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INTEGRATED NUTRIENT MANAGEMENT FOR ENHANCING GROWTH AND PRODUCTIVITY OF MAIZE (*Zea mays* L.)

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ABSTRACT

A field experiment entitled integrated nutrient management for enhancing productivity and profitability of maize (*Zea mays* L.) was conducted on sandy loam soils of dry land farm of Sri Venkateswara Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University during *kharif*, 2019. The experiment was laid out in randomized block design with nine treatments replicated thrice. The highest dry matter production, kernel yield stover yield and harvest index in maize were recorded with application of STBR + FYM @ 5 t ha^{-1} (T_8), which was statistically at par with the application of STBR + *Azospirillum*+ PSB + KSB + ZnB (T_9) and soil test based recommendation (T_7) and significantly superior over the rest of the treatments tried The lowest dry matter production, kernel yield stover yield and harvest index were observed with control (T_1).

KEYWORDS: Dry matter production, Kernel yield, INM and Maize.

INTRODUCTION

Maize (*Zea mays* L.) is the third important cereal crop next to rice and wheat in the world. It is mainly used as a food for human, feed for livestock and also a major source of industrial products like corn oil, flour, corn sugar, starch, alcohol and syrup. Worldwide maize is grown over an area of 180 million hectares with a production of 1033 million tonnes and productivity of 5.71 tonnes per hectare. In India, it is grown over an area of 9.5 million hectares with a production of 25 million tonnes with a productivity of 2.6 tonnes per hectare (Anonymous, 2017). In spite of magnificent progress in acreage as well as production for the past two decades, the productivity of maize in India is far below compared to the world average productivity.One of the reasons for lower production is imbalanced use of fertilizers by the farmers without knowing soil fertility status and nutrient requirement of crops, which causes adverse effects on soil and crop both in terms of nutrient toxicity and deficiency (Ray *et al*., 2000).

Usage of chemical fertilizers in the recent past is increasing day by day in order to achieve higher productivity which led to the deleterious effect on the environment as well as soil health.It has been found that no single source of nutrient is capable of supplying the necessary elements in adequate and balanced proportion and the use of inorganic fertilizers being a costly affair also leads to deterioration of soil health and quality of the produce. However, the use of organic sources alone, do not result in spectacular increase in crop yields, due to their low nutrient status and are also not easily available for a large scale use. Hence balanced nutrition is one of the essential and necessary components of nutrient management, which plays a major role in increasing the productivity and quality of maize. Keeping this in view the present study was conducted to study the effect of "Effect different integrated nutrient management practices on growth parameters of maize (*Zea mays* L.)"

MATERIAL AND METHODS

The field experiment was carried out in Dryland Farm at S.V. Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University during Kharif 2019 on sandy loam soils with low in available nitrogen, medium in available phosphorus, potassium and zinc. The test hybrid of maize DHM-117, was used in the experiment..The experiment was laid out in randomized block design with nine treatments replicated thrice.The treatments consists of T_1 : Control, T_2 : RDF (180-60-50 kg N, P_2O_5 and K_2O ha^{-1}), T_3 : RDF + FYM @ 5 t ha^{-1}, T_4 : RDF + *Azospirillum* + PSB + KSB + ZnB, T_5 : 75% RDF + FYM @ 5 t ha^{-1}, T_6 : 75% RDF + *Azospirillum* + PSB + KSB + ZnB, T_7 : Soil test based fertilizer recommendation (STBR), T_8 : STBR + FYM @ 5 t ha^{-1} and T_9 : STBR + *Azospirillum*+ PSB + KSB + ZnB. Five

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plants at random from the border rows leaving the extreme row were destructively sampled at 25, 50, 75 DAS and at harvest. The plant samples were shade dried and then oven dried at 60°C to a constant weight and expressed in kg ha^{-1}. Grain and stover yield of each net plot was recorded separately and finally calculated in terms of kg ha^{-1}. Harvest Index (HI) was calculated by using the following formula given by Singh and Stoskofif (1971) and expressed in percentage.

