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Productivity and profitability of maize as influenced by genotypes, spacing and nutrient levels under irrigated situation

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Abstract

A field experiment was conducted on "Productivity and profitability of maize as influenced by genotypes, spacing and nutrient levels under irrigated situation" during the *Kharif* 2019 at Agriculture Research Station, Siruguppa, Karnataka, India. It is situated on the latitude of 15°38' N, longitude 76°54' E, 380 m elevation from MSL belongs to Northern Dry Zone (Zone 3) of Karnataka. The soil of the experimental site was medium deep black cotton soil with organic carbon content of 0.43 per cent, low in available N (226 kg ha⁻¹), medium in available phosphorus (18 kg ha⁻¹) and high in potassium (380 kg ha⁻¹) content. Trail consisting 12 treatment combinations of 3 genotypes viz. V₁: GPMH 1101, V₂: GH 0727 and V₃: RCRMH 4 in main plots, two spacing S₁: 60cm x 20cm and S₂: 45cm X 20cm in sub plots and two nutrient levels F₁: 150:75:37.5 kg NPK/ha and F₂: 225:112.5:56.5 kg NPK/ha in sub-sub plots laid out in split-split plot design and replicated three times. The experimental results revealed that, among the genotypes, RCRMH 4 recorded higher maize grain (8939 kg ha⁻¹), stover yield (14167 kg ha⁻¹) compared to other genotypes. Spacing did not influenced on grain and stover yield. Maize fertilized with 225:112.5:56.5 kg NPK/ha registered significantly superior grain (8085 kg/ha) and stover yield (13013 kg/ha) than lower dose. Similarly, maximum gross return (Rs. 140249/ha), net return (Rs.110651/ha) with B: C (4.75) was recorded in RCRMH 4 compared to other genotypes. Application of 225:112.5:56.5 kg NPK/ha gave higher gross, net returns and B: C of Rs. 126989 /ha, Rs. 96034/ha and 4.11, respectively than lower fertilizer dose. Similar trend in cob weight, 100 seed weight, cob length, cob girth, number of grain rows per cob and grain rows per cob were observed in RCRMH 4 and higher dose of fertilizer compared to rest of the genotypes and fertilizer level. But, spacing did not significantly influence on monetary returns.

Keywords: Maize, genotypes, spacing, fertilizer levels, grain and stover yield, yield parameters, gross return, net return and BC ratio.

Introduction

Maize (*Zea mays* L.) is an important cereal crop in the world and contributes to food security in most of the developing countries. Globally, it is popularly known as queen of cereals due to its highest genetic yield potential among the cereals. Maize is emerging as third most important crop in India after rice and wheat. Since it is having wider adaptability under varied agro-climatic conditions and it can be cultivated in different seasons and ecologies for multiple purposes. At present, out of the total maize produced, nearly 55 per cent is used as food, about 14 per cent for livestock, 18 per cent for poultry feed, 12 per cent for starch and one per cent as seed. Maize consists of 71.5 per cent starch, 1.9 per cent protein, 4.8 per cent fat and 1.4 per cent ash (Rathore, 2001) ^[1]. It is not only used as human food and animal feed but at the same time it is also widely used in corn starch industry, corn oil production, and as baby corn in different recipes also (Singh, 2014) ^[14]. Maize is being cultivated in an area of 10.2 m ha with a production of 26.2 m t with an average productivity of 2.57 t ha⁻¹ in India, and it is being the fourth largest producer in the world contributing three percent of the global production (Anon., 2017) ^[2]. In Karnataka, it occupies an area of 12.67 lakh ha with a production of 3.31 m t and an average productivity of 2.6 t ha⁻¹ (Anon., 2016) ^[1].

