Effect of Planting Methods and Fertility Level on Growth of Hybrid Maize

Rima Taipodia* and N. D. Singh

Krishi Vigyan Kendra
West Kameng, Dirang-790 101 (Arunachal Pradesh)

ABSTRACT

A field study was conducted to assess the growth behaviour of hybrid maize variety Allrounder under different planting methods and nutrient levels. The treatments comprised of three planting methods i.e. flat sowing in single row at 70 cm spacing, in double-rows on strips of 105 cm wide and on ridges at 70 cm spacing. The nutrient levels tested 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. Leaf area index (LAI) of 4.21, dry matter (DM) of 1377.61 g/ m^2, crop growth rate (CGR) of 30.11 g /m^2 /day and net assimilation rate (NAR) of 7.08 g /m^2 /day were found significantly higher ($P<0.05$) in crop sown on ridges than on flat surface. The effect of application of sulphur was significant on growth parameters of maize as LAI, DM, CGR and NAR were higher in treatments where 15 kg S was applied along with 250 -150 kg NP than NP alone. The effect of application of S or Mg or both S + Mg to NPK 250--150-100 kg/ha was significant in terms of increase in growth of maize than NPK alone.

Key Words: Hybrid maize; Planting methods; Nutrient management, Sulphur, Magnesium

INTRODUCTION

Maize (Zea *mays* L.) is an important cereal crop and ranked third in production after wheat and rice. It has great nutritional value as it contains about 72 per cent starch, 10 per cent protein, 4.8 per cent oil, 8.5 per cent fiber, 3 per cent sugar and 1.7 per cent ash Chaudhary (1983). In most of the developing countries, about 50 to 55 per cent of the total maize production is consumed as food. Requirement of about 305 MT of food grains is anticipated for 1.4 billion population of India and the anticipated demand for individual food grains has been expected to about 120 MT for rice, 95 MT for wheat, 25 MT for maize and 24-26 MT for pulses by the year 2025 Tiwari (2001). Due to higher yield potential, short growing period, high value for food, forage and feed for livestock, poultry and a cheaper source of raw material for agro-based industry, it is increasingly gaining an important position in the cropping system. Among the many reasons for low productivity, mismanagement of plant nutrition and agronomic practices are considered to be the major ones. Hence, for getting higher maize production of better quality, there is a need to improve these two major components of the production technology.

Planting technique is of considerable importance among the agronomic practices, as appropriate adjustment of plants in the field not only ensures optimum plant populace but also enables the plants to exploit the land and other input resources more efficiently and definitely towards growth and development. Maize planted on paired ridges performed better than that grown in single-rows (Khaliq *et al.,* 1988; Ahmad *et al.,* 2000). For increasing crop production and its quality, balanced nutrition plays a significant role and is an essential component of nutrient management. The presence of nutrient elements like N, P, K, S, Mg etc. in balanced form is essential for the major processes of plant development and yield formation.

The present study was, therefore, planned to assess the effect of different planting methods and

* STO O/o Deputy Commissioner, Dibang Valley, Annini, Arunachal Pradesh
Corresponding author e-mail: rtaipodia@yahoo.com

nutrient management on various agronomic traits of hybrid maize variety Allrounder under the agro-ecological condition of Dirang, West Kameng, Arunachal Pradesh.

MATERIALS AND METHODS

The experiment was conducted at the KVK farm, Dirang, West Kameng, on a sandy clay loam soil having 0.053% total N, 1 ppm available P and 135 ppm available K. The treatments comprised three planting methods:

M_1: Flat sowing at 70 cm spaced single rows,

M_2: Flat sowing at 105 cm spaced double-row strips (35/105 cm)

M_3: Sowing at 70 cm spaced ridges

and seven nutrient levels as given under :

Sr. No.	Name of Treatment	Dose (kg/ha)				
		N	P	K	S	Mg
1	$N_0P_0K_0$	0	0	0	0	0
2	$N_1P_0K_0$	250	0	0	0	0
3	$N_1P_1K_0$	250	150	0	0	0
4	$N_1P_1K_1$	250	150	100	0	0
5	$N_1P_1K_1$ S	250	150	100	15	0
6	$N_1P_1K_1$ Mg	250	150	100	0	15
7	$N_1P_1K_1$ SMg	250	150	100	15	15

The plot size was 4.20 x 7.5 m. with a split plot arrangement, keeping plantation methods in main plots and nutrient levels in subplots using three replications, the experiment was laid out in a Randomized Complete Block Design (RCBD).