$$\text{Harvest index (\%)} = \frac{\text{Economic yield}}{\text{Biological yield}}$$

RESULTS AND DISCUSSION

Dry Matter Production

Dry matter production of maize was significantly influenced by various integrated nutrient management practices (Table1). Among all the treatments, application of STBR + FYM @ 5 t ha^{-1} (T_8) recorded significantly higher dry matter production, which was statistically at par with application of STBR + *Azospirillum*+ PSB + KSB + ZnB (T_9) and soil test based recommendation (T_7) at all the stages of observation. The increase in dry matter production due to the application of STBR + FYM @ 5 t ha^{-1} (T_8) might be the result of increase in the plant stature, size and number of leaves, that might have increasedthe dry matter production and this was in agreement with the findings of Priya *et al*. (2014). STBR + *Azospirillum*+ PSB + KSB + ZnB (T_9) performed better due to the mobilization of nutrients in the soil by the favourable effect of bio fertilizers, which in turn increase the photosynthetic area, as a result increase in size and number of leaves thus increase in the dry matter production. Enhanced growth of maize under elevated supply of nutrients has been undisputed fact and universally acceptable proportion as could be visualized from the research evidence (Kumar *et al.,* 2010). The next best treatment producing higher dry matter production was RDF + FYM @ 5 t ha^{-1} (T_3), which was statistically at par with RDF + *Azospirillum* + PSB + KSB + ZnB (T_4) and RDF(T_2) followed by 75% RDF + FYM @ 5 t ha^{-1} (T_5) and 75% RDF + *Azospirillum* + PSB + KSB + ZnB (T_6).The lowest dry matter production was noticed in control (T_1) due to poor nutrient status of the soil.

Seed, Stover Yield and Harvest index

Seed yield and stover yield of maize differed significantly with different integrated nutrient management practices (Table 2). Application of fertilizers based on STBR + FYM @ 5 t ha^{-1} (T_8) recorded the highest seed and stover yield in maize, which was statistically at par with application of STBR + *Azospirillum*+ PSB + KSB + ZnB and soil test based recommendation. Seed yield of maize is a function of yield attributes, which were significantly higher with these nutrient management practices. Further due to supply of elevated levels of nitrogen, which might have facilitated better growth and development of maize and which ultimately increased the yield components and yield. Similar results were also reported by Rani *et al*. (2012) and Khan *et al*. (2018). Enhanced stover yield is the outcome of the positive and synergistic interaction between the nutrient supply and growth stature of maize as reflected in enhanced growth parameters with supply of highest dose of NPK. The increase in biological yield is also attributed to increase in plant height, number of leaves and dry matter production (Fageria *et al.,* 2006).

The next best treatment was RDF + FYM @ 5 t ha^{-1} (T_3), which was statistically at par with RDF + *Azospirillum* + PSB + KSB + ZnB (T_4) and RDF (T_2), which was significantly superior over 75% RDF + FYM @ 5 t ha^{-1} (T_5) and 75% RDF + *Azospirillum* + PSB + KSB + ZnB (T_6). The increase in grain yield might be due to the mobilisation of nutrients in the soil and making it more available to the plant resulting in better growth of the plant coupled with early flowering, better translocation of photosynthates to the sink, which in turn resulted in more number of larger sized seeds and finally higher yield.

Application of STBR + *Azospirillum*+ PSB + KSB + ZnB (T_9) resulted in 26 per cent increase in the grain yield over 100% RDF (T_2). This may be due to increased nutrient availability with application of 125% RDN (225 kg ha^{-1}) in combination with FYM, which might have been utilized by crop leading to higher values of growth and yield components, which ultimately increased the grain yield of maize. The results are in corroborative with the findings of Khambalkar *et al*. (2017) and Trimurthulu and Rao (2014). Similarly application of 100 RDF + FYM @ 5 t ha^{-1} (T_3) recorded 26 percent higher grain yield in maize compared to application of 75 RDF + FYM @ 5 t ha^{-1}(T_5), and this might be due to poor performance of maize at sub-optimal dose of nitrogen in T_5.

