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GROWTH AND YIELD PERFORMANCE OF MAIZE SEEDED IN LINE AND BROADCASTED TO VARYING DOSES OF NITROGEN

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ABSTRACT. Improving production through better agronomic management is continued to feed ever-increasing population. The objective of this study was to quantify the effect of N on maize seeded in line or broadcasted. Treatments included four level of urea nitrogen (N), i.e. 0, 60, 120 and 180 kg ha^{-1} and two sowing techniques, i.e. drill sowing (improved) and broad cast (farmer practice). Improved method of sowing had improved yield and yield contributing parameters whereas emergence m^{-2} and biological yield was higher in broadcast method of sowing. Increasing N application had increased biological yield, number of plants at harvest and grains ear^{-1} linearly. Cobs per plant, grain yield, 1000 grains weight and harvest index showed sigmoid response to N application and was maximum at 120 kg N ha^{-1}. Sowing of maize seed in line method and receiving 120 kg N ha^{-1} had increased grain yield by 45% over broad cast method of sowing receiving the same dose of nitrogen. However, the farmer practices method had increased the forage (straw) when received higher amount of N, i.e. 180 kg N ha^{-1}. Thus, it is concluded from the experiment that application of 120 kg N ha^{-1} and seed sown in line had increased the yield and yielding parameters, compared to other treatments and is, therefore, recommended for general cultivation of variety Azam in agro-climatic condition of Peshawar.

Keywords: agronomic management; maize production; nutrients; sowing methods.

INTRODUCTION

Maize (*Zea mays* L.) is the staple food of the mountainous areas of the province (Khan *et al.*, 2003) and is given priority when chilling conditions and snowfall limit the growing period of other cereals, due its short duration status (Saeed and Saleem, 2000). It is also the third important crop of the country after wheat and rice (GOP, 2009). It is used as a staple food for humans as a feed

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for livestock and as a raw material for industry.

Maize production needs to be improved to feed the growing population. Its production is influenced by management of the previous crop (Wiatrak *et al.*, 2006), but is also dependent on current year management. The major problems regarding low productivity could be the traditional method of sowing (Badar and Din, 2005), imbalance use of nutrients (Sharma *et al.*, 2003) and other management practices. The farmer used traditional methods of growing, which is less productive as well as highly laborious and time consuming. Maize can be grown according to modern and improved sowing methods, i.e. mechanical method of sowing in contrast to broadcast method of sowing (Asharfi *et al.*, 2009). Line method of sowing had improved yield and yielding components in maize (Arif *et al.*, 2001; Somroo *et al.*, 2009), compared to broadcast method of sowing. Line sowing minimize lodging in maize crop Sharma and Saxena (2002), compared to flat bed and thus improve crop productivity.

The continuous declining of soil fertility is still attracting the scientist toward the nutrients management. Nitrogen fertilization plays a significant role in improving soil fertility and increasing crop productivity (Habtegebrial et al., 2007). Soil receiving optimum nitrogen improves productivity, as well as farmer livelihood (Khan *et al.*, 2009). Nitrogen fertilization results in increased grain yield (43-68 %) and biomass (25-42 %) in maize. It improved the individual plant performance (Khan *et al.*, 2005), as well as yield and yielding components (Khan *et al.*, 2009).

Information about how the maize crop interacts morphologically and physiologically in improved sowing method receiving different level of nitrogen is lacking for the maize growers. This necessitates exploring the management practice, which can maximize and optimize the maize yield.

MATERIALS AND METHODS

A field experiment was carried out at the Agricultural Research Farm of Khyber Pakhtunkhwa Agricultural University Peshawar Pakistan (71º E and 35º N), during 2009. The soil of the experimental farm is a silt clay loam with mean annual rainfall about 360 mm (Khan *et al.*, 2009). The experimental soil was deficient in mineral N and organic matter.

The experiment was carried out in randomized complete block design with split plot arrangement having three replications. The sowing method (drill vs. broad cast) was allotted to main plots, whereas urea N level (0, 60, 120,180 kg N ha^{-1}) to subplots. Urea (46% N) was applied in a split application, half at sowing and the other half just after first irrigation (after 15 days). Subplots of 4.5 x 5 m with six rows 75 cm apart and 5 m long were maintained in the experimental field. Phosphorus (P_2O_5) was applied at the rate of 100 kg ha^{-1} before sowing. All other agronomic practices were applied uniformly to all sub plots.

