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Effect of INM on Growth and Physiological Parameters of Maize in Maize-Groundnut Cropping System in Southern Telangana Region

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ABSTRACT

A field experiment entitled "Direct and residual effect of integrated nutrient management in Maize-Groundnut crop sequence in Southern Telangana region" was conducted during kharif and rabi 2014-15 and 2015-16 at College Farm, College of Agriculture, Rajendranagar, Hyderabad, Southern Telangana Agro climatic Zone of Telangana State. Growth parameters of maize viz., plant height, leaf area index, leaf area duration, dry matter accumulation and radiation use efficiency was significantly higher in 75% RDF+25% RDN through urban compost (T_5) and was on par with 75% RDF+25% RDN through FYM (T_3). Growth and physiological parameters viz., Plant height, dry matter accumulation, LAI, LAD and RUE were not significantly influenced at 30 days after sowing during both the years.

Key words: *Groundnut, Maize, Kharif, Nutrient.*

INTRODUCTION

In recent years, agricultural production system in India has shown sustained growth in order to achieve food and nutritional security as well as to avoid ecological degradation of natural resources on account of their continued over-exploitation. Since very little scope exists for horizontal growth, the only alternative seems to be achieving vertical growth through increasing crop productivity. Now the genetic gains are fading away and further increase in productivity can be achieved only through appropriate production technologies. Today, we are more aware of the adverse off-site impacts that nutrients may have when they leave agricultural fields with surface runoff or leaching and enter surface or ground water in excessive amounts. Nutrient losses, which may be important from an economic standpoint, may still cause impacts harmful to aquatic ecosystems or harmful to human health.

Maize (*Zea mays* L.) – Groundnut (*Arachis hypogaea*) is one of the important cropping systems in telangana of India and maintenance of optimum soil fertility is an important consideration for obtaining higher and sustainable yield.

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The responses of the succeeding crops in a cropping system are influenced greatly by the preceding crops and the inputs applied therein. Therefore, recently greater emphasis is being laid on the cropping system as whole rather than on the individual crops in a sequence.

Maize (*Zea mays L.*) is one of the most important cereal crop of the world, occupying third rank in production after wheat and rice. In India, maize ranks third in terms of area sown and production next to rice and wheat. India produced 14.7 million tonnes of maize from 7.4 million hectares of land with an average productivity is 1.72 and 1.26 t ha^{-1} of India and Telangana respectively, as compared to highest yield realized in USA (8.4 t ha^{-1}). Maize has wide distribution and varied uses as food, feed and fodder. Maize is an exhaustive crop and requires very high doses of nitrogen and other nutrients. Ensuring balanced quantity of nutrients in a given soil for good plant growth is the greatest challenge of the day as yield potentials vary among soils. For maintaining sustained crop production, balanced manuring is essential to build up soil health. Wide use of short statured high yielding varieties and hybrids is common in maize. The organic sources will improve the nutrient use efficiency of added chemical fertilizers by reducing nutrient losses and enhancing nutrient availability to plant. Integration and incorporation of organic manure (FYM/urban compost) in the cropping system helps to improve soil structure, soil microbial activity and soil moisture conservation and which in turn helps to stabilize the production and productivity of the crops. Integrated nutrient management is also important for marginal farmers who cannot afford to supply crop nutrients through costly chemical fertilizers.

