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Effect of Combined Use of Organic and Inorganic Fertilizers on Yield and uptake of Nutrients in Maize

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ABSTARCT

A field experiment was conducted at Agricultural college farm, Bapatla, during *kharif*, 2018 to investigate the effect of organic, inorganic and biofertilizers on yield and uptake of maize. Experiment was laid out in randomised block design with different combination of organic and inorganic sources in different splits and replicated three times. Among the treatments highest grain and stover yields were recorded significantly with 100% of RDF (N in Four Splits) + vermicompost + azosprillum + PSB + KSB (5721 kg ha^{-1} and 5968 kg ha^{-1} in grain and straw, respectively). Highest N uptake was recorded with 100% RDF (N in three splits) + vermicopost + azosprillum + PSB+KSB in grain (79.1 kg ha^{-1}) but in stover highest uptake was observed with 100%RDF (N in four splits) + vermicompost + azosprillum + PSB + KSB (47.1 kg ha^{-1}). The highest P and K uptake of maize were recorded in treatment applied with 100% of RDF (N in four splits) + vermicompost + azosprillum + PSB + KSB in grain were 27.5 and 49.0 kg ha^{-1}, respectively whereas in stover were 16.7 % and 82.2 kg ha^{-1}, respectively.

Keywords: *Maize, Yield, Uptake, Organics, Inorganics, Bio fertilizers and Vermicompost*

Wheat, rice and maize are the most important cereal crops in the world but maize is the most popular due to its high yielding, ease of processing, readily digested and less cost than other cereals (Jaliya *et al.*, 2008). Maize as a major source of carbohydrate is used as food, in livestock diet and in alcohol production. Maize has immense potential in the tropics with yield of 7.5 t ha^{-1}. Unfortunately, yields are still generally below 5000 kg ha^{-1} (FAO, 2007) and this had caused inadequacy of maize for its numerous usages.

As a heavy feeder of nutrients, maize productivity is largely dependent on nutrient management. Therefore, it needs fertile soil to express its yield potential. Chemical fertilizers are the primary source of plant nutrient. But, soils which received plant nutrient only through chemical fertilizer are showing declining productivity despite being supplied with sufficient nutrients. Excessive use of chemical fertilizer has been associated with decline in soil physical and chemical properties and crop yield and significant land problem such as degradation due to over exploitation of land, soil pollution caused by high application rates of fertilizer and pesticide (Singh, 2000).

Highest productivity of crops in sustainable manner without deteriorating the soil and other natural resources could be achieved only by applying appropriate combination of different organic manures and inorganic fertilizers (Chandrashekara *et al.*, 2000). An integrated use of organic, inorganic and biofertilizers should be opted for maximizing economic yield and to improve soil health (Syed *et al.*, 2001).

Hence, a study was conducted to assess the suitable combination of fertilizers, organic manures and biofertilizers for maximizing the productivity of maize during *kharif*.

MATERIAL AND METHODS

The experiment was conducted at College Farm, Agricultural College, Bapatla during the year 2018 and experiment was laid out in RBD with seventeen treatments and replicated thrice. The treatments comprised of T_1-Absolute control; T_2-75% of RDF (N in Three splits);T_3-75% of RDF (N in Four Splits); T_4-100% RDF (N in Three splits); T5- 100% RDF (N in four splits);T_6- 75% of RDF (N in Three splits) + vermicompost; T_7-75% of RDF (N in Four Splits) + vermicompost; T_8- 100% RDF (N in three splits) + vermicompost (2.5t ha-1); T_9-100% RDF (N in four splits) +vermicompost; T_{10}-75% RDF(N in three splits) + Azosprillum + PSB + KSB; T_{11}-75% RDF (N in four splits) + azosprillum + PSB + KSB; T_{12}–100% RDF (N in three splits) + azosprillum + PSB + KSB; T_{13}-100%RDF(N in four splits) + azosprillum + PSB + KSB; T_{14}-75% RDF (N in three splits) + vermicompost + azosprillum + PSB + KSB; T_{15}-75% RDF (N in four splits) + vermicompost + azosprillum + PSB + KSB; T_{16}-100% RDF (N in three splits) + vermicompost + azosprillum + PSB + KSB; T_{17}-100% RDF (N in four splits) + vermicompost + azosprillum + PSB + KSB. Vermicompost 2.5 t ha^{-1} was applied two days before sowing. *Azospirillum lipoferum* was applied one day before sowing by mixing with FYM. Nitrogen was applied as per the treatments. Recommended dose of phoshorus and potassium were applied in the form of SSP and MOP uniformly to all the treatments. Uptake of nutrients (N, P and K) was calculated by multiplying the dry matter production (kg ha^{-1}) with the corresponding nutrient content of the plant parts at harvest stage.

