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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON PLANT GROWTH AND SEED YIELD IN HYBRID MAIZE (ARJUN)

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ABSTRACT
An experiment was carried out in RBD design with three replications and nine treatments. Among the treatments, significantly highest plant height (198.9 cm), number of leaves (10.30), leaf area index (2.19), chlorophyll content (54.30), dry matter accumulation (297.1 g plant^{-1}) at harvest, cob weight (184.5 g plant^{-1}), number of seeds (434.7 seeds cob^{-1}), seed weight (130.7 g cob^{-1}), shelling percentage (74.7), seed yield (58.36 q ha^{-1}) and 100 seed weight (30.27 g) were recorded in T_9 (50 % RDN through VC + 50 % RDF + $ZnSO_4$ @10 kg ha^{-1} + *Azospirillum* @ 500 g ha^{-1} + PSB @ 500 g ha^{-1} + FYM @ 10 t ha^{-1}). Whereas, lowest plant height (170.4 cm), number of leaves (8.40), leaf area index (1.38), chlorophyll content (43.18) and dry matter accumulation (224.0 g plant^{-1}) at harvest, cob weight (138.9 g plant^{-1}), number of seeds (372.4 seeds cob^{-1}), seed weight (94.2 g cob^{-1}), shelling percentage (62.3), seed yield (41.20 q ha^{-1}) and 100 seed weight (24.97 g) were noticed in T_2 (50 % RDN through FYM + 50 % RDF). From this study, it can be concluded that among the different treatments T_9 was best to get higher seed yield in hybrid seed production of maize.

INTRODUCTION

Maize (*Zea mays* L.) is one of the world's most widely grown cereals, having great significance as human food, animal feed and raw material source for large number of industrial products. The development and release of the hybrid maize in India marked the beginning of the establishment of seed industry on a sound footing in the country. A good coverage with these hybrids was mainly due to their high yielding potentiality and the timely availability of hybrid seed at a reasonable cost. Seed production is a function of genetic potential of crop varieties, soil productivity and environmental condition through its internal, physiological and biological processes. Of these, soil productivity assumes paramount importance. For maintenance of soil fertility and productivity, nourishing the soil by addition of organic manures along with biofertilizers apart from nutrient supply through fertilizers in right amount and proper balance is necessary to get higher production on sustainable basis (Inderjeet *et al.*, 2014). Presently, the chemical fertilizers are considered as the major source of nutrients. However, the escalating input cost, coupled with increasing usage of chemical fertilizers and depleting soil health necessitates the safe and efficient use of organics in crop production (Kumpawat, 2010). Application of organic manures in general improves the availability of micro nutrients like zinc, iron, manganese and copper (Ashok Kumar *et al.*, 2008). However, the research on integrated nutrient management in maize seed production is lacking in particularly newly released hybrids. Keeping these points in view, an investigation was carried out with an objective to know the effect of integrated nutrient management on plant growth and seed yield in hybrid seed production of maize (Arjun).

MATERIALS AND METHODS

The field experiment was carried out to study the effect of integrated nutrient management on seed yield, quality and economics of hybrid seed production in maize (Arjun) during *kharif* 2011 at Main Agriculture Research Station, University of Agricultural Sciences, Dharwad. This experiment consisted of parents of Arjun hybrid (CI-4 X CI-5) as female and KDMI-16 as male. Experiment was laid down in Randomized Block Design with three replications and nine treatments. The treatment details were T_1: FYM @ 10 t ha^{-1} +100 % RDF + $ZnSO_4$ @10 kg ha^{-1} + *Azospirillum* @ 500 g ha^{-1} + PSB @ 500 g ha^{-1}, T_2: 50 % RDN through FYM + 50 % RDF, T_3: T_2 + $ZnSO_4$ @ 10 kg ha^{-1} + *Azospirillum* @ 500 g ha^{-1} + PSB @ 500 g ha^{-1}, T_4: 50 % RDN through VC + 50 % RDF, T_5: T_4 + $ZnSO_4$ @10 kg ha^{-1} + *Azospirillum* @ 500 g ha^{-1} + PSB @ 500 g ha^{-1}, T_6: T_2 + FYM @ 10 t ha^{-1}, T_7: T_3 + FYM @ 10 t ha^{-1}, T_8: T_4 + FYM @ 10 t ha^{-1}, T_9: T_5 + FYM @ 10 t ha^{-1}. The required quantity of FYM as per treatment were applied for each plot 15 days before sowing and vermicompost was applied uniformly at the time of sowing on the soil surface and mixed into the soil. A recommended fertilizer dose of 150 : 75 : 37.5 kg NPK ha^{-1} of which 50 per cent N and full doses of P and K