MATERIAL AND METHODS

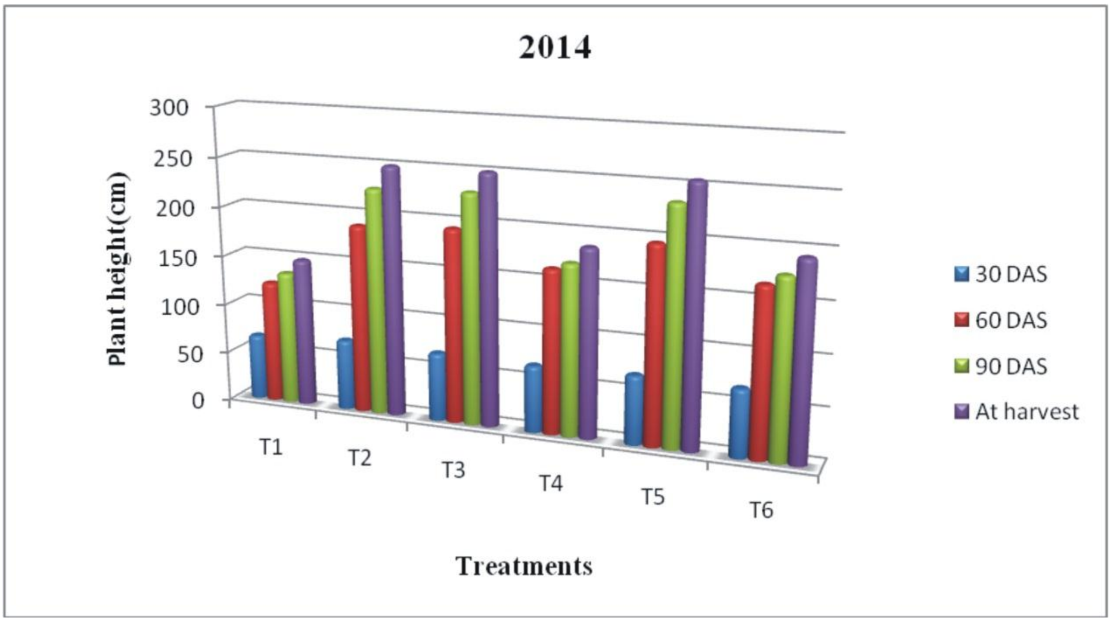
A field experiment entitled "Direct and residual effect of integrated nutrient management in Maize-Groundnut crop sequence in Southern Telangana region" was conducted during *kharif* and *rabi* 2014-15 and 2015-16 at College Farm, College of Agriculture, Rajendranagar, Hyderabad, Southern Telangana climatic Zone of Telangana. The soil of experimental site was sandy clay loam with pH of 7.6, Electrical conductivity 0.86 dSm^{-1}, low in organic carbon (0.73 %), low in available nitrogen (217 kg ha^{-1}) and medium in phosphorus (64 kg ha^{-1}) and high in potassium (402 kg ha^{-1}). The experiment was laid out in a randomized block design for maize during *kharif* 2014 and 2015 with six treatments consisting of combinations of three fertilizers levels 100,75 and 50 per cent RDF through fertilizer and 25 and 50 per cent RDN through two manures (FYM, Urban compost) with four replications. In *Kharif*, maize hybrid (DHM-117) was sown on 27th July during first year and 19th June during second year adopting a spacing of 60 x 20 cm. In general the climatic conditions were congenial during crop growth period and incidence of pest and disease attack was noticed to some extent. The observations on plant growth parameters *viz.*, plant height, leaf area index, dry matter accumulation and photosynthetic active radiation at 30, 60, 90 days after sowing and at harvest in groundnut were taken. The observations on growth analysis like LAD at 30-60 DAS, 61-90 DAS and at 91 DAS-at harvest were also taken.

RESULTS AND DISCUSSION

Growth Parameters

Plant height:

During both years of study, no significant difference was observed with plant height due to different treatments at 30 days after sowing. At 60,90 days after sowing and at harvest significantly higher plant height was recorded with 75% RDF+25% RDN through urban compost (T_5) compared to all other treatments except 75% RDF+25% RDN through FYM (T_3) and 100% RDF (T_2) which was on par with each other. The higher yield obtained through Integrated Nitrogen Management (INM) systems can also be attributed to increased plant height of maize crop. Similar results were reported by Kumpawat[4]. Adequate NPK might have helped in harvesting of solar energy as reflected by increased leaf area index and dry matter production. The increased uptake of nutrients promoted plant height, LAI and dry matter accumulation, probably by promoting greater meristematic and photosynthetic activities[3].



