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Effect of nutrient management on growth, yield and quality of maize

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Abstract
Considering the effect of green revolution technologies in rice wheat system and prospects of maize cultivation, studies on INM in maize (*Zea mays*. L) in upper gangetic plains region were conducted on sandy loam soil, low in organic carbon and available N, medium available P and K with 9.1 kg S ha^{-1}, 0.82 g Zn ha^{-1}, 0.6 g B ha^{-1} and slightly alkaline in reaction during *kharif* 2015 at SVPUAT, Meerut to observe the effect of nutrient management practices on (Plant height, Number of functional leaves per plant, plant population at maturity,initial plant population), yield attributes (Cob length, Number of grain rows per cob, Number of grains per row, Number of grains per cob, Grain weight per cob, Test weight etc.) Crop fertilized with 75% NPK + FYM @ 7.5 t + Zn + B + S registered best growth and consequently highest (48.8 q ha^{-1}) grain yield and attributes. Favorable effect of Zn by Lui *et al.* (1993), B by Hosseini *et al.* (2007) [3] and S by Channabasamma *et al.* (2013) [2] on growth and yield of maize have also been obtained.

Keywords: plant height, number of functional leaves per plant, leaf area index (LAI), Dry Matter.

Introduction
Maize (*Zea mays* L.) is one of the most important cereal crops next to rice and wheat in world agricultural economy both as food for men and feed for animals. It is the most versatile crop having wider adaptability and known as queen of cereals for its highest genetic yield potential. Maize grains contain approximately 72% starch, 10% protein, and 4% fat and a calorific value 365 Kcal/100 g. Low production costs and high consumption of maize flour and cornmeal, especially where micronutrient deficiencies are common, public health problems, make this food staple and ideal food vehicle for fortification (Ranum *et al.*, 2014) [6]. It is cultivated across 160 countries on nearly 150 m ha with 782 m t of grain production. The crop has already developed into a multi dollar business in foreign countries (Thailand, Taiwan, Singapore, Malaysia, USA, Canada and Germany) because of its potential as a value added product for export and a good food substitute (Mugalkhod *et al.*, 2011) [5]. In India, maize covers 9.42 m ha area producing 24.34 m t of grains with average productivity of 2583 kg ha^{-1}. Uttar Pradesh shares 21% area (0.74 m ha^{-1}) and 6.1 % production (1.23 m t) with productivity of 1671 kg ha^{-1} (AICRP, 2014). Maize productivity in United State America is as high as 76.37 q ha^{-1} and that in China 58.86 q ha^{-1} (FAOSTAT, 2015) [7] being far higher than that of India and Uttar Pradesh.

Material and Methods
The present study was conducted at Crop Research Center of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (Uttar Pradesh), India during *kharif* season of 2015 on the topic of "Effect of nutrient management practices on plant population, maturity stage, plant height and number of functional leaves per plant of maize. The experiment was conducted was conducted in Randomized Dlock Design (RBD) and replicated the three times. The different growth parameters studied were maize as plant height, number of functional leaves per plant, leaf area index (LAI) and dry matter accumulation.

Result
The initial plant population of maize did not show any significant difference among the

Treatments and varied within a narrow range of 83,670 to 83,880 plants ha^{-1}. Whereas, at maturity highest plant population (82430 plants ha^{-1}) was noted with 75% NPK + FYM @ 7.5 t + Zn + B + S against the lowest of 70,600 plants ha^{-1} with no nutrient application.

Growth parameters *viz.* plant height, number of functional leaves per plant leaf area index and dry matter accumulation per plant at different growth stages differed under the treatments. Such difference were significant at all the stages in respect of plants height, leaf area index and dry matter accumulation and at harvest only for number of functional leaves per plants. Invariably crop fertilized with 75% NPK + FYM @ 7.5 t + Zn + B + S exhibited best growth i.e plant height, number of functional leaves per plant, leaf area index and dry matter accumulation. Application of Zn, B and S alone or together with 100%NPK improved crop growth over 100% NPK. *Azotobacter* and PSB also had favorable effect on crop growth. Application of Zn, B, S, Zn + B + S, *Azotobacter*, PSB and *Azotobacter* + PSB increased dry matter accumulation by 3.5, 1.7, 1.8, 3.8, 1.8, 2.4 and 2.8 % over 100% NPK at maturity stage.

Table 1: Number of functional leaves per plant

Treatments	Number of functional leaves		
	30 DAS	**60 DAS**	**At harvest**
Control	2.7	Control	2.7
100% NPK	3.7	100% NPK	3.7
75% NPK + FYM @ 7.5 t	3.7	75% NPK + FYM @ 7.5 t	3.7
100% NPK + Zn	4.7	100% NPK + Zn	4.7
100% NPK + B	4.3	100% NPK + B	4.3
100% NPK + S	4.3	100% NPK + S	4.3
100% NPK + Zn + B + S	4.7	100% NPK + Zn + B + S	4.7
75% NPK + FYM @ 7.5 t + Zn + B + S	5.3	75% NPK + FYM @ 7.5 t + Zn + B + S	5.3
100% NPK + *Azotobacter*	4.3	100% NPK + *Azotobacter*	4.3
100% NPK + PSB	4.3	100% NPK + PSB	4.3
100% NPK + *Azotobacter* + PSB	4.3	100% NPK + *Azotobacter* + PSB	4.3
75% NPK + FYM @ 7.5 t + *Azotobacter* + PSB	4.7	75% NPK + FYM @ 7.5 t + *Azotobacter* + PSB	4.7
SEm±	0.6	SEm±	0.6
CD (P= 0.05)	NS	CD (P= 0.05)	NS