The main aim of agronomists is to achieve higher grain yield of crops either in rainfed or in irrigated ecosystem through maintenance of optimum plant density is the most important factor. A spatial arrangement of plant governs the shape and size of the leaf area per plant,

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which in turn influences efficient interception of radiant energy as well as proliferation and growth of roots and their activity. Maximum yield can be expected only when plant population allows individual plant to achieve their maximum inherent potential. Therefore, there is need to work out an optimum population density by adjusting inter and intra row spacing in relation to other agronomic factors. In addition judicious use of fertilizer is a key to get higher maize yield as they alone contribute 40-60 per cent of the crop yield (Mathukai, 2014) ^[6]. Maize is known for its nutrient exhaustive crop and requires huge quantities of nitrogen and phosphorus. Besides, every year either public or private sectors are releasing new genotypes both in India as well as in Karnataka state also. These newly released genotypes have the potential to give more yields. In this context agronomic practices such as seed rate, plant population and fertilizer management are known to affect crop environment, which influence the growth and ultimately the yield (Lomte and Khuspe, 1987) ^[5]. Keeping all these points in view, the present investigation was carried out to study the productivity and profitability of maize genotypes as influenced by spacing and nutrient levels under irrigated situation.

Materials and methods

A field experiment was conducted on "Productivity and profitability of maize as influenced by genotypes, spacing and nutrient levels under irrigated situation" during the *Kharif* 2019 at Agriculture Research Station, Siruguppa, Karnataka, India. It is situated on the latitude of 15°38' N, longitude 76°54' E, 380 m elevation from MSL belongs to Northern Dry Zone (Zone 3) of Karnataka. The soil of the experimental site was medium deep black cotton soil with organic carbon content of 0.43 per cent, low in available N (226 kg ha⁻¹), medium in available phosphorus (18 kg ha⁻¹) and high in potassium (380 kg ha⁻¹) content. Trial consisting 12 treatment combinations of 3 genotypes viz. V₁: GPMH 1101, V₂: GH 0727 and V₃: RCRMH 4 in main plots, two spacing S₁: 60cm x 20cm and S₂: 45cm X 20cm in sub plots and two nutrient levels F₁: 150:75:37.5 kg NPK/ha and F₂: 225:112.5:56.5 kg NPK/ha in sub-sub plots laid out in split-split plot design and replicated three times. All the other agronomic practices were kept normal and uniform for all the treatments. At crop maturity observations on desired parameter were recorded

using standard procedures. The data collected were statistically analyzed by using Fisher's analysis of variance technique and treatment means were compared by LSD (Steel and Torrie, 1984) ^[16].

Results and discussion

Effect of genotypes, spacing and fertilizer levels on yield

Maize yield was greatly influenced by genotypes, spacing and fertilizer levels (Table 1). The results revealed that among the genotypes, RCRMH 4 recorded significantly higher maize grain (8939 kg ha⁻¹) and stover yields (14167 kg ha⁻¹) compared to other genotypes. The magnitude of increase in grain yield with RCRMH 4 was to the extent of 17.1 to 32.3 over GH0727 and GPMH1101, respectively. This might be due to genetic makeup of the plant, internally morphological characters and insect, disease resistance coupled with higher values of yield attributing parameters (Vishuddha, 2015) ^[17] and (Sharanabasappa and Basavanneppa, 2019) ^[12]. Among the spacing, even though there were no significant differences in the maize grain and stover yields. However, 60 cm x 20 cm produced numerically higher grain (7697 kg/ha) and stover yields (11824 kg/ha) compared to 45cm x 20 cm. This might be due to plant receive more sunlight by the canopy of plant and sufficient nutrient from the soil which results higher growth of plant and maximum yield attributes (Rao, 2010) ^[9] and Vishuddha, 2015) ^[17]. In the present study maize fertilized with 225:112.5:56.5 kg NPK/ha registered significantly superior grain yield (8085 kg/ha) and stover yields (13013 kg/ha) compared to application of 150:75:37.5 kg NPK ha⁻¹ (6850 kg ha⁻¹ and 10610 kg ha⁻¹, respectively). This might be due to the fact that higher levels of NPK led to adequate supply of nutrients to the plant resulting in better growth which in turn led to better physiological process and movement of photosynthates to sink. These results are in cognizance with findings of Paramasivan *et al.* (2011) ^[8], Vishuddha (2015) ^[17] and Sharanabasappa and Basavanneppa (2019) ^[12]. In a study conducted by Rashid and Ryan (2004) ^[10] at Faisalabad Pakistan revealed that maize crop fertilized with @ 250: 150: 100: 15 NPKS kg/ha produced significantly more grain yield (8.52 t ha⁻¹), stover yields (12.08 t ha⁻¹), in the present study, the interaction effect between genotypes, spacing and fertilizer levels were not significant.