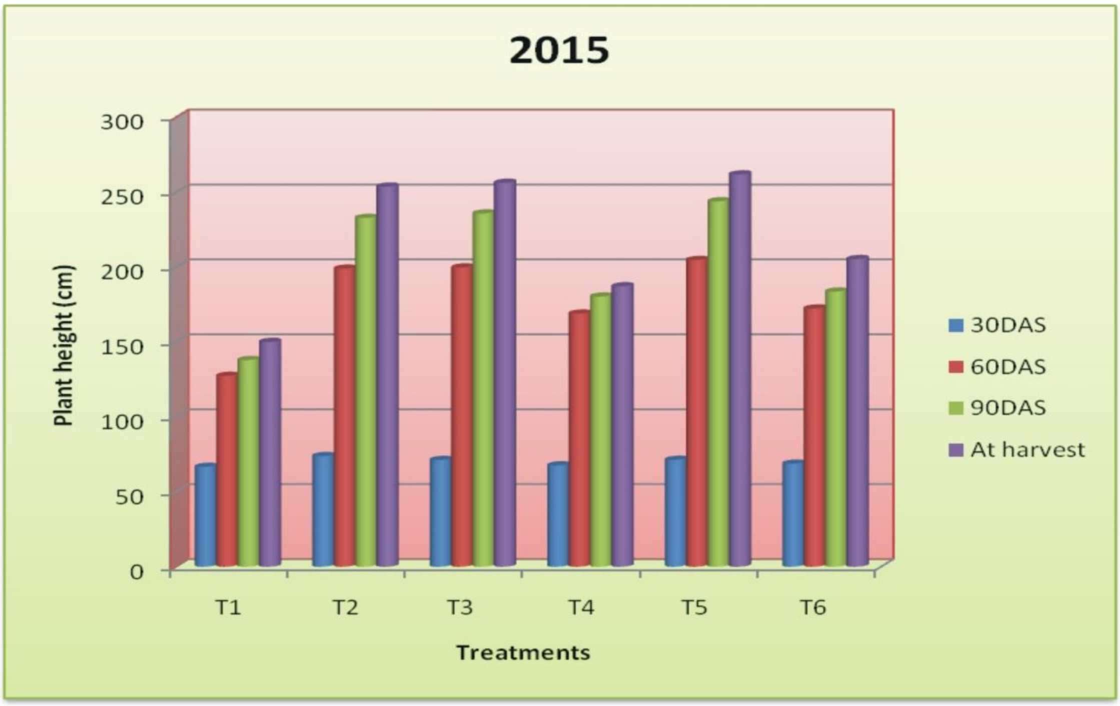


Fig. 1: Plant height (cm) at different growth stages of maize crop as influenced by different treatments

Dry matter accumulation

During both the years of study no significant difference observed due to different treatments at 30 days after sowing. At 60,90DAS and at harvest significantly higher dry matter accumulation was recorded with 75% RDF+25% RDN through urban compost (T_5) compared to all other treatments except 75% RDF+25% RDN through FYM (T_3) and 100% RDF (T_2) which were on par with each other. The increased plant height and DMP under integrated nutrient management resulted in greater canopy development, which could be evidenced from increased leaf area index recorded under integrated nutrient management with urban compost and farmyard manure to maize. The increased LAI seemed to have resulted in better interception, absorption and utilization of radiant energy with greater CO_2 fixation, leading to enhanced photosynthetic efficiency resulting in dry matter accumulation as observed by Abayomi *et al*[1]., and Kalaiyarasan[3]. The dry matter accumulation tended to increase progressively with advance in the age of crop up to harvest. Different fertilizer levels and their integration with 25, 50 per cent RDN through FYM or Urban compost during certain stages of crop growth altered the dry matter accumulation.

Physiological Parameters

Leaf area index

During both the years, the leaf area index recorded at 90 days after sowing was higher than that of leaf area index recorded at harvest, irrespective of treatments. Leaf area index was not significantly differed with different treatments at 30 days after sowing in both years of investigation. Significantly lower leaf area index was recorded at 30, 60, 90 days after sowing and at harvest with control (T_1) as compared to rest of the treatments in both the years. During first year, the leaf area index recorded with application of 75% RDF+25% RDN through urban compost (T_5) was comparable with that received 75% RDF+25% RDN through FYM (T_3) and 100% RDF (T_2) which were significantly superior over rest of the treatments at 60,90 days after sowing and at harvest. During second year also application of 75% RDF+25% RDN through urban compost (T_5) recorded comparable leaf area index as that of 75% RDF+25% RDN through FYM (T_3) and 100% RDF (T_2) and were significantly superior over rest of the treatments. Adequate supply of nitrogen had produced larger leaves which in turn, resulted more photosynthetic surface area i.e. LAI. The significant response with urban compost application on LAI might be due to addition of manures that tend to increase the respiration rate metabolism and growth of plants[6].

