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Effect of Different Planting Methods and Nutrient Management on Quality Traits of Hybrid Maize

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ABSTRACT

A two year field study was conducted to evaluate the growth behavior of hybrid maize under different planting techniques and nutrient levels. The planting methods comprised 70 cm spaced single rows, 105 cm spaced double-row strips and 70 cm spaced ridges. The nutrient levels were 250 kg N, 250 kg N + 150 kg P, 250 kg N + 150 kg P + 100 kg K, 250 kg N + 150 kg P + 100 kg K + 15 kg S, 250 kg N + 150 kg P + 100 kg K + 15 kg Mg and 250 kg N + 150 kg P + 100 kg K + 15 kg S + 15 kg Mg ha^{-1}. Crop was sown on ridges. The crop sown on ridges or in 105 cm spaced double-row strips produced significantly the higher grain oil, protein and starch content than the crop sown in 70 cm spaced single rows but were at par with each other. Addition of S or Mg or both with NPK increased significantly the grain protein content (GPC), grain oil content (GOC) than NPK alone.

Key Words: Planting methods; Nutrient management; Hybrid maize

INTRODUCTION

Maize (*Zea mays* L.) is an important food and feed crop which ranks third after wheat and rice in the world, because of its expanded use in the agro-industries. It is recognized as a leading commercial crop of great agro-economic value. Pakistan grows about 0.97 mha of maize with total annual production of 1.73 million tone of grain giving an average yield of 1790 kg ha^{-1} (Govt. of Pakistan, 2001) which is tremendously lower than other many maize growing countries of the world. There are many reasons of low productivity. Among them mismanagement of plant nutrition and agronomic practices are considered to be the major ones. Hence there is a need to improve these two major components of the production technology for getting higher maize production of better quality.

Of the agronomic practices, planting technique is of considerable importance as proper adjustment of plants in the field not only ensures optimum plant population but also enables the plants to utilize the land and other input resources more efficiently and resolutely towards growth and development (Ali *et al.*, 1998). According to Khaliq *et al.* (1988) and Ahmad *et al.* (2000) maize planted on paired ridges performed better than that grown in single-rows.

Balanced nutrition is an essential component of nutrient management and plays a significant role in increasing crop production and its quality. For the major processes of plant development and yield formation the presence of nutrient elements like N, P, K, S, Mg etc. in balanced form is essential (Mahmood *et al.*, 1999; Colomb *et al.*, 2000; Randhawa & Arora, 2000). Thus, there is a need to carry out a systematic research on these lines in order to develop comprehensive information in this regard. The present study was, therefore, planned to determine the effect of different planting techniques and nutrient management on various agronomic traits of hybrid maize under the agro-ecological condition of Faisalabad, Punjab, Pakistan.

MATERIALS AND METHODS

The experiment was conducted at the research area of Agronomy department, University of Agriculture, Faisalabad during the autumn of 1997 and 1998 on a sandy clay loam soil having 0.043% total N, 1 ppm available P and 125 ppm available K. The treatments comprised three planting methods {(70 cm spaced single rows, 105 cm spaced double-row strips (35/105 cm) & 70 cm spaced ridges)} and seven nutrient levels i.e. 250 kg N, 250 kg N + 150 kg P, 250 kg N + 150 kg P + 100 kg K, 250 kg N + 150 P + 100 kg K + 15 kg S, 250 kg N + 150 kg P + 100 kg K + 15 kg Mg and 250 kg N + 150 kg P + 100 kg K + 15 kg S + 15 kg Mg. The experiment was laid out in a Randomized Complete Block Design (RCBD) with a split plot arrangement keeping plantation methods in main plots and nutrient levels in subplots using three replications. The net plot size measured 4.20 x 7.5 m.

Grain protein concentration (GPC). Nitrogen content of maize grain samples, randomly selected from each sub-plot was determined by using microkjeldhal method (Anonymous, 1980) and then the crude protein content was calculated by using the following formula.

