



Effect of Fertilizer Levels and Planting Geometry on Growth and Seed Yield of Single Cross Maize Hybrid NAH-2049 (Nithyashree)

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Abstract

The field experiment was conducted at National Seed Project, GKVK Campus, UAS, Bangalore during *Kharif* 2011 to assess the response of fertilizer treatments and Planting Geometry on growth and yield of single cross maize hybrid NAH-2049. Experimental data revealed that fertilizer application at 225:112.5:60 NPK kg ha⁻¹+ ZnSO₄ @ 10 kg ha⁻¹+ Boron spray (1%) + *A. chroococcum*+*B. megaterium*+ *G. fasciculatum* recorded significantly higher plant height and number leaves at 90 DAS in both male and female parent (134.90 and 152.80 cm) (11.98 and 12.95 respectively), cob weight (135.40 g) and hybrid seed yield (3237.65 kg ha⁻¹) superior over other fertilizer treatments. Among the planting geometry higher hybrid seed yield (2836.90 kg ha⁻¹) was recorded in 75 X 30 cm planting geometry compared to 60 X 30 cm (2765.09 kg ha⁻¹). Growth and yield attributes of female parent (SKV 50) *viz.*, number of leaves per plant (13.30), days to 50% tasseling and silking (45.33 and 46.67) and pith weight (34.27 g) was observed in fertilizer application @ 225:112.5:60 NPK kg ha⁻¹ +10 kg ZnSO₄+ Boron spray (1%) + *A. chroococcum*+*B. megaterium*+ *G. fasciculatum* with planting geometry of 75 X 30 cm.

Key words: Maize, *B. megaterium*, *G. fasciculatum*, tasseling and silking.

Introduction

Maize (*Zea mays* L.) is one of the most important cereal crop of the world next to wheat and rice. One of the basic requirements in production of hybrid seeds is used to optimum plant population and planting ratios of pollen parent to seed parent to get higher seed set and yield. The pattern of planting ratio contribute substantially for the uniform supply of pollen to all the seed parent rows in achieving higher seed set and yield. An adequate availability of inter and intra row spacing is necessary for enhancing metabolic activities of the plant which intern influence the plant growth. This would be achieved by efficient utilization of biological resources such as solar energy, water and nutrients.

Plant geometry is one of the major management aspects; which is limiting the seed production of maize. Optimum spacing would help in efficient utilization of solar energy with less competition for growth factors. Maize is highly exhaustive crop because of its high nutrient requirement. One of the most important dramatic features of increased maize productivity in the last half century was due to increased use of fertilizer dosage and agronomic practices for the commercial crop have been standardized, the information regarding the optimum spacing and nutrient requirement of single cross hybrids. The productivity of maize largely depends on its nutrient requirement and spacing. Therefore, the present investigation was undertaken.

Material and Methods

A field experiment was undertaken at the National Seed Project, GKVK campus, University of Agricultural Sciences, Bengaluru during *kharif* season 2011. Study the effect of fertilizer levels and spacing on growth and seed yield of NAH-2049 single cross maize hybrid. The foundation seeds of both female parent (SKV-50) and male parent (MAI-105) obtained from Natonal Seed Project, GKVK, University of Agricultural Sciences, Bengaluru were used for the study.

The experiment involved eighteen treatment combinations of nine fertilizer treatments *viz.*, (T₁)150:75:40 NPK kg ha⁻¹+10 kg ZnSO₄, (T₂) 187.5:93.5:50 NPK kg ha⁻¹+10 kg ZnSO₄+Boron spray (1%), (T₃)225:112.5:60 NPK kg ha⁻¹ +10 kg ZnSO₄+ Boron spray (1%), (T₄)150:75:40 NPK kg ha⁻¹ +5 kg ZnSO₄+ ZnSO₄ spray (2%), (T₅)187.5:93.5:50 NPK kg ha⁻¹ +5 kg ZnSO₄+ ZnSO₄ spray (2%) +Boron spray (1%), (T₆)225:112.5:60 NPK kg ha⁻¹ +5 kg ZnSO₄+ ZnSO₄ spray (2%) + Boron spray(1%), (T₇)T₁+Azotobacter+PSB+VAM+Boron spray (1%), (T₈) T₂+Azotobacter+PSB+VAM and (T₉)T₃+Azotobacter +PSB+VAM and two spacings *viz.*, (S₁) 75x30 cm and (S₂) 60x30 cm respectively. However, 50 per cent of the nitrogen and entire phosphate and potassium were applied in the form of urea, single super phosphate and murate of potash respectively has basal dose and the remaining 50% urea was top dressed at knee high stage of the crop. The seeds of female and male parents were sown with row ratio of 3:1. Parental lines were treated with 25 g per kg of seeds with *Azotobacter chroococcum* and Phosphate Solubilizing Bacteria (PSB) strain of *B.megaterium* and *Glomus fasciculatum* (50 g/ plot) were applied at the time of sowing for respective treatments. As per the treatment details, 2 gram of ZnSO₄ dissolved in hundred ml of water in a container to get the concentration of 2 per cent ZnSO₄ solution. Similarly, 1 gram of borax is also dissolved in hundred ml of water in another container to make 1 per cent borax solution. Then both the micronutrient solutions were used to spray. These solutions were sprayed as per the treatment details before floral initiation in both the parents by using knapsack sprayer.