were applied as basal dose at the time of sowing and remaining dose of N was applied at 30 and 45 days after sowing as top dressing to the representative treatments. *Azospirillum* and Phosphate Solublizing Bacteria (PSB) were used to treat the seeds as per treatment details. Isolation distance of 400 m was provided and four rows of male parent was grown as border rows all along the experimental site with a planting ratio of 4 : 2. Tassels were removed as and when they emerged from female parent lines in all the plots and all agronomic operations were conducted as per package of practices, UAS, Dharwad. Cobs from male parent were harvested first, then from female (F_1). The cobs were dried and kernels were separated by hand and dried to 12 per cent moisture content. The observations on plant growth and seed yield were recorded as per the standard procedures. The mean data of the experiment were statistically analyzed by adopting appropriate statistical methods as outlined by Panse and Sukhatme (1978). The critical differences were calculated at five per cent level of probability wherever 'F' test was found significant for various growth and seed yield parameters under study.

RESULTS AND DISCUSSION

Growth in plant has various phases, which start with activation of embryo and ends with maturation of seeds. The processes involved in growth are very complex and influenced by many factors, of which nutrient supply is one of the most important factors that determines the growth of crops. The differences in the yield components among the treatments were mainly due to the variation in growth parameters. The combined application of inorganic and organics manure (FYM, VC and biofertilizer) significantly influenced these growth and yield parameters (Table 1and 2). Among the treatments, significantly highest plant height (198.9 cm), number of leaves (10.30), leaf area index (2.19), chlorophyll content (54.30), dry matter accumulation (297.1 g plant^{-1}) at harvest, cob weight (184.5 g plant^{-1}), number of seeds (434.7 seeds cob^{-1}), seed weight (130.7 g cob^{-1}), shelling percentage (74.7), seed yield (58.36 q ha^{-1}), stover yield (8.62 t ha^{-1}) and 100 seed weight (30.27 g) were recorded in T_9 (50% RDN through VC + 50 % RDF through inorganic fertilizers + $ZnSO_4$ @ 10 kg per ha

Table 1: Effect of integrated nutrients on plant growth and growth parameters in maize hybrid (Arjun)

Treatments	Plant height (cm)	Number of leaves per plant	Leaf area index	Chlorophyll content	Dry matter production (g plant^{-1})
T_1: FYM @ 10 t ha^{-1} + 100 % RDF + $ZnSO_4$ @ 10 kg ha^{-1} + *Azospirillum* @ 500 g ha^{-1} + PSB @ 500 g ha^{-1}	193.7	8.50	1.95	51.94	264.6
T_2: 50 % RDN through FYM + 50 % RDF	170.4	8.40	1.38	43.18	224.0
T_3: T_2 + $ZnSO_4$ @ 10 kg ha^{-1} + *Azospirillum* @ 500 g ha^{-1} + PSB @ 500 g ha^{-1}	177.9	8.90	1.64	48.77	253.1
T_4: 50 % RDN through VC + 50 % RDF	174.5	8.47	1.56	46.20	241.2
T_5: T_4 + $ZnSO_4$ @ 10 kg ha^{-1} + *Azospirillum* @ 500 g ha^{-1} + PSB @ 500 g ha^{-1}	178.4	9.13	1.71	50.11	269.4
T_6: T_2 + FYM @ 10 t ha^{-1}	187.6	9.37	1.75	50.96	279.6
T_7: T_3 + FYM @ 10 t ha^{-1}	195.0	9.77	2.06	53.20	294.2
T_8: T_4 + FYM @ 10 t ha^{-1}	191.5	9.53	1.98	52.62	288.2
T_9: T_5 + FYM @ 10 t ha^{-1}	198.9	10.30	2.19	54.30	297.1
Mean	185.3	9.15	1.80	50.14	267.9
S.Em±	4.5	0.39	0.06	1.52	6.8
CD (P = 0.05)	13.5	1.18	0.18	4.8	20.4

PSB = Phosphate solubilising bacteria, RDF = Recommended doses of fertilizer (150 Kg N: 75 Kg P_2O_5: 37.5 Kg K_2O); FYM = Farm yard manure, VC = Vermicompost Note: (*Azospirillum* and PSB) @ 500 g per ha for seed treatment

Table 2: Effect of integrated nutrients on seed yield and yield components of maize hybrid (Arjun)