Control (T_1) recorded the lowest seed and stover yield because of the deflated stature of growth parameters

Table 1. Dry matter production (kg ha^{-1}) at different stages of maize asinfluenced by integrated nutrient management practices

Treatments	Dry matter production (kg ha^{-1})			
	25 DAS	50 DAS	75 DAS	At harvest
T_1 : Control	162	1260	1825	2820
T_2 : RDF (180-60-50 kg N, P_2O_5 and K_2O ha^{-1})	299	2791	6100	9328
T_3 : RDF + FYM@ 5 t ha^{-1}	312	2882	6338	9780
T_4 : RDF + *Azospirillum* + PSB + KSB + ZnB	309	2808	6251	9565
T_5 : 75% RDF + FYM @ 5 t ha^{-1}	276	2518	5410	8450
T_6 : 75% RDF + *Azospirillum* + PSB + KSB + ZnB	274	2492	5400	8100
T_7 : Soil test based fertilizer recommendation (STBR)	331	3125	6752	10680
T_8 : STBR + FYM @ 5 t ha^{-1}	341	3246	6942	10890
T_9 : STBR + *Azospirillum* + PSB + KSB + ZnB	336	3194	6804	10688
SEm±	6.0	46.2	108.1	198.4
CD (P= 0.05)	18	141	328	600

Table 2. Seed yield, stover yield (kg ha^{-1}) and harvest index (%) of maize as influenced by integrated nutrient management practices

Treatments	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)
T_1 : Control	629	1871	25.16
T_2 : RDF (180-60-50 kg N, P_2O_5 and K_2O ha^{-1})	4140	4875	45.90
T_3 : RDF + FYM@ 5 t ha^{-1}	4410	4990	46.80
T_4 : RDF + *Azospirillum* + PSB + KSB + ZnB	4278	4990	46.20
T_5 : 75% RDF + FYM @ 5 t ha^{-1}	3498	4444	44.00
T_6 : 75% RDF + *Azospirillum* + PSB + KSB + ZnB	3321	4379	43.12
T_7 : Soil test based fertilizer recommendation (STBR)	5020	5420	48.08
T_8 : STBR + FYM @ 5 t ha^{-1}	5400	5696	48.66
T_9 : STBR + *Azospirillum* + PSB + KSB + ZnB	5120	5468	48.35
SEm±	130	140	0.29
CD (P = 0.05)	400	424	0.91

and yield attributes and finally lower yields due to the deficiency of N, P, K and Zn as the experimental soil is poor in all the above nutrients in available form, there by poor root and shoot growth. These results are corroborated with the findings of Ramachandrappa *et al.* (2007) and Zerihun *et al*., (2013), Priya *et al*., (2014), Lone *et al*., (2013) and Shanwad *et al*., (2010).

Among the various treatments, the highest harvest index (48.66) in maize was obtained with the application of STBR + FYM @ 5 t ha^{-1}, which was statistically at par with the application of STBR + *Azospirillum*+ PSB + KSB + ZnB (48.35) and soil test based recommendation (48.08) and was significantly superior over the other treatments tried. This might due to better absorption, translocation of essential nutrients in balanced proportion, which increased the physiological activity of the plant to mobilize the photosynthates from source towards sink. Application of STBR + FYM @ 5 t ha^{-1} (T_8) might have resulted in maintaining the crop demand during its peak period, thus resulting in higher grain yield and finally the increment in the harvest index. Control (T_1) resulted in the lowest harvest index over other treatments (5) that might be due to the poor soil nutrient reserve in the soil causing poor source sink relationship during the crop peak period, which in turn resulted in poor yields and thus lower harvest index.

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