All other cultural practices were followed as per the recommended package of practice, the emerging tassels in the female lines were detasseled before the shedding of pollens to facilitate crossing with male lines. Observation on growth parameters viz., plant height, number of leaves, days to 50 per cent tasseling and silking, height of the Plant was measured from the ground level to base of fully opened leaf of the plant at 90 DAS and recorded in cm. Number of days taken for 50 per cent tasseling and silking from the date of sowing was recorded based on the appearance of tassel and silks in 50 per cent of the plants of male parent (MAI-105) and seed parent (SKV-50) in each plot and expressed in days. Yield attributes like cob length (cm), cob diameter (cm), pith weight (g), number of rows per cob, number of seeds per row and hybrid seed yield kg ha^{-1} were recorded from ten randomly selected plants. The length of cob was measured from the base to tip by using scale and mean of ten cobs was expressed in cm. The weight of the individual cob after drying to uniform moisture content 15 per cent was recorded and the mean of ten cobs was expressed in grams per cob. The total seed yield per hectare was computed from net plot. Seeds at 12 per cent seed moisture content yield was expressed in kg per hectare. The experimental data were analyzed by suitable ANOVA (Sundararaj *et al.* (1972).

Results and Discussion

Statistical analysis of data indicated that different fertilizer levels and planting geometry had significantly affected the growth and seed yield characters of hybrid maize.

1. *Effect of fertilizer treatments:* The present study on growth parameters namely plant height, number of leaves increased linearly with increases in the fertilizer levels. Higher dosage of fertilizer levels along with foliar application of micro nutrients and biofertilizer seed treatment recorded higher plant height, number of leaves, good synchrony between pollen parent and seed parent and better seed setting. Increase in fertilizer levels and spacing resulted in the early silking in the female parent and early tasseling in the male parent that may be due to availability of nutrient results in better nicking between male and female parent was observed (table I). Among the fertilizer treatments (T_9) 225:112.5:60 NPK kg ha^{-1} +10 kg ZnSO_4 + Boron spray (1%) + *A. chroococcum* + *B. megaterium* + *G. fasciculatum* recorded significantly higher plant height at 90 DAS in both male and female parent (134.90cm and 152.80cm respectively). Similarly, number of leaves (11.98 and 12.95 respectively), days to 50 per cent tasseling and silking on parents (46.83 and 51.00), cob length (14.74 cm), cob diameter (12.16cm), cob weight (135.40 g), pith weight (32.33g), seeds per row (26.97), 100 seed weight (35.18), hybrid seed yield (3237.65 kg/ha), compare to other fertilizer treatments. With respect to fertilizer levels, similar trend was noticed where in higher seed yield was recorded with higher dose of fertilizer application Krishnaveni and Ramaswamy (1985) and (Virupaksha, 2002), (Muniswamy *et al.*, 2007) also noticed similar positive effects fertilizer levels on seed yield on maize hybrids. However, the interaction due to fertilizer levels and spacing did not differed significantly on both growth and yield parameters. Yield is rather complex product of many of its attributing traits the present investigation the important yield attributes namely cob length, cob weight, pith weight and number of rows per cob (table II) were recorded increased with increasing fertilizer levels and spacing these results are in conformations with Prasad and Singh (1990).

2. *Effect of spacing:* Wider spacing (75 X 30 cm) recorded slightly higher plant height and number of leaves than the narrow (60 X 30 cm) spacing. Wider spacing of 75 X 30 cm resulted significantly higher plant height at 90 DAS in both male and female parent (130.45cm and 145.12cm respectively). Similarly, significantly higher number of leaves (12.25 and 11.42 respectively), days to 50 per cent tasseling and silking on parents (50.74 and 55.15), cob length (14.12 cm), cob diameter (11.68cm), cob weight (124.44 g), pith weight (28.64g), seeds per row (25.99), 100 seed weight (34.32) and hybrid seed yield (2836.90 kg/ha) were observed compared to 60 X 30 cm. The wider spacing of 75 x 30 cm recorded higher seeds yield 2836.90 kg/ha over 60x30 cm spacing. The results are agreement with findings of Yadav and Singh (2000), Bangarwa and Kairon, 1993 and Channakeshava 1998).