Treatments	Cob weight per plant (g)	Number of seeds per cob	Seed weight per cob (g)	Shelling (%)	Seed yield (q/ha)	Stover yield (t/ha)	100 seed weight (g)
T_1: FYM @ 10 t /ha + 100 % RDF + $ZnSO_4$ @10 kg /ha + *Azospirillum* + PSB	172.2	410.6	116.3	72.4	51.55	7.40	28.04
T_2: 50% RDN through FYM + 50% RDF	138.9	372.4	94.2	62.3	41.20	6.00	24.97
T_3: T_2 + $ZnSO_4$ @10 kg /ha + *Azospirillum* + PSB	159.5	408.9	103.2	68.4	45.03	6.57	25.33
T_4: 50% RDN through VC + 50% RDF	157.1	402.0	98.9	64.6	43.96	6.17	24.67
T_5: T_4 + $ZnSO_4$ @10 kg /ha + *Azospirillum* + PSB	169.1	417.8	109.0	69.5	48.45	7.02	26.10
T_6: T_2 + FYM @ 10 t /ha	174.9	426.5	116.7	71.6	51.88	7.31	27.37
T_7: T_3 + FYM @ 10 t /ha	179.4	430.2	126.0	74.6	55.69	7.98	29.33
T_8: T_4 + FYM @ 10 t /ha	174.8	427.3	121.3	73.5	53.77	7.63	27.78
T_9: T_5 + FYM @ 10 t /ha	184.5	434.7	130.7	74.7	58.36	8.62	30.27
Mean	167.8	414.1	112.9	70.2	49.66	7.19	27.09
S.Em±	4.1	10.8	5.6	1.75	2.39	0.30	1.10
CD (P=0.05)	12.9	32.3	16.8	NS	7.18	0.89	3.29

PSB = Phosphate solubilising bacteria, RDF = Recommended doses of fertilizer (150 Kg N: 75 Kg P_2O_5: 37.5 Kg K_2O) FYM = Farm yard manure, VC = Vermicompost Note: (*Azospirillum* and PSB) @ 500 g per ha for seed treatment

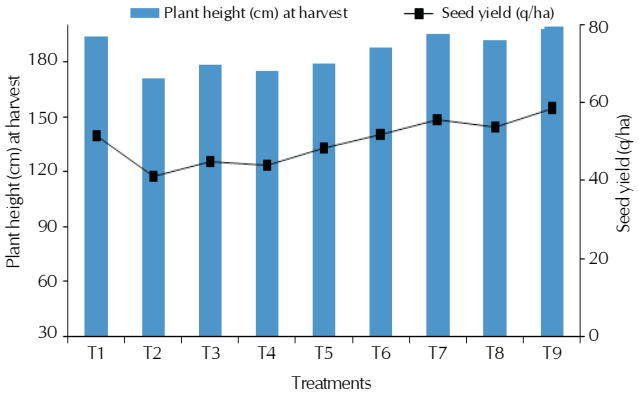

Figure 1: Effect of integrated nutrients on plant height and seed yield of maize hybrid (Arjun)

+*Azospirillum* @ 500 g per ha + PSB @ 500 g per ha + FYM @ 10 t per ha). Whereas, lowest plant height (170.4 cm), number of leaves (8.40), leaf area index (1.38), chlorophyll content (43.18) and dry matter accumulation (224.0 g plant^{-1}) at harvest, cob weight (138.9 g plant^{-1}), number of seeds (372.4 seeds cob^{-1}), seed weight (94.2 g cob^{-1}), shelling percentage (62.3), seed yield (41.20 q ha^{-1}), stover yield (6.00 t ha^{-1}) and 100 seed weight (24.97 g) in T_2.

Increased plant growth and seed yield in the treatment T_9 may be due to application of nutrients in combination led to increase in the above characters resulted in the efficient photosynthetic structural system which enabled the plant to intercept higher amount of radiation energy and converted the same into chemical energy, due to this higher accumulation of dry matter per plant as recorded in Table 1. Higher accumulation of dry matter per plant might be due to increase in leaf area index, chlorophyll content and plant height which leads to increased seed yield as indicated in Table 2 and depicted in Fig. 1. These results are in accordance with (Wagh, 2002; Ashok Kumar *et al.*, 2008; Gable *et al.*, 2008; Narolia *et al.*, 2009) in maize and Maruthi *et al.* (2014) in soybean. The biofertilizers like *Azosprillum* and PSB were also found to fix atmospheric nitrogen into available nitrogen to the plants Okon *et al.* (1981). Hence the seed treatment with biofertilizers responsible for supply of nutrient to plant growth at subsequent stages of growth lead to increase in the plant growth parameters like accumulation of more dry matter per plant. This is in agreement with the reports of Ashok Kumar *et al.* (2008) in maize; Kumpawat (2010) in bajra and Inderjeet *et al.* (2014) in okra.

From this study it can be concluded that, the application of 50 % RDN through VC + 50 % RDF through inorganic fertilizers + $ZnSO_4$ @ 10 kg ha^{-1} + *Azospirillum* @ 500 g ha^{-1} + PSB @ 500 g ha^{-1} + FYM @ 10 t ha^{-1} (T_9) was found better in order to obtain more seed yield in hybrid seed production of maize (Arjun).

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