Leaf area duration

During both the years, the leaf area duration recorded at 61-90 days after sowing was higher than that of leaf area duration recorded at 91 days after sowing-to harvest, irrespective of treatments. Significantly lower leaf area duration was recorded at 30-60 DAS, 61-90 DAS and 91 days after sowing - to harvest with control (T_1) as compared to rest of the treatments in both the years. During first year, the leaf area duration recorded with application of 75% RDF+25% RDN through urban compost (T_5)was comparable with treatments that received 75% RDF+25% RDN through FYM (T_3) and 100% RDF (T_2) which was significantly superior over rest of the treatments at 30-60 DAS, 61-90 DAS and 91 days after sowing- to harvest. During second year also similar trend was observed.

LAD is a function of leaf area index which indicates persistence of photosynthetic activity in the plant. It indicates the maintenance of assimilatory surface area over a period of time, which is pre requisite for prolonged photosynthetic activity and the ultimate productivity in crop plants. Increased availability of soil moisture content at all the stages of crop growth and available N, P_2O_5 and K_2O at harvest, especially nitrogen might have resulted in development of required efficient photosynthetic system as reflected by higher LA and LAI and retention of it for longer period of time as evidenced by higher LAD. Surkod[7] and Patil *et al*[5]., also recorded increased LAD with increase in integrated nutrient management in maize crop.

Radiation use efficiency (RUE)

A significant influence of different fertilizer levels and their integration with 25 and 50 per cent RDN through FYM or Urban compost on RUE was observed at all growth stages in both the years of study. The values of RUE increased following the tendency of canopy expansion and varied from 1.47 to 21.98 g lx^{-1} during first year and 7.48 to 26.82 g lx^{-1} during second year. RUE was not significantly different with treatments at 30 days after sowing in both years of study. Significantly high radiation use efficiency was recorded for maize with application of 75% RDF+25% RDN through urban compost (T_5) followed by 75% RDF+25% RDN through FYM (T_3) and 100% RDF (T_2) which were on par with each other and rest of the treatments are significantly different at all growth stages except 30 days after sowing during the both years of investigation. Leaf area influences the interception and utilization of solar radiation of crop canopies and consequently dry matter accumulation and ultimately the grain yield. Morever, it is an important factor in the estimation of canopy photosynthesis in crop growth simulation models that compute dry matter accumulation from temporal integration of canopy photosynthesis[2].

Table 1: Plant height (cm) at different growth stages of maize crop as influenced by different treatments

Treatments	2014				2015			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1- Control (0 NPK)	65.7	122.5	133.9	148.8	66.7	127.4	138.0	150.1
T_2- 100% RDF of NPK	70.7	188.7	226.5	249.6	73.9	199.0	232.9	253.8
T_3 -75% RDF of NPK +25% N-FYM	68.0	193.5	229.6	250.0	71.3	199.8	235.9	256.3
T_4 -50% RDF of NPK +50% N-FYM	66.5	163.1	169.8	186.5	67.7	169.0	180.4	187.2
T_5 -75% RDF of NPK +25% N-Urban Compost	68.3	195.6	234.2	255.2	71.4	204.8	244.0	261.9
T_6 -50% RDF of NPK +50% N-Urban Compost	67.1	166.1	176.0	193.5	68.8	172.4	183.7	205.4
S.Em ± / SEd	2.57	3.38	4.19	4.32	3.94	3.30	6.40	4.44
CD @5%	NS	7.20	8.92	9.21	NS	7.04	13.64	9.46

Table 2: Dry matter accumulation (g plant^{-1}) at different growth stages of maize crop as influenced by different treatments

Treatments	2014				2015			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1- Control (0 NPK)	6.92	40.57	49.83	56.58	7.12	41.69	52.83	59.55
T_2- 100% RDF of NPK	7.29	76.88	94.20	106.50	7.52	78.86	98.58	109.55
T_3 -75% RDF of NPK +25% N-FYM	7.16	77.85	94.75	104.15	7.39	79.84	97.70	107.38
T_4 -50% RDF of NPK +50% N-FYM	6.99	61.60	74.03	80.63	7.19	62.82	76.88	83.47
T_5 -75% RDF of NPK +25% N-Urban Compost	7.24	79.53	97.50	110.10	7.43	80.75	100.43	113.33
T_6 -50% RDF of NPK +50% N-Urban Compost	7.10	65.35	77.10	83.85	7.30	66.45	79.95	87.15
S.Em ±/ SEd	0.39	1.74	1.84	3.04	0.43	1.72	1.91	2.94
CD @5%	NS	3.71	3.92	6.47	NS	3.67	4.06	6.26

