

Integrated Nitrogen Management for Enhancing Productivity of Maize

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ABSTRACT

A field experiment was conducted at Agricultural college farm, Bapatla, during *kharif*, 2017 to investigate the effect of nitrogen levels, bio fertilizers, FYM and vermin compost on yield nutrient content and uptake of maize. Experiment was laid out in thrice. Results of the experiment indicated that highest grain and Stover yields were recorded significantly with 100 % recommended dose of nitrogen (5827 kg ha⁻¹ and 6026 kg ha⁻¹ respectively) Further, it was observed that highest N content and uptake of maize were recorded with 100 % recommended dose of nitrogen in both grain (1.19 % and 69.62 kg ha⁻¹, respectively) and Stover (0.74 % and 44.92 kg ha⁻¹, respectively) whereas highest P & K content in grain was recorded with 50 % RDN + 50 % N through FYM. In grain, highest P & K uptake was observed with 75 % RDN + 25 % N through FYM (14.02) kg ha⁻¹) and 100 % recommended dose of nitrogen (29.14 kg ha⁻¹), respectively. In post-harvest soil, highest available nitrogen (170.3 kg ha⁻¹) was recorded with 100 % recommended dose of nitrogen, whereas highest available phosphorous and potassium were recorded in treatment applied with 50 % RDN + 50 % N through FYM.

Key words: Bio fertilizers, Content and Uptake and Post-harvest soil, FYM, Vermicompost, Nitrogen.

Maize is the third most important cereal crop in India after rice and wheat. It accounts for 9 per cent of total food grain production in the country. It is cultivated in an area 9.43 M ha with annual production of 24.3Mt. Maize has greater nutritional value (Has *et al.*, 2009) and harvest the nutrients heavily from the soil. Hence, yield of maize is alarmingly affected by the deficiency of nutrients (especially N). Maize needs ample quantity of N for its better production. It is, therefore, imperative to use an optimum amount of N through a suitable and efficient source because it plays a very significant role in crop development (Ahmad, 2000). Organic manures contribute to plant growth through their favorable effects on the physical, chemical and biological properties of soil. Organic manures also have a pronounced residual effect on the nutrient availability. The integration of organic sources with synthetic sources of nutrients not only supply essential nutrients but also have some positive interaction with chemical fertilizers to increase their efficiency and thereby, reduce environmental hazards (Uyovbisere and Elemo, 2000). In this context, an experiment was conducted on effect of different levels of nitrogen, vermicompost, FYM and biofertilizers on macronutrient (NPK) content and uptake by maize to find out the possible combinations of inorganic and organic sources.

MATERIAL AND METHODS

A field experiment was carried out in sandy loam soils at Agricultural college farm, Bapatla,

Andhra Pradesh during *kharif* 2017. The experimental soil was slightly acidic (pH: 6.7) and non saline (EC: 0.27 dS m⁻¹) in nature with low Organic carbon (0.25%). The available nutrient status of N, P and K were 150, 54.34 and 268 kg ha⁻¹, respectively. The experiment was designed with eight (8) treatments in three replications using randomized block design. The treatments consisted of Absolute control (T₁); Recommended dose of nitrogen (T₂); 50% RDN + 50% N through vermicompost (T₃); 50% RDN + 50% N through FYM (T₄); 50% RDN + Azospirillum @ 5 kg ha⁻¹ (T₅); 75% RDN + 25% N through vermicompost (T₆); 75% RDN + 25% N through FYM (T₇); 75% RDN + Azospirillum @ 2.5 kg ha⁻¹ (T₈). Maize crop was (variety Pioneer 3396) used as a test crop. The organic manure (FYM) was applied one week prior to sowing. Vermicompost was applied two days before sowing. Azospirillum was applied one day before sowing. N, P₂O₅ and K₂O were applied in the form of urea (in three equal splits), single super phosphate (basal) and muriate of potash (basal), respectively. The seeds were dibbled at spacing of 60 cm x 20cm. The plant samples were collected at different stages i.e., knee high, tasseling and harvest (Stover and grain) and estimated for nutrient (NPK) content and uptake by employing suitable methods (N by Subbaiah and Asija, 1956, P by Jackson, 1973 and K by Muhr *et al.*, 1965)) Data interpretation was made by suitable statistical method (Panse and Sukhatme, 1978).