Crude protein = Nitrogen x 6.25

Grain oil concentration (GOC). Grain oil content was determined by Soxhlet method described by Low (1990).

Grain Starch concentration (GSC). Grain starch content was determined by using the method given by Juliano (1991).

RESULTS AND DISCUSSION

The crop grown in 105 cm spaced double-row strips (M_2) and on 70 cm spaced ridges (M_3) produced statistically similar starch content with a range of 72.10 to 72.14% which was significantly higher than M_1 (71.86%) in 1997 (Table I). These results are in conformity with those of Irshad (1987) and Khan (1992) who reported that GSC was higher in the crop sown on ridges and in 90 cm spaced double-row strips than 60 and 70 cm spaced single-rows, respectively. But these results are in contradiction to those of Agha (1989) who reported non-significant impact of different plantation methods on GSC.

The GSC also varied significantly among different nutrient levels in both years. Although, all the nutrient levels increased the GSC significantly over control, the grain starch level was statistically the same in F_3, F_4, F_5 and F_6 indicating thereby that application of S or Mg or S + Mg in addition to NPK did not affect the GSC to a significant level. An increase in grain starch content in response to K_2O application might be due to enhanced starch synthetase activity with adequate supply of K (Tisdale, 1990).

Grain protein concentration. The crop planted in 70 cm spaced single-rows (M_1) produced significantly less grain protein (9.12%) than that planted either in 105 cm spaced double-row strips (M_2) or 70 cm spaced ridges (M_3) which were statistically on a par with each other showing GPC of 9.33 and 9.29%, respectively (Table I) Variation in GPC under different planting patterns has also been reported by Irshad (1987) for crops sown on ridges and Muhammad (1997) for crop sown in wider rows than conventional planting method (70 & 60 cm spaced single-rows, respectively). But these results are in contradiction to those of Agha (1989).

There was significant variation among the different nutrient levels. Although all the nutrient levels increased the GPC over control, differences among F_4, F_5 and F_6 were statistically non-significant indicating thereby that application of S or Mg or S + Mg along with NPK did not affect GPC. Almost similar results were reported by Hussain *et al.* (1999) and Sakal *et al.* (2000) who narrated that addition of S to NPK increased the GPC in contrast to Ali *et al.* (2000) who observed non-significant effect of Mg on GPC. Davidescu (1965) in Switzerland and Diuf (1978) in Russia also reported significant effect of K on GPC.

Grain oil concentration. Non-significant difference between M_2 and M_3 was exhibited but both M_2 and M_3 were significantly different from M_1 and gave GOC of 4.72, 4.75 and 4.64%, respectively. These results are in consonance with those of Al-Rudha and Al-Younis (1978), Khan (1992), Esechie *et al.* (1996) and Ahmad *et al.* (2000) who reported that different planting patterns had no effect on GOC (Table I).

There was significant variation in GOC among the different nutrient levels in both years. GOC was increased significantly over control with the application of fertilizers. Among the nutrient levels, although the highest GOC (4.97%) was recorded in F_6 (250-150-100-15-15 kg NPKS Mg ha^{-1}), it was statistically similar to F_4 and F_5. The difference between F_2 and F_3 was also non-significant. It indicated that application of K did not affect the GOC to a significant level over NP. It was further observed that application of S along with NPK improved the GOC significantly over NPK. Promotive effect of sulphur in grain oil content may be due to the reason that sulphur is needed for the formation of disulfide bonds between polypeptide chains. Such disulfide linkages stabilize the various enzymes. This in turn, may increase the activity of enzyme. Besides sulphur is required for the synthesis of various metabolites reg. Coenzyme A which is involved in the oxidation and synthesis of fatty acids (Tisdale *et al.*, 1990).