3. *Effect of fertilizer treatments X spacing:* Although the plant height and number of leaves did not differ significantly with interaction of fertilizer levels and spacing. Interaction effect of fertilizer application (T_9) and spacing of 75 X 30 cm has recorded significantly, days to 50 per cent tasseling and silking (45.33 and 46.67 days), pith weight (34.27 g) and 100 seed weight (35.61 g).

Table I: Effect of fertilizer treatments and spacing on plant growth parameters and flowering behaviour of maize single cross F₁ hybrid NAH-2049

| FERTILIZER TREATMENTS | Plant height 90 DAS | | Number of leaves 90 DAS | | Days to 50% Tasseling (MAI-105) | Days to 50% silking (SKV-50) |
|----------------------------------|------------------------|-------------|----------------------------|-------------|---------------------------------------|------------------------------------|
| | SKV-50 | MAI-105 | SKV-50 | MAI-105 | | |
| T ₁ | 114.32 | 129.45 | 10.77 | 10.23 | 56.50 | 68.00 |
| T ₂ | 123.50 | 135.48 | 10.88 | 11.33 | 53.83 | 63.67 |
| T ₃ | 127.87 | 138.07 | 11.10 | 11.90 | 48.67 | 57.50 |
| T ₄ | 124.33 | 135.80 | 11.30 | 11.37 | 53.83 | 64.17 |
| T ₅ | 130.87 | 144.88 | 11.32 | 12.47 | 52.33 | 63.00 |
| T ₆ | 132.87 | 147.13 | 11.40 | 12.53 | 49.17 | 58.00 |
| T ₇ | 134.00 | 147.67 | 11.58 | 12.13 | 51.33 | 58.50 |
| T ₈ | 134.77 | 150.53 | 11.63 | 12.70 | 48.50 | 55.00 |
| T ₉ | 134.90 | 152.80 | 11.98 | 12.85 | 46.83 | 51.00 |
| S.E.m± | 1.394 | 2.37 | N S | 0.32 | 0.46 | 1.01 |
| CD @ 5% | 4.005 | 6.82 | - | 0.92 | 1.33 | 2.92 |
| SPACING (S) | | | | | | |
| S ₁ 75 X 30 cm | 130.45 | 155.12 | 11.42 | 12.25 | 50.74 | 55.15 |
| S ₂ 60 X 30 cm | 126.76 | 139.73 | 11.24 | 11.65 | 51.70 | 64.59 |
| S.E.m± | 0.657 | 1.11 | N S | 0.15 | 0.21 | 0.48 |
| CD @ 5% | 1.888 | 3.21 | - | 0.43 | 0.63 | 1.38 |
| INTERACTION TABLE (T X S) | | | | | | |
| T ₁ S ₁ | 120.27 | 134.77 | 10.93 | 10.93 | 57.00 | 67.67 |
| T ₂ S ₁ | 125.87 | 136.17 | 11.10 | 11.73 | 53.67 | 60.00 |
| T ₃ S ₁ | 128.40 | 137.40 | 11.20 | 11.07 | 48.00 | 50.00 |
| T ₄ S ₁ | 126.07 | 136.47 | 11.33 | 12.33 | 53.33 | 60.67 |
| T ₅ S ₁ | 133.67 | 147.97 | 11.43 | 12.53 | 52.00 | 59.67 |
| T ₆ S ₁ | 133.43 | 150.60 | 11.47 | 12.40 | 47.67 | 50.00 |
| T ₇ S ₁ | 135.00 | 151.33 | 11.63 | 12.73 | 50.67 | 53.33 |
| T ₈ S ₁ | 135.87 | 155.20 | 11.67 | 13.20 | 49.00 | 48.67 |
| T ₉ S ₁ | 135.47 | 156.20 | 12.00 | 13.30 | 45.33 | 46.67 |
| T ₁ S ₂ | 108.37 | 124.13 | 10.60 | 9.53 | 56.00 | 68.33 |
| T ₂ S ₂ | 121.13 | 134.80 | 10.67 | 10.93 | 54.00 | 67.33 |
| T ₃ S ₂ | 126.27 | 138.73 | 11.00 | 12.73 | 49.33 | 65.00 |
| T ₄ S ₂ | 123.67 | 135.13 | 11.27 | 10.40 | 54.33 | 67.67 |
| T ₅ S ₂ | 128.07 | 141.80 | 11.20 | 12.40 | 52.67 | 66.33 |
| T ₆ S ₂ | 132.30 | 143.67 | 11.33 | 12.67 | 50.67 | 66.00 |
| T ₇ S ₂ | 133.00 | 144.00 | 11.53 | 11.53 | 52.00 | 64.00 |
| T ₈ S ₂ | 133.67 | 145.87 | 11.60 | 12.20 | 48.00 | 61.33 |
| T ₉ S ₂ | 134.33 | 149.40 | 11.97 | 12.40 | 48.33 | 53.33 |
| S.E.m± | N S | N S | N S | 0.45 | 0.65 | 1.44 |
| CD @ 5% | - | - | - | 1.30 | 1.89 | 4.14 |