Table 1. Effect of different levels of nitrogen, FYM, vermicompost and biofertilizers on yield (kg ha⁻¹) of maize

Treatments	Yield (kg ha ⁻¹)		Harvest index
	Grain	Stover	
T ₁	3035	3186	0.48
T ₂	5827	6026	0.49
T ₃	4405	4574	0.49
T ₄	3940	4124	0.48
T ₅	3488	3662	0.48
T ₆	5763	5962	0.49
T ₇	5310	5499	0.49
T ₈	4858	5037	0.49
SEm ±	179	197	0.01
CD (p= 0.05)	545	600	NS
CV (%)	6.8	7.2	4.5

Table 2. Effect of different levels of nitrogen, FYM, vermicompost and biofertilizers on major nutrient content (%) and uptake (kg ha⁻¹) in grain by maize

Treatments	Content (%)			Uptake (kg ha ⁻¹)		
	Nitrogen	Phosphorus	Potassium	Nitrogen	Phosphorus	Potassium
T ₁	0.85	0.21	0.46	25.87	6.49	14.16
T ₂	1.19	0.22	0.48	69.62	13.19	29.14
T ₃	0.97	0.27	0.56	42.97	11.9	25
T ₄	0.94	0.28	0.58	37.08	11.22	22.51
T ₅	0.92	0.26	0.54	32.06	9.07	19.04
T ₆	1.13	0.24	0.5	65.36	14.02	28.01
T ₇	1.09	0.24	0.52	58.28	13.07	27.58
T ₈	1.04	0.23	0.49	50.7	11.33	23.97
SEm ±	0.03	0.01	0.02	2.14	0.92	1.2
CD (p= 0.05)	1.1	NS	NS	6.51	2.8	3.65
CV (%)	5.6	9.8	8.2	7.7	14.1	8.8

Table 3. Effect of different levels of nitrogen, FYM, vermicompost and biofertilizers on major nutrient content (%) and uptake (kg ha⁻¹) in Stover by maize

Treatments	Content (%)			Uptake (kg ha ⁻¹)		
	Nitrogen	Phosphorus	Potassium	Nitrogen	Phosphorus	Potassium
T ₁	0.14	0.17	0.96	13.28	5.62	30.66
T ₂	0.74	0.18	1.05	44.92	10.81	64.93
T ₃	0.58	0.20	1.18	26.82	9.20	54.24
T ₄	0.53	0.20	1.19	22.10	8.56	49.29
T ₅	0.46	0.20	1.17	17.03	7.33	43.02
T ₆	0.67	0.18	1.08	40.34	11.05	63.74
T ₇	0.65	0.19	1.15	35.65	10.59	63.28
T ₈	0.63	0.18	1.06	31.64	9.25	53.26
SEm ±	0.02	0.01	0.05	1.59	0.57	3.50
CD (p= 0.05)	0.07	NS	NS	4.82	1.74	10.64
CV (%)	6.90	7.70	8.90	9.50	10.90	11.50

Table 4. Effect of different levels of nitrogen, FYM, vermicompost and biofertilizers on available macronutrient (N, P and K) content soil post-harvest soil larve

Treatments	Nitrogen	Phosphorus	Potassium
	Kg ha ⁻¹		
T ₁	143	50	267.9
T ₂	170.3	51.4	346.9
T ₃	153.6	63.4	434.6
T ₄	147.2	65.6	473.8
T ₅	146.1	61.9	427.1
T ₆	168.1	58.9	415.9
T ₇	160.8	60.4	419.7
T ₈	160.8	53.9	415.9
SEm ±	7.39	2.18	16.6
CD (p= 0.05)	22.4	6.6	50.4
CV (%)	8.2	6.5	7.2