Table I. Effect of different plantation methods and nutrient levels on qualitative traits of hybrid maize

Treatments						Grain starch concentration (GSC) (%)	Grain protein concentration (GPC) (%)	Grain oil concentration (GOC) (%)
Plantation methods								
M_1 = 70 cm spaced single rows						71.51 b	9.07 b	4.63 b
M_2 = 105 cm spaced double row strips						71.76 a	9.28 a	4.72 a
M_3 = 70 cm spaced ridges						71.75 a	9.26 a	4.74 a
LSD 5%						0.08	0.04	
Nutrient levels (kg ha^{-1})								
	N	P	K	S	Mg			
F_0	0	0	0	0	0	70.72 c	7.84 e	4.08 e
F_1	250	0	0	0	0	69.69 d	9.06 d	4.55 d
F_2	250	150	0	0	0	71.39 b	9.34 c	4.71 c
F_3	250	150	100	0	0	72.31 a	9.39 bc	4.78 bc
F4	250	150	100	15	0	72.32 a	9.64 a	4.96 a
F_5	250	150	100	0	15	72.46 a	9.50 b	4.83 b
F_6	250	150	100	15	15	72.50 a	9.64 a	4.96 a
LSD (0.05)						0.45	0.13	0.11

Means in a column not sharing a letter differ significantly at 0.05 P; NS = Non-significant

Almost similar trend was exhibited during 1998. By contrast, 2-year average data revealed that there was a non-significant difference between F_4 and F_6 but both these treatments differed significantly from F_5 indicating thereby that Mg is in synergy with sulphur.

The contrasts F_0 vs. (F_1 … + F_6), F_1 vs. (F_2 … + F_6) were highly significant in both years, while the contrast F_2 (F_3…. + F_6) was highly significant in 1997 and significant in 1998. Similarly, the contrast F_3 vs. (F_4…. + F_6) was significant in 1997 but non-significant in 1998. The rest of the contrasts i.e. F_4 vs. (F_5 + F_6) and F_5 vs. F_6 were non-significant in both years.

The interaction between M x F was, however, non-significant in both years. Similar results were reported by Davidescu (1965) who observed significant role of K in increasing the GOC over NP and Sachev and Deb (1990) who recorded an increase in GOC of maize when S was applied along with NPK.

REFERENCES

Agha, K.H., 1989. Studies on maize productivity as affected by maize legume intercropping and geometry of planting. *Ph.D. Thesis*, Dept. Agron., Univ. Agri., Faisalabad, Pakistan

Ahmad, G., Z. Qureshi and H. Ullah, 2000. Effect of different sowing methods on the performance of sunflower. *Pakistan J. Biol. Sci.*, 3: 1829–31

Ahmad, R., N. Ahmad, S. Ahmad and T. Ahmad, 1993. Source-sink relationships in maize under varying nitrogen regimes. *Pakistan J. Agric. Res.*, 14: 173–6

Ahmed, M.A., 1989. Response of leaf surface and growth of maize varieties to nitrogen rates. *Ann. Agric. Sci.* (*Cairo*), 34: 873–87

Ali, M., S.K. Khalil, S. Ayaz and M.I. Marwat, 1998. Phenological stages, flag leaf area, plant height, and leaves per plant of corn influencd by phosphorus levels and plant spacing. *Sarhad J. Agric*., 14: 515–22

Anonymous, 1995. Flat versus ridge sowing. *Annual Report* p. 19, 1994-95 MMRI, Yousafwala, Pakistan

Bajwa, M.S., A. Akhtar, M.R. Hussain, and M.B. Raja, 1987. Effect of irrigation frequencies and nitrogen rates on the yield and protein contents of maize. *Pakistan J. Agric. Res.*, 8: 325–8

Beadle, C.L., 1987. *Plant Growth Analysis. In:* Coomlos, J.D.O. hall, S.P. Long and J.M.O. Scurlock (eds.), *Techniques in Bio-productivity and Photosynthesis*, 2nd Ed., pp: 21–2. Pergamon Press, Oxford, New York

