390.81 a	225.51 a	35.34 a
3. 60 x 30 cm	245.35 a	34.37 c	1.018	397.43 a	228.21 a	31.28 b

N.S. = Non-significant.

* = Any two means not sharing a letter differ significantly at 5 percent level of probability.

Table 2. Number of cob bearing plants/plot as affected by size of nutritional area at different fertility levels

Treatments (kg NPK/ha)	60 x 20 cm	60 x 25 cm	60 x 30 cm	Mean
0-0-0	45.25 bc*	35.75 f	30.25 g	37.08 c
150-0-0	46.75 b	39.50 e	35.50 f	40.58 b
150-75-0	52.75 a	42.00 de	35.25 f	43.33 a
150-75-75	53.25 a	43.00 cd	36.50 f	44.25 a
Mean	49.50 a	40.06 b	34.37 c	

* = Any two means not sharing a letter differ significantly at 5 percent level of probaility.

Table 3. Number of grains per cob as affected by size of nutritional area at different fertility levels

Treatments (kg NPK/ha)	60 x 20 cm	60 x 25 cm	60 x 30 cm	Mean
0-0-0	280.00 e*	315.50 d	306.25 d	301.91 c
150-0-0	370.50 c	378.75 c	405.25 b	384.83 b
150.75-0	427.75 a	430.00 a	431.75 a	429.81 a
150-75-75	426.75 a	435.75 a	446;50 a	436.08 a
Mean	376.25 b	390.81 a	397.43 a	

* = Any two means not sharing a letter differ significantly at 5 percent level of probability.

no need to apply K in such soils. As regards size of nutritional area, the number of plants with cobs was significantly higher (49.5) in 60 x 20 cm than other treatments. Interestingly enough the various fertilizer levels and size of nutritional area have significantly interacted (Table 2). The plots with 60 x 20 cm nutritional area and NPK (150 + 75 + 75 kg/ha) and NP(150 + 75 kg/ha) have given significantly higher (53.25 and 52.75) number of cob bearing plants than all other plots due to higher level of plant population. These two plots have shown statistically equal number of cob bearing plants and in this succession the lowest number of cob bearing plants (35.25) was observed in plots with no fertilizer and 60 x 30 cm nutritional area. However, all the plots with 60 x 30 cm and 60 x 25 cm nutritional area, and zero fertilizer remained statistically same due to low plant population level. It appears that if nutrients are applied in adequate amounts then increased economic harvest can be achieved even under high level of plant population. These results are in agreement to the previous findings [7].

It is obvious from the data (Table I) that number of cobs per plant was not affected by any of the treatments and differences remained non-significant. This is because it is a genetically controlled character and environmental conditions do not show any sort of influence in this direction. These results confirm the previous investigation [7,8].

The data show (Table 1 & 3) that number of grains per cob was significantly increased in all the treatments over control and fertilizer levels and size of nutritional area have interacted (Table 3). The application of NPK fertilizer (150 + 75 + 75 kg/ha) in 60 x 30 cm nutritional area produced maximum number of grains (446.5) per cob but was at par with NP(150 + 75 kg /ha) in 60 x 25 cm nutritional area. In case of fertilizer levels, 150 kg N/ha produced significantly less number of grains per cob than the treatments with 150 + 75 kg NP/ha and 150 + 75 + 75 kg NPK/ha but had significantly higher number of grains over control. These results follow the previous trend and are in agreement with Tiwary *et al.* [17].

Different fertilizer levels and size of nutritional area has affected the 1000-grain weight significantly. The higher 1000-grain weight was found in plot with NPK(150 + 75 kg/ha) fertilizer in 60 x 30 cm nutritional area. The 1000-grain weight in 60 x 25 cm and 60 x 30 cm nutritional area was statistically similar but significantly higher than 60 x 20 cm nutritional area. As regards NPK rates, the 1000-grain weight was equal in 150 kg N + 75 kg P_2O_5/ha and 150 kg N + 75 kg P_2O_5 + 75 kg K_2O/ha treatments but both these treatments gave significantly higher grain weight than 150 kg N/ha alone and control. However, application of 150 kg N was significantly superior over control. This suggest that nutritional area 60 x 25 cm with fertilizer level of 150 kg + 75 kg P_2O_5/ha is best combination for planting corn. These results support the findings of various researchers [12,13,17].