T₁: (150:75:40NPK kg ha⁻¹) + ZnSo₄@ 10 kg ha⁻¹

T₂: (187.5:93.5: 50 NPK kg ha⁻¹) + ZnSo₄ @ 10 kg ha⁻¹ + Boron spray (1%)

T₃: (225:112.5:60 NPK kg ha⁻¹) + ZnSo₄ @ 10 kg ha⁻¹ + Boron spray (1%)

T₄: (150:75:40NPK kg ha⁻¹) + ZnSo₄@ 5 kg ha⁻¹ + ZnSo₄ spray (2%)

T₅: (187.5:93.5: 50 NPK kg ha⁻¹) + ZnSo₄@ 5 kg ha⁻¹ + ZnSo₄ spray (2%)+Boron spray 1%)

T₆: (225:112.5:60 NPK kg ha⁻¹) + ZnSo₄ @ 5 kg ha⁻¹ + ZnSo₄spray (2%)+ Boron spray(1%)

T₇: T₁ + Azotobacter +PSB+VAM + Boron spray (1%)

T₈: T₂+ Azotobacter +PSB+VAM, T₉: T₃+Azotobacter +PSB+VAM

Table II: Effect of fertilizer treatments and spacing on seed yield attributes of maize single cross F₁ hybrid NAH-2049

| FERTILIZER TREATMENTS (T) | Yield parameters | | | | 100 seed weight (g) | Hybrid seed yield Kg ha ⁻¹ |
|----------------------------------|------------------|-----------------|----------------|------------------------|---------------------|---------------------------------------|
| | Pith weight (g) | Cob length (cm) | Cob weight (g) | Number of rows per cob | | |
| T ₁ | 22.53 | 10.95 | 101.50 | 10.13 | 30.77 | 2253.09 |
| T ₂ | 26.60 | 11.68 | 109.77 | 10.27 | 32.06 | 2424.07 |
| T ₃ | 30.33 | 13.15 | 124.50 | 10.27 | 33.34 | 2918.21 |
| T ₄ | 26.47 | 12.94 | 115.70 | 10.33 | 33.12 | 2561.73 |
| T ₅ | 28.37 | 12.79 | 115.47 | 10.33 | 32.54 | 2711.11 |
| T ₆ | 25.77 | 12.90 | 125.60 | 10.27 | 33.56 | 3154.01 |
| T ₇ | 28.00 | 13.13 | 119.63 | 10.47 | 32.53 | 2748.46 |
| T ₈ | 28.43 | 14.66 | 129.35 | 10.53 | 32.98 | 3200.62 |
| T ₉ | 32.33 | 14.74 | 135.40 | 10.60 | 35.18 | 3237.65 |
| S.Em± | 0.93 | 0.39 | 2.96 | N S | 0.32 | 167.20 |
| CD @ 5% | 2.69 | 1.12 | 8.50 | - | 0.92 | 480.46 |
| SPACING (S) | | | | | | |
| S ₁ 75 X 30 cm | 28.64 | 14.12 | 124.44 | 10.40 | 34.32 | 2836.90 |
| S ₂ 60 X 30 cm | 26.66 | 11.87 | 114.87 | 10.31 | 31.48 | 2765.09 |
| S.Em± | 0.44 | 0.18 | 1.39 | N S | 0.15 | N S |
| CD @ 5% | 1.26 | 0.53 | 4.00 | - | 0.43 | - |
| INTERACTION TABLE (T X S) | | | | | | |
| T ₁ S ₁ | 23.13 | 11.73 | 104.67 | 10.13 | 32.64 | 2345.68 |
| T ₂ S ₁ | 29.40 | 13.20 | 118.53 | 10.40 | 33.94 | 2379.01 |
| T ₃ S ₁ | 32.33 | 14.20 | 127.57 | 10.27 | 34.78 | 2993.83 |
| T ₄ S ₁ | 28.07 | 14.70 | 121.07 | 10.40 | 34.53 | 2561.73 |
| T ₅ S ₁ | 27.93 | 13.57 | 119.27 | 10.13 | 34.81 | 2811.11 |
| T ₆ S ₁ | 25.27 | 14.55 | 128.47 | 10.40 | 34.02 | 3122.84 |
| T ₇ S ₁ | 30.67 | 14.57 | 126.93 | 10.53 | 33.37 | 2842.59 |
| T ₈ S ₁ | 26.67 | 14.87 | 134.93 | 10.53 | 34.15 | 3209.88 |
| T ₉ S ₁ | 34.27 | 15.65 | 138.53 | 10.53 | 35.61 | 3265.43 |
| T ₁ S ₂ | 21.93 | 10.17 | 98.33 | 10.00 | 28.89 | 2160.49 |
| T ₂ S ₂ | 23.80 | 10.17 | 101.00 | 10.13 | 30.17 | 2469.14 |
| T ₃ S ₂ | 28.33 | 11.70 | 1021.43 | 10.13 | 31.90 | 2842.59 |
| T ₄ S ₂ | 24.87 | 11.19 | 110.33 | 10.27 | 31.72 | 2561.73 |
| T ₅ S ₂ | 28.80 | 12.02 | 111.67 | 10.53 | 30.27 | 2611.11 |
| T ₆ S ₂ | 26.27 | 11.26 | 122.73 | 10.13 | 32.09 | 3185.19 |
| T ₇ S ₂ | 25.33 | 12.06 | 112.33 | 10.40 | 31.69 | 2654.32 |
| T ₈ S ₂ | 30.20 | 13.81 | 123.77 | 10.53 | 31.81 | 3191.36 |
| T ₉ S ₂ | 30.40 | 14.45 | 132.27 | 10.67 | 34.76 | 3209.88 |
| S.Em± | 1.32 | N S | N S | N S | 0.46 | N S |
| CD @ 5% | 3.80 | - | - | - | 1.31 | - |