Table 1: Grain yield and yield parameters of maize as influenced by genotypes, spacing and fertilizer levels in irrigated situation

| Treatments | Grain yield (kg/ha) | Stover yield (kg/ha) | Cob wt (g) | Cob length (cm) | Cob girth (cm) | No of grain rows/cob | No. of grains/row | 100 seed wt (g) |
|------------------------------|---------------------|----------------------|------------|-----------------|----------------|----------------------|-------------------|-----------------|
| Genotypes(V) | | | | | | | | |
| V1:GPMH1101 | 6052 | 9809 | 596 | 12.28 | 12.54 | 13.42 | 27.33 | 24.11 |
| V2:GH0727 | 7411 | 11457 | 668 | 13.74 | 13.56 | 13.80 | 29.13 | 27.19 |
| V3:RCRMH4 | 8939 | 14167 | 748 | 16.05 | 13.54 | 13.67 | 33.14 | 26.22 |
| S Em ± | 149 | 173 | 5 | 0.073 | 0.073 | 0.068 | 0.112 | 0.039 |
| C.D @ 5% | 585 | 680 | 19 | 0.286 | 0.288 | 0.267 | 0.440 | 0.154 |
| Spacings | | | | | | | | |
| S1: 60 X 20 cm | 7237 | 11798 | 704 | 14.34 | 13.13 | 13.23 | 31.39 | 26.73 |
| S2: 45X 20 cm | 7697 | 11824 | 637 | 13.71 | 13.29 | 14.02 | 28.35 | 24.91 |
| S Em ± | 164 | 62 | 5 | 0.048 | 0.053 | 0.031 | 0.078 | 0.056 |
| C.D @ 5% | NS | 216 | 16 | 0.168 | NS | 0.109 | 0.271 | 0.192 |
| Fertilizer management | | | | | | | | |
| F1:150:75:37.5 kg NPK/ha | 6850 | 10610 | 604 | 13.86 | 12.97 | 13.43 | 29.27 | 24.59 |
| F2: 225:112.5:56.5 kg NPK/ha | 8085 | 13013 | 738 | 14.19 | 13.47 | 13.82 | 30.47 | 27.22 |
| S Em ± | 121 | 83 | 4 | 0.036 | 0.039 | 0.046 | 0.065 | 0.120 |
| C.D @ 5% | 374 | 257 | 12 | 0.110 | 0.119 | 0.142 | 0.200 | 0.369 |
| Interactions (VxSxF) | | | | | | | | |
| S Em ± | 717 | 518 | 23 | 0.241 | 0.255 | 0.250 | 0.403 | 0.532 |
| C.D @ 5% | NS | 1810 | 75 | 0.841 | NS | 0.841 | 1.383 | 1.664 |