RESULTS AND DISCUSSION

The highest drymatter yield was recorded with application of 100% recommended dose of nitrogen at knee high (896 kg ha⁻¹), tasseling (3447 kg ha⁻¹), grain (5827 kg ha⁻¹) and Stover (6026 kg ha⁻¹) which was significantly superior over other treatments (Table 1). Highest yield in fertilizer treated plots might be due to greater solubility and accelerated release of nitrogen besides providing favorable rhizosphere for maize to utilize higher quantum of nutrients. It was observed that, highest nitrogen content (1.19 %) in grain was recorded in the treatment receiving recommended dose of nitrogen (T₂), where as P and K contents were recorded highest (0.28 % and 0.58 %, respectively) in the treatment receiving 50 % RDN + 50 % N through FYM (Table 2.). In grain, highest N & K uptake (69.62 kg ha⁻¹ & 29.14 kg ha⁻¹ respectively) was observed in T₂ treatment where recommended dose of nitrogen was applied and it was significantly superior over other treatments, where as highest P content was observed in T₆ treatment which received 75 % RDN + 25 % N through vermicompost (14.02 kg ha⁻¹). Similar trend was noticed in case of stover also, wherein highest N and K uptake (44.92 kg ha⁻¹ and 64.93 kg ha⁻¹, respectively) was observed in T₂ treatment and highest P content was observed in T₆ treatment, (Table3). The highest N and P uptake by maize was observed with increasing levels of nitrogen, which might be due to the enhanced number of small root hairs which in turns facilitated the absorbing ability per unit dry weight (Sunitha and Reddy, 2012 and Hammad *et al.*, 2011). Increased P uptake in the plots treated with organic sources is majorly due to solubilizing action of organic acids produced during

decomposition of organic manures which might have increased the release of native P, stimulated microbial growth in soil, favoured root growth and had finally led to increased P uptake (Sharma *et al.*, 2015).

At harvest, highest available nitrogen (170.3 kg ha⁻¹) was recorded with application of 100 % recommended dose of nitrogen which was significantly superior over other treatments (Table 4). Highest accumulation of available N in all the treatments when compared to control was due to increase in net N mineralization rates by the application of inorganic as well as organic fertilizers (Sharma *et al.*, 2017). However, highest available phosphorus (65.6 kg ha⁻¹) was recorded in the treatment receiving 50 % RDN + 50 % N through FYM (T₄) which was on par with 50 % RDN + 50 % N through vermicompost (T₃), 50 % RDN + Azospirillum @ 5 kg ha⁻¹ (T₅) and 75 % RDN + 25 % N through FYM (T₇). Highest accumulation of available P in FYM treated plot might be due to the addition of organic manures (FYM), biofertilizers and inorganic fertilizers helps in enhancing the P concentration in solution through mineralization of organic P and solubilization of native soil P compounds by producing organic acids (Roy *et al.*, 2017). Highest available potassium (473.8 kg ha⁻¹) was recorded with application of 50 % RDN + 50 % N through FYM (T₄) which was significantly superior over other treatments (Table 4). Highest available Potassium in integrated nitrogen management treatment might be due to the addition of organic matter that reduced K fixation and released K due to interaction of organic matter with clay, besides the direct addition of potassium to the pool of soil (Urkurkar *et al.*, 2010).

CONCLUSION

It can be concluded that, highest N content in grain and Stover was recorded in treatment receiving 100 % recommended dose of nitrogen (T_2) where as highest P and K contents were observed with application of 50 % RDN + 50 % N through FYM (T_4).

Highest N & K uptake in grain and Stover were recorded in treatment T_2 which received recommended dose of N, but highest P uptake was recorded in the treatment received which 75 % RDN + 25 % N through vermicompost (T_6).

Application of recommended dose of nitrogen also recorded highest available N content where as application of 50 % RDN + 50 % N through FYM (T_4) recorded highest available P & K contents.

In the present study, treatment T_2 which received recommended dose of nitrogen was significantly superior in yield of maize when compared to other treatments.

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