Table 3: Leaf area index at different growth stages of maize crop as influenced by different treatments

Treatments	2014				2015			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1- Control (0 NPK)	0.42	1.21	1.65	0.93	0.44	1.51	2.05	1.18
T_2- 100% RDF of NPK	0.52	3.74	4.45	2.22	0.54	4.05	4.86	2.47
T_3 -75% RDF of NPK +25% N-FYM	0.47	3.75	4.50	2.30	0.49	4.03	4.90	2.45
T_4 -50% RDF of NPK +50% N-FYM	0.44	1.92	3.60	1.74	0.46	2.24	4.03	1.94
T_5 -75% RDF of NPK +25% N-Urban Compost	0.49	3.95	4.74	2.40	0.52	4.25	5.15	2.65
T_6 -50% RDF of NPK +50% N-Urban Compost	0.47	2.05	3.78	1.79	0.49	2.37	4.21	2.07
S.Em $\pm$/ SEd	0.12	0.11	0.18	0.11	0.14	0.11	0.19	0.12
CD @5%	NS	0.23	0.39	0.24	NS	0.24	0.40	0.26

Table 4: Leaf area duration (dm^2 days) at different growth stages of maize crop as influenced by different treatments

Treatments	2014			2015		
	30-60 DAS	61-90 DAS	91 DAS-At harvest	30-60 DAS	61-90 DAS	91 DAS-At harvest
T_1- Control (0 NPK)	24.45	42.90	38.70	29.14	53.40	48.56
T_2- 100% RDF of NPK	65.52	126.47	101.05	69.59	133.39	112.95
T_3 -75% RDF of NPK +25% N-FYM	63.34	123.79	102.11	67.91	134.02	110.63
T_4 -50% RDF of NPK +50% N-FYM	35.44	82.76	80.06	40.57	94.01	89.47
T_5 -75% RDF of NPK +25% N-Urban Compost	66.68	130.28	107.10	71.47	141.0	117.08
T_6 -50% RDF of NPK +50% N-Urban Compost	37.72	87.34	83.47	42.82	98.63	94.16
S.Em $\pm$/ SEd	1.63	3.70	3.99	1.66	3.80	4.15
CD @5%	3.48	7.88	8.52	3.53	8.09	8.84

Table 5: Radiation use efficiency (g lx^{-1}) at different growth stages of maize crop as influenced by different treatments

Treatments	2014				2015			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1- Control (0 NPK)	1.47	4.98	9.31	4.64	3.10	7.48	10.31	7.74
T_2- 100% RDF of NPK	1.53	10.58	20.33	11.38	3.15	12.78	25.53	14.53
T_3 -75% RDF of NPK +25% N-FYM	1.54	10.14	20.90	11.19	3.17	12.64	25.90	14.39
T_4 -50% RDF of NPK +50% N-FYM	1.52	9.27	18.25	9.79	3.14	11.77	22.25	12.93
T_5 -75% RDF of NPK +25% N-Urban Compost	1.55	10.64	21.98	11.65	3.18	13.14	26.98	14.83
T_6 -50% RDF of NPK +50% N-Urban Compost	1.52	9.47	19.01	10.21	3.14	11.97	25.01	13.35
S.Em $\pm$/ SEd	0.08	0.44	0.95	0.23	0.07	0.44	0.78	0.24
CD @5%	NS	0.94	1.74	0.50	NS	0.94	1.54	0.50

CONCLUSION

Application of 75% RDF+25% RDN through urban compost (T_5) produced taller plants at all stages. The growth parameter *viz.,* leaf area index, dry matter accumulation, leaf area duration and radiation use efficiency recorded significantly higher with 75% RDF+25% RDN through urban compost (T_5) on par with 75% RDF+25% RDN through FYM (T_3) and 100% RDF (T_2), while growth parameters and growth analysis *viz.,* Plant height, dry matter accumulation, LAI, LAD and RUE were not significantly influenced at 30 days after sowing during both the years.

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