The grain yield was significantly affected by fertilizers and size of nutritional area but their interaction was non-significant. The treatments 150 kg N + 75 kg P_2O_5 + 75 kg K_2O and 150 kg N + 75 kg P_2O_5/ha gave statistically same yield but both these treatments showed significantly higher grain yield/ha than 150 kg N alone and control. Plants with nutritional area of 60 x 25 cm showed significantly higher grain yield than 60 x 20 cm or 60 x 30 cm while both later treatments remained statistically at par with each other. This clearly indicate that 150 kg N + 75 kg P_2O_5/ha is optimum fertilizer dose for the soil having

sufficient potash (500 ppm) and 60 x 25 cm nutritional area. The higher grain yield in 60 x 25 cm planted corn means that it gave the optimum planting density per hectare in which the plants had exploited the soil resources in a better way. These results support the findings of various research workers [5,13].

REFERENCES

1. B.A. Abukar, More food better technology, FAO, Rome Italy (1983).
2. N. Ahmad, Pak. J. Agri. Res., 1(2): 125-130 (1980).
3. Anonymous, Report of Food and Agri. Commission, Pak. Govt. Printing Press, Karachi (1960).
4. Anonymous, Agricultural Statistics of Pakistan, Ministry of Food, Agri. and Coop., Govt. of Pakistan, Islamabad (1983).
5. R.D. Arjal, D.J. Prato and L.M. Peterson, Calif. Agri. **32**(3): 14-15 (1978) Field Crop. Abst., **32(5)**: 2904; (1979)
6. S.L. Bapna and P.C. Trivedi, Ind. J. Agron. **16**(1): 134 (1971). (Field crop Absts., **26**(11): 5446; 1973).
7. J. Davelous, M. Asca and A.L. Valdez, Anales, Scientificos **9**(1): 72-93 (1971). (Field crop Absts. **26**(7): 3114; 1973).
8. F. Din, Effect of row spacing, Nitrogen fertilization and weed control on the growth and yield of corn, M. Sc. thesis, Univ. of Agri; Faisalabad (1978).
9. D. Ekka, M.M. Shahane and C.V. Srivastava, Ind. J. Agron. **22**(3): 196 (1977) (Field crop Absts., **32**(9): 6057; 1979).
10. M.S. Gill and N. Hussain, W. Pak. J. Agri. Res., 1: 108 (1964).
11. A.Y. Malik, A.A. Sheikh, V.H. Shafi and R. Hussain, W. Pak. J. Agri. Res., **6**(3): 104-109 (1968).
12. M. Naeem, Effect of NP levels and plant spacings on the growth and yield of maize variety Agaiti-72, M.Sc. thesis Univ. Agri., Faisalabad (1976).
13. R. Raj, H.S.D. Rao and K.B. Lingegeuda, Ind. J. Agri. Sci., **41**(11): 944-947 (1971). (Field crop Abst., 264): 1619. 1973).
14. K.S. Sandha, S.V. Shah and C.B. Wright, J. Res. Punjab Agri. Univ. **12**(3): 228-231 (1975).
15. C.M. Singh, R.B. Scod and C.S. Medgal, Exptl, Agri; **14**(4): 395-398 (1978).
16. R.G.D. Steel and J.H. Torrie, Principles and Procedure of Statistics, Mc-Graw Hill Book Co. Inc., New York (1960).
17. S. Tiwary M.N. Shahani and R.D. Singh, Allahabad. Farmer **44**(6): 397-400 (1970). (Field Crop Absts: **27**(2), 857; (1974).