Plant growth analysis:

Leaf area index (LAI) was calculated as the ratio of total leaf area to land area as:

$$LAI = \frac{\text{Leaf area } (m^2)}{\text{Land area } (m^2)} \times 100$$

Dry matter accumulation (DMA):

Five plants were taken from each treatment at 30, 45, 60, 75 and 90 days after sowing for calculating DMA. Each plant was chaffed, mixed thoroughly and then sun dried. The samples were placed in an oven at 70°C±5°C to dry the plant material to their constant dry weight. The dry weight per plant was calculated and converted into dry matter per unit land area (m^2).

Crop growth rate:

Crop growth rate (CGR) was calculated as per the formula given by Beadle (1987)

$$CGR = \frac{W2 - W1}{t_2 - t_1}$$

Where W2 = DW m^{-2} land area at second harvest

W1 = DW m^{-2} land area at first harvest

t_2 = time corresponding to second harvest

t_1 = time corresponding to first harvest

Net assimilation rate:

Net assimilation rate (NAR) was determined using the formula given by Beadle (1987).

$$NAR = \frac{TDM}{LAD}$$

Where,

TDM = Total dry matter

LAD = Leaf area duration

Leaf Area Duration (LAD) was calculated by the formula of Beadle (1987).

$$LAD = (LAI_1 + LAI_2) \times (t_2 - t_1)/2$$

Where,

LAI_1 = Leaf area Index at t_1

LAI_2 = Leaf area index at t_2

t_1 = time of first observation

t_2 = time of second observation

RESULTS AND DISCUSSION

At a particular growth stage, the leaf area index (LAI) of the crop indicates its photosynthetic potential or the level of its dry matter accumulation. Increased DMA potential of the crop was due to more LAI, and vice versa. The two years average data showed that LAI of crop

was very low in the beginning (30 DAS) but effect of different plantation methods and the fertilizer treatments was significant in both years. It increased progressively and reached the maximum at 75 DAS and thereafter declined at 90 DAS with the progression of the growth period.

As evident from Table 1, at 75 DAS, the average LAI was significantly ($P<0.05$) higher (4.21) in the crop planted at 70 cm spaced ridges (M3) than that recorded in M_2 (4.19) and M_1 (4.02) which were also statistically different from each other. These results substantiate the findings of Irshad (1987) and Khaliq *et al.,* (1988) who observed that higher LAI in the crop sown on ridges was probably due to more availability of nutrients and moisture in ridges. The different nutrient levels also affected the LAI significantly. The non-significant differences among $N_1P_1K_1$ S, $N_1P_1K_1$ Mg and $N_1P_1K_1$SMg suggest that S or Mg or both S + Mg along with NPK had no effect on LAI. The observations are in line with findings of Keerio and Singh (1985) and Colomb *et al.,* (2002).

The effect of planting method on DMA was statistically significant. At 75 DAS, the maximum DMA (1377.61g/m^2) was recorded in the crop planted on 70 cm spaced ridges followed by crop planted at 105 cm spaced double-row strips (M_2) and 70 cm spaced single-rows (M_1) which produced dry matter of 1332.02 g/m^2 and 1232.74 g/m^2 respectively. Higher DM accumulation in M_3 can be attributed to more interception of solar radiation because of better orientation of the crop plants as compared to M_2 and M_1. The results were in corroboration with findings of Khaliq *et al.,* (1988) and Anonymous (1995).