Seedling emerged in two central rows were counted when 80% seedling emerged in each sub plots to record emergence m^{-2}. Plant height was recorded by measuring the length of randomly selected ten representative plants. Grains/cobs were recorded by counting the grains in five randomly selected cobs, after threshing manually. At harvest maturity plants in two central rows were counted, and then harvested and dried to record plants ha^{-1}, grain yield and biological yield accordingly. After threshing, 1000 grains were counted and were weighed to record the thousand grain weight. After completing emergence, plants from 0.5 m^{-2} was harvest at a regular interval of 20 days for recoding fresh and dry weight of the crop.

Analysis of variance (ANOVA) and standard errors of means was used for hypothesis testing. The statistical software GenStat release 7.22 DE (GenStat, 2009) was used for analysis of all data.

RESULTS AND DISCUSSION

Yield contributing parameters

Plant stand in term of plants ha^{-1} was higher in broadcast method of sowing, compared to line method of sowing (*Table 1*). This higher plant stand in broadcast method of sowing could be associated with the plant morphology in broadcast method, and/or might be due to non-uniform plants spacing. Plants stand was not affected by nitrogen application. Our results are in disagreement with the finding of Soomro *et al.* (2009), who reported that plant nutrients affect the plants stand at harvest.

Table 1 - Plant stand, yielding components, and biological yield of maize as affected by sowing method and nitrogen application.

Treatments	Plants ha^{-1}	Grains per cob	1000 grains weight (g)	Cobs $plant^{-1}$	Biological yield (kg ha^{-1})	Harvest index (%)
Sowing methods						
Broadcast	54527	273	211.26	1.16	11729	19.40
Drill	38527	330	243.79	1.22	9149	35.11
Significance	**	*	NS	NS	**	**
Urea N kg ha^{-1}						
0	44444	279	198.69	1.11	9362	27.88
60	45833	285	222.83	1.15	10153	27.84
120	46611	286	264.50	1.31	10413	28.29
180	49222	347	224.74	1.15	11827	23.96
$LSD_{0.05}$	NS	49.69*	26.21**	NS	328.9**	1.12**

* and ** - mean significant at p≤0.05 and 0.01, respectively

Other yield contributing parameters, i.e. 1000 grain weight, and cobs per plant were not affected by sowing methods. Whereas, improved sowing method had increased grains per cob than farmer practice sowing method (*Table 1*). The probable reason could be the sufficient interplant distance, which allowed the plants to grow well, compared to broadcast method of sowing (Arif *et al.*, 2001). In line sowing, the plants have started tasseling and silking before the broadcast sown crop so the maximum time availability for line-sowing crop to produce grains could be the other possible reason. Fertilizer application had affected grains per cob, 1000 grain weight, but had not affected cobs per plant. A linear increase in grains per cob and thousand grains weight was observed with increasing N application up to 180 kg ha^{-1}. Our results are in line with the finding of Maqbool *et al.* (2006). The possible reasons for improved grains per cob and grains weight could be associated with optimum nutrients supply to the plants (Soomro *et al.*, 2009). The individual plants performance in N applied plots could be the other probable reasons for improved grains per cob and heavier grains.

Biological yield

Improved sowing method had lesser biological yield than farmer practice sowing method (*Table 1*). The green herbage of the plants directly affects biological yield, which was higher in broadcast method than line method of sowing. Furthermore, the higher plants ha^{-1} in broadcast method had added to higher biological yield. A 26% increase in biological yield was observed when N application increased from control to 180 kg N ha^{-1}. The biological yield was also linearly increased with increasing N rates. The probable reason could be the improved vegetative growth of the plants due to N application, which would have increased the leafiness of wheat and, thus, had resulted in higher biological yield (Chaudhry and Jamil, 1998). The improved individual plant performance might be the other possible reasons for improved biological yield in N applied plots.

Grain yield

Grains yield was significantly affected by sowing methods and nitrogen application (*Fig. 1*). Line method of sowing had higher grain yield than broadcast method at all levels of N application. The improved grain yield in drill method might be due to lesser N losses (Arif *et al.*, 2001), optimum plant geometry (Soomro *et al.*, 2009) and lesser weed density (Ashrafi *et al.*, 2009). The equal opportunity to all plants for nutrients to the plants, and improved water use efficiency as well as light use efficiency in line sowing could be the other possible reasons for improved grain yield. Statistical analysis revealed that grain yield increased with increasing N rates from control to 120 kg N ha^{-1}, in both improved as well as broadcast method of sowing, and thereafter decrease. This trend could be associated with supply of nutrients in N applied plots, compared to the control, which had improved the grain yield (Khan *et al.*, 2009). The higher N had delayed the reproductive stage and, thereby, reduced the grain filling duration, which could have decreased the grain yield.