T₁ : (150:75:40NPK kg ha⁻¹) + ZnSo₄@ 10 kg ha⁻¹

T₂ : (187.5:93.5: 50 NPK kg ha⁻¹) + ZnSo₄ @ 10 kg ha⁻¹ + Boron spray (1%)

T₃ : (225:112.5:60 NPK kg ha⁻¹) + ZnSo₄ @ 10 kg ha⁻¹ + Boron spray (1%)

T₄ : (150:75:40NPK kg ha⁻¹) + ZnSo₄@ 5 kg ha⁻¹ + ZnSo₄ spray (2%)

T₅ : (187.5:93.5: 50 NPK kg ha⁻¹) + ZnSo₄@ 5 kg ha⁻¹ + ZnSo₄ spray (2%)+Boron spray 1%)

T₆ : (225:112.5:60 NPK kg ha⁻¹) + ZnSo₄ @ 5 kg ha⁻¹ + ZnSo₄spray (2%)+ Boron spray(1%)

T₇ : T₁ + Azotobacter +PSB+VAM + Boron spray (1%)

Therefore, the present study suggests that, fertilizer levels 225:112.5:60 NPK kg ha⁻¹ + ZnSO₄ 10 kg ha⁻¹ + A. *chroococcum*+B. *megaterium*+ G. *fasiculatum* Boron spray (1%) and spacing of 75 x 30 cm exploited to get maximum growth and yield attributes in single cross maize hybrid NAH-2049 under bangaluru condition.

Conclusion: The study result indicated that fertilizer treatments (T₉) 225:112.5:60 NPK kg ha⁻¹ +10 kg ZnSO₄+ Boron spray (1%) + A. *chroococcum*+B. *megaterium*+ G. *fasiculatum* recorded significantly higher plant height at 90 DAS in both male and female parent (134.90cm and 152.80cm respectively). Similarly, number of leaves (11.98 and 12.95 respectively), days to 50 per cent tasseling and silking on parents (46.83 and 51.00), cob length (14.74 cm), cob diameter (12.16cm), cob weight (135.40 g), pith weight (32.33g), seeds per row (26.97), 100 seed weight (35.18), hybrid seed yield (3237.65 kg/ha), compare to other fertilizer treatments similarly wider spacing (75 X 30 cm) recorded slightly higher plant height and number of leaves than the narrow (60 X 30 cm) spacing. Wider spacing of 75 X 30 cm resulted significantly higher plant height at 90 DAS in both male and female parent (130.45cm and 145.12cm respectively).

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