Among various nutrient levels, in $N_1P_1K_1$ S, $N_1P_1K_1$ Mg and $N_1P_1K_1$SMg treatments, differences in DM production were non-significant indicating that application of Mg along with NPK over NPKS did not affect the DM production. However, significant increase in DM in $N_1P_1K_1$treatment plots over $N_1P_1K_0$ and $N_1P_1K_1$ +S over $N_1P_1K_1$ respectively can be attributed to K and S application.

The crop growth rate at (30-75) DAS was significantly higher in the crop planted on 70 cm spaced ridges (M_3) than that grown either in 105 cm spaced double- row strips (M_2) or in 70 cm spaced single-rows (M_1). The finding are contrary to those of Khan *et al.,* (1994) who reported that CGR of maize crop grown in 105 cm spaced double row strips was significantly higher than that grown on ridges.

Table 1. Growth analysis of maize as influenced by planting methods and nutrient management.

Treatments	Leaf area index (LAI) at 75 DAS	Dry matter accumulation at 75 DAS (g/m^2)	Crop growth rate (CGR) g/ m^2 /day (30--75) DAS	Net assimilation rate (NAR) g/m^2 /day at (30-75)DAS
Plantation methods				
M_1 = 70 cm spaced single rows	4.02 c	1232.74 c	26.96 c	6.57 c
M_2 = 105 cm spaced double row strips	4.19 b	1332.02 b	29.14 b	6.88 b
M_3 = 70 cm spaced ridges	4.21 a	1377.61 a	30.11 a	7.08 a
LSD at 5%	0.01	2.82	0.06	0.02
Nutrient levels				
$N_0P_0K_0$	2.47 e	716.23 f	15.94 f	5.73 f
$N_1P_0K_0$	3.79 d	1199.63 e	26.20 e	6.68 e
$N_1P_1K_0$	4.32 c	1361.21 d	29.74 d	6.91 d
$N_1P_1K_1$	4.56 b	1452.97 c	31.77 c	7.06 c
$N_1P_1K_1$ S	4.61 a	1490.42 ab	32.54 ab	7.18 ab
$N_1P_1K_1$ Mg	4.61 a	1479.42 a	32.28 a	7.12 bc
$N_1P_1K_1$ SMg	4.62 a	1498.99 a	32.69 a	7.23 a
LSD at 5%	0.02	14.49		0.07

Although the CGR was the highest in the crop fertilized with $N_1P_1K_1$ S Mg among the fertilizer treatments, yet it was statistically on a par with $N_1P_1K_1$ S. In principal, CGR was significantly ($P<0.05$) higher in the fertilized crop than the unfertilized crop. This type of growth rate variation was also reported by Mohsan (1999) who reported an increase in CGR of maize crop with the application of nitrogen over control. Similarly, Biagovestra (1981) reported an increase of CGR by addition of P to N alone. These results also corroborate the finding of Mahmood *et al*., (1999).

During the period of 30-75 DAS, the highest NAR (7.08 g/ m^2 /day) was recorded in the crop planted on 70 cm spaced ridges (M_3) against 6.88 and 6.57 in M_2 and M_1, respectively as per the recorded assimilation rate (NAR) . NAR increased significantly with addition of more elements in fertilizers i.e. up to $N_1P_1K_1$ S and obtained the maximum (7.23 g/ m^2 /day) in $N_1P_1K_1$ S Mg, yet, the difference between $N_1P_1K_1$ S Mg and $N_1P_1K_1$ S was found no significant. It indicated that application of S or Mg did not show any effect on NAR of the crop. Mohsan (1999) also reported variation in NAR as a result of different levels of fertilizers.

CONCLUSION

It can be concluded that hybrid maize performed better when sown on ridges. The growth indicated by LAI, DM, CGR and NAR were found significantly higher with addition of 15 kg S and /or 15 kg Mg to NPK. Hence, for analyzing crop performance in response to agronomic treatments, the results suggested that crop growth analysis is a valuable tool.

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