Effect of genotypes, spacing and fertilizer levels on yield parameters

Yield attributes viz; cob length, cob girth, cob weight, number of grains rows per cob, number of grains per row and 100 seed weight significantly influenced by genotypes, spacing and fertility levels present in Table 1. The maximum yield attributes were obtained with maize genotype (RCRMH 4) compared to other genotypes. Better performance of yield attributes in 60 cm x 20cm spacing was mainly due to better availability of resources such as sunshine, movement of air and availability of nutrients than the narrow spacing 45cm x 20cm. Similar findings were reported by Laskari *et al.* (2011)^[4], Vishuddha (2015)^[17] and Sharanabasappa and Basavanneppa(2019)^[12]. The cob length (14.19 cm), cob girth (13.47 cm), cob weight (739 g) number of grain rows/cob (13.82), number of grains/row (30.47) and 100 seed weight (27.22 g) were significantly more in maize fertilized with 225:112.5:56.5 kg NPK/ha than application of lower dose. This might be due to adequate supply of nutrients results in improve the overall growth of the plants. These results are in agreement with the findings of Vishuddha (2015)^[17] and Sharanabasappa and Basavanneppa (2019)^[12]. In another study conducted elsewhere by Panchannathan *et al.* (1987)^[7] reported that application of 120 kg N/ha recorded maximum number of grains per cob, cob length, cob girth and 1000

grain weight, which was at par with application of 180 kg N /ha but significantly higher than 60 kg N/ha and no nitrogen.

Effect of spacing and fertilizer levels on profitability

Among the maize genotypes, RCRMH4 recoded significantly higher gross return (Rs. 140249/ha), net return (Rs. 110651/ha) and BC ratio (4.75) than other genotypes. This was mainly attributed to higher grain and stover yield. Magnitude of increase in net return under RCRMH 4 was ranged from 21.9 to 40.8 per cent over GH0727 and GPMH1101, respectively (Table 2). Spacing did influence on the monetary returns. Maximum gross returns, net returns and BC ratio (Rs. 126989/ha, Rs. 96034/ha and 4.11, respectively) was recorded with the application of 225:112.5:56.5 NPK kg/ha compared lower fertilizer level and it was mainly due to production of higher maize grain and stover yields. These results are in conformity with findings of Ashwani *et al.* (2015)^[3] and Sharanabasappa *et al.* (2017)^[13]. In another study conducted by Singh *et al.* (2010)^[15] reported that net return and B: C increased significantly with successive increase in fertility level of 180+38.7+74.7 kg N +P+K per hectare in baby corn. In the present study interaction effect between genotypes, spacing and fertilizer levels were found non-significant.

Table 2: Monetary returns of maize as influenced by genotypes, spacing and fertilizer levels in irrigated situation

| Treatments | Cost of cultivation (Rs./ha) | Gross returns (Rs./ha) | Net returns (Rs./ha) | B:C |
|------------------------------|------------------------------|------------------------|----------------------|-------|
| Genotypes(V) | | | | |
| V1:GPMH1101 | 29598 | 95115 | 65517 | 3.21 |
| V2:GH0727 | 29598 | 116049 | 86451 | 3.90 |
| V3:RCRMH4 | 29598 | 140249 | 110651 | 4.75 |
| S Em ± | | 2196 | 2196 | 0.072 |
| C.D @ 5% | | 8621 | 8621 | 0.284 |
| Spacings | | | | |
| S1: 60 X 20 cm | 30060 | 113791 | 83731 | 3.78 |
| S2: 45X 20 cm | 29136 | 120484 | 91348 | 4.13 |
| S Em ± | | 2397 | 2397 | 0.081 |
| C.D @ 5% | | NS | NS | 0.282 |
| Fertilizer management | | | | |
| F1:150:75:37.5 kg NPK/ha | 28241 | 107286 | 79045 | 3.80 |
| F2: 225:112.5:56.5 kg NPK/ha | 30955 | 126989 | 96034 | 4.11 |
| S Em ± | | 1764 | 1764 | 0.059 |
| C.D @ 5% | | 5437 | 5437 | 0.182 |
| Interactions (VxSxF) | | | | |
| S Em ± | | 10478 | 10478 | 0.351 |
| C.D @ 5% | | NS | NS | NS |

Conclusion

Maize genotype RCRMH4 gave significantly higher maize grain yield, stover yield, gross return, and net returns and BC ratio compared to other genotypes. Application of 225:112.5:56.5 NPK kg/ha was registered significantly higher grain, stover yield, gross return, net return and BC ratio compared to lower fertilizer level.

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