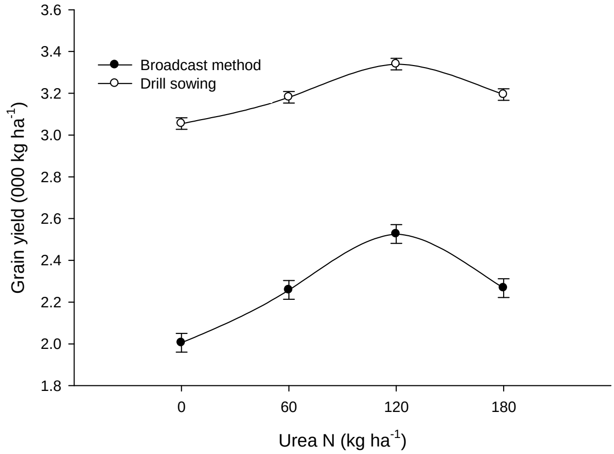

Figure 1 - Grain yield of of maize as affected by sowing method and urea nitrogen application. Vertical bars are standard error of means.

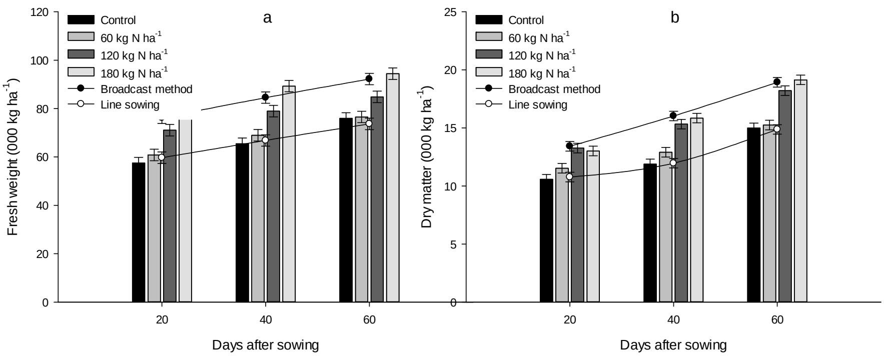

Figure 2 - Fresh weight (a) and dry weight (b) of maize as affected by sowing method and urea nitrogen application. Vertical bars are standard error of means.

Harvest index

Harvest index was significantly affected by sowing methods and nitrogen levels (*Table 1*). Maximum harvest index was calculated in line sowing, while the minimum harvest index was calculated in broadcast sowing. It may be due to the reason that line sowing has produced more grain yield but less biological yield while, in case of broadcast method, it was *vice versa*. Increasing nitrogen levels from zero to 120 kg ha^{-1} increased the harvest index, but with further increase in nitrogen decreased the harvest index. Our findings are in line with the results obtained by Bangarwa *et al.* (1990), who reported that harvest index increased with increasing nitrogen rate.

Fresh and dry matter yield

Interactive response of days to cutting, nitrogen and sowing method was significant for fresh weight of maize, while non-significant for dry matter (*Fig. 2*). Delaying days to cutting increased fresh weight in both method of sowing, however, the increment is higher in broadcast method than line method. In the same way, increasing nitrogen and delaying days to cutting had increased fresh matter. Decrease in days to cutting decrease the fresh weight. The improved average leaf area in wheat (Kibe *et al.*, 2006) could be associated for higher fresh matter in N fertilized plots (Habtegebrial *et al.*, 2007). At all fertilizer levels, the dry weight increased linearly with delaying cutting in both line, as well as broadcast method of sowing. At all N interval, the line method of sowing had higher dry weight than broadcast method. Dry matter are closely associated with N (Miller, 1939) and, hence, crop productivity. N remobilization into grain occurred from vegetative reserve (Simpson *et al.*, 1983) and account for about 60 to 92% of N accumulated in the gains at maturity (Papakosta and Gagianas, 1991).

CONCLUSIONS

It was concluded form the experiment that drill sowing had improved the grain yield at 120 kg N ha^{-1} in addition to other yield contributing parameters, whereas broadcast method of sowing had increased the forage (biological yield), when higher amount of N was applied to the plants. Increasing N rate up to 120 kg N ha^{-1} had increased both grain and biological yield, and thereafter no increment was observed. About five-six times greater fresh weight was observed at each sampling date, compared to dry weight of sampled maize.

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