Bennett, J.M., L.S.M. Mutti, P.S.C. Rao and J.W. Jones, 1989. Interactive effect of nitrogen and water stresses on biomass accumulation, nitrogen uptake and seed yield of maize. *Field Crop Res.*, 19: 297–311

Biagovestra, S.T., 1981. Rate and ratios of mineral fertilizers for maize under irrigation on the leached chernozem smolnits a poil of the Yambal region Bulgaria ii) Effect of fertilizer application on maize growth and development. *Rastenieved Nauki*, 18: 94–8 (*Biol. Absts.*, 14: 65694; 1982)

Colomb, B., J.R. Kiniry and P. Debacke, 2000. Effect of soil phosphorus on leaf development and senescence dynamics of field grown maize. *Agron. J.*, 92: 428–37

Govt. of Pakistan, 2001. *Economic Survey Govt. of Pakistan*, 2000-2001. pp: 15–3. Finance Division, Economic Advisory Wing, Islamabad, Pakistan

Irshad, J., 1987. Effect of different planting methods on growth, yield and quality attributes of maize cv. Akbar. *M.Sc. (Hons.) Agri. Thesis*, Dept. of Agron., Univ. Agri., Faisalabad, Pakistan

Jafar, M., N. Ali, K.H. Hassani and M.Ayyub. 1988. Effect of planting pattern on growth and yield of summer maize. *J. Agric. Res.*, 26: 41–4

Keerio, H.K. and S.P. Singh, 1985. Effect of intercropping on yield of hybrid sorghum under different nitrogen levels. *Pakistan J. Agric. Res.*, 6: 26–7

Khaliq, A., M. Munir and J. Asif, 1988. Effect of different planting methods on some agronomic and physiological traits of maize. *Pakistan J. Agric. Res.*, 9: 145–58

Khan, H., 1992. Studies on production potential of maize in relation to legume association and trace elements application. *Ph.D. Thesis*, Dept. Agron, Univ. Agri. Faisalabad, Pakistan

Khan, H., M.Q. Khan and M.S. Nazir, 1994. Yield and yield components of spring maize as affected by planting geometry and associated legume cultures. *Gomal Univ. J. Res.*, 14: 12–9

Mahmood, T., M. Saeed, R. Ahmad and A. Ghaffar, 1999. Water and potassium management for enhanced maize (*Zea mays* L.) Productivity. *Int. J. Agri. Biol.*, 1: 314–22

Maman, N., S.C. Mason, T. Galush and M.O. Clegg, 1999. Hybrid and nitrogen influence on pearl millet production in nebraska: Yield, growth, and nitrogen uptake, and nitrogen use efficiency. *Agron. J.*, 91: 737–46

Mohsan, S., 1999. Population dynamics and nitrogen management effects on maize productivity. *Ph.D. Thesis*, Dept. Agron. Univ. Agri., Faisalabad, Pakistan

Moussa, B.I.M. and M.S. Bersoum, 1995. The mutual effect of sulphur and magnesium under Zn application on maize at South Tahreer Province. *Ann. Agric. Sci. Mashtohar*, 33: 1035–50

Randhawa, P.S. and C.L. Arora, 2000. Phosphorus-sulphur interaction effects on dry matter yield and nutrient uptake by wheat. *J. Indian Soc. Soil Sci.*, 48: 536–40

Tariq, M., J.M. Nelson and J.A. Gartner, 1999. Interactive effect of nitrogen and phosphorus on dry matter weight, root growth, nutrient concentration and grain yield of corn. *Pakistan J. Soil Sci.*, 9: 74–9

Tisdale, S.L., W.L. Nelson and J.D. Beaton, 1990. *Soil Fertility and Fertilizer. Elements Required in Plant Nutrition.* 4th Ed. pp: 52–92. Max well MacMillan Pub., Singapore

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