Table 2: Plant height

Treatments	Plant height (cm)		
	30 DAS	**60 DAS**	**At harvest**
Control	13.4	135.5	155.4
100% NPK	17.7	161.0	175.3
75% NPK + FYM @ 7.5 t	18.8	166.6	188.1
100% NPK + Zn	24.8	181.0	200.5
100% NPK + B	20.8	176.7	181.5
100% NPK + S	21.5	180.4	183.3
100% NPK + Zn + B + S	25.5	185.6	201.3
75% NPK + FYM @ 7.5 t + Zn + B + S	28.0	197.5	204.7
100% NPK + *Azotobacter*	19.3	179.2	190.1
100% NPK + PSB	18.9	176.3	188.0
100% NPK + *Azotobacter* + PSB	22.1	177.7	193.4
75% NPK + FYM @ 7.5 t + *Azotobacter* + PSB	22.3	178.0	183.3
SEm±	1.6	1.7	1.7
CD (P= 0.05)	4.9	5.1	5.2
Control	13.4	135.5	155.4
100% NPK	17.7	161.0	175.3

Table 3: Leaf area index

Treatments	Leaf area index		
	30 DAS	**60 DAS**	**At harvest**
Control	0.4	Control	0.4
100% NPK	0.4	100% NPK	0.4
75% NPK + FYM @ 7.5 t	0.5	75% NPK + FYM @ 7.5 t	0.5
100% NPK + Zn	0.6	100% NPK + Zn	0.6
100% NPK + B	0.5	100% NPK + B	0.5
100% NPK + S	0.5	100% NPK + S	0.5
100% NPK + Zn + B + S	0.6	100% NPK + Zn + B + S	0.6
75% NPK + FYM @ 7.5 t + Zn + B + S	0.7	75% NPK + FYM @ 7.5 t + Zn + B + S	0.7
100% NPK + *Azotobacter*	0.5	100% NPK + *Azotobacter*	0.5
100% NPK + PSB	0.5	100% NPK + PSB	0.5
100% NPK + *Azotobacter* + PSB	0.6	100% NPK + *Azotobacter* + PSB	0.6
75% NPK + FYM @ 7.5 t + *Azotobacter* + PSB	0.6	75% NPK +FYM @ 7.5 t + *Azotobacter* + PSB	0.6
SEm±	0.06	SEm±	0.06
CD (P= 0.05)	0.2	CD (P= 0.05)	0.2

Table 4: Dry matter accumulation

Treatments	Dry matter accumulation per plant (g)		
	30 DAS		**30 DAS**
Control	4.1	Control	4.1
100% NPK	5.4	100% NPK	5.4
75% NPK + FYM @ 7.5 t	5.5	75% NPK + FYM @ 7.5 t	5.5
100% NPK + Zn	6.0	100% NPK + Zn	6.0
100% NPK + B	5.7	100% NPK + B	5.7
100% NPK + S	5.8	100% NPK + S	5.8
100% NPK + Zn + B + S	6.1	100% NPK + Zn + B + S	6.1
75% NPK + FYM @ 7.5 t + Zn + B + S	6.3	75% NPK + FYM @ 7.5 t + Zn + B + S	6.3
100% NPK + *Azotobacter*	5.6	100% NPK + *Azotobacter*	5.6
100% NPK + PSB	5.5	100% NPK + PSB	5.5
100% NPK + *Azotobacter* + PSB	5.8	100% NPK + *Azotobacter* + PSB	5.8
75% NPK + FYM @ 7.5 t + *Azotobacter* + PSB	5.9	75% NPK + FYM @ 7.5 t + *Azotobacter* + PSB	5.9
SEm±	0.3	SEm±	0.3
CD (P= 0.05)	0.9	CD (P= 0.05)	0.9

Conclusion

Growth parameters *viz.* plant height, number of functional leaves per plant leaf area index and dry matter accumulation per plant at different growth stages differed under the treatments. Such difference were significant at all the stages in respect of plants height, leaf area index and dry matter accumulation and at harvest only for number of functional leaves per plants. Invariably crop fertilized with 75% NPK + FYM @ 7.5 t + Zn + B + S exhibited best growth i.e plant height, number of functional leaves per plant, leaf area index and dry matter accumulation. Application of Zn, B and S alone or together with 100%NPK improved crop growth over 100% NPK. *Azotobacter* and PSB also had favorable effect on crop growth. Application of Zn, B, S, Zn + B + S, *Azotobacter*, PSB and *Azotobacter* + PSB increased dry matter accumulation by 3.5, 1.7, 1.8, 3.8, 1.8, 2.4 and 2.8 % over 100% NPK at maturity stage.

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