Table 1. Effect of combined use of organic and inorganic fertilizers on yield (kg ha^{-1}) of maize

Treatments	Yield (kg ha^{-1})		Harvest index
	Grain	Stover	
T_1	2639	2817	0.48
T_2	3250	3445	0.49
T_3	3236	3428	0.49
T_4	4428	4554	0.49
T_5	4472	4502	0.49
T_6	3569	3778	0.49
T_7	3624	3785	0.49
T_8	4569	4937	0.48
T_9	4624	4939	0.48
T_{10}	3860	4019	0.49
T_{11}	3958	4133	0.49
T_{12}	5499	5608	0.49
T_{13}	5513	5664	0.49
T_{14}	4402	4538	0.49
T_{15}	4596	4698	0.49
T_{16}	5610	5830	0.49
T_{17}	5721	5968	0.5
SEM(±)	176.2	182.9	
CD (5%)	507.7	526.8	
CV (%)	7.06	7.03	

RESULTS AND DISCUSSION

Grain and Stover yield

The results revealed that the highest grain yield (5721 Kg ha^{-1}) was recorded significantly in 100% RDF(N in four splits) + vermicompost + azosprillum + PSB + KSB followed by 100% RDF (N in three splits) + vermicompost + azosprillum + PSB + KSB (T_{16}), whereas highest Harvest Index was observed in 100%RDF (N in four splits) + vermicompost + azosprillum + PSB + KSB (T_{17}). Increase in the grain yield with vermicompost application along with NPK fertilizers may be due to the fact that added

Table 2. Effect of comibined use of organic and inorganic fertilizers on major nutrientcontent (%) and uptake (kg ha^{-1}) in grain by maize

Treatment	Content %			Uptake (kg ha^{-1})		
	Nitrogen	Phosphorus	Potassium	Nitrogen	Phosphorus	Potassium
T_1	0.82	0.29	0.57	21.6	7.6	15.0
T_2	0.95	0.34	0.64	30.9	11.1	20.7
T_3	0.96	0.36	0.66	31.1	11.6	21.3
T_4	1.21	0.41	0.71	53.6	18.2	31.3
T_5	1.2	0.39	0.74	53.7	17.4	33.0
T_6	0.97	0.35	0.67	34.6	12.3	23.8
T_7	0.99	0.37	0.69	35.9	13.4	24.9
T_8	1.25	0.42	0.73	57.1	19.2	33.2
T_9	1.27	0.44	0.77	58.7	20.3	35.5
T_{10}	1.03	0.38	0.7	39.8	14.7	26.9
T_{11}	1.02	0.4	0.71	40.4	15.8	28.0
T_{12}	1.34	0.46	0.79	73.7	25.3	43.3
T_{13}	1.33	0.45	0.82	73.3	24.8	45.0
T_{14}	1.12	0.41	0.73	49.3	18.0	32.0
T_{15}	1.19	0.43	0.75	54.7	19.8	34.3
T_{16}	1.41	0.47	0.84	79.1	26.4	47.0
T_{17}	1.38	0.48	0.86	78.9	27.5	49.0
SEM(±)	0.05	0.02	0.03	3.4	1.1	1.9
CD (5%)	0.14	0.05	0.09	9.7	3.1	5.5
CV (%)	7.6	7.2	7.29	10.4	10.4	10.4

biofertilizers and vermicompost served as store house of several macro and micro-nutrients which are released during the process of mineralization (Sai *et al* (2018) and Shilpa *et al.,* (2012)). Application of organic manures either alone or integrated with chemical amendments for maize, performed better (Mujeeb *et al.,* 2010). Similar results were observed in stover yield also. Highest and significant yield (5968 Kg ha^{-1}) was recorded in 100% RDF (N in four splits) + vermicomost + azosprillum +PSB + KSB (T_{17}) followed by 100% RDF(N in three splits) + vermicompost + azosprillum + PSB+ KSB (T_{16}) (5830 kg ha^{-1}).

N, P and K uptake

The amount of fertiliser applied is responsible for the amount of nitrogen, phosphorus and potassium uptake in maize. Among the treatments, 100% RDF (N in 3 splits) + vermicompost + azosprillum + PSB + KSB (T_{16}) recorded significant and the highest uptake of N in grain (79.1 kg ha^{-1}), whereas, uptake of P (27.5kg ha^{-1}) and K (49.0 kg ha^{-1}) (Table 2) was found to be the highest in100% RDF (N in four splits) + vermicompost + azosprillum + PSB + KSB (T_{17}) followed by 100% RDF (N in three splits) + vermicompost + azosprillum + PSB + KSB (T_{16}) which were on par with each other. In case of stover

Table 3. Effect of combined use of organic and inorganic fertilizers on major nutrientcontent (%) and uptake (kg ha^{-1}) in stover by maize

Treatment	Content %			Uptake (kg ha^{-1})		
	Nitrogen	Phosphorus	Potassium	Nitrogen	Phosphorus	Potassium
T_1	0.39	0.11	1.09	11.00	3.10	30.60
T_2	0.58	0.14	1.16	20.00	4.80	39.90
T_3	0.55	0.16	1.18	18.90	5.50	40.30
T_4	0.7	0.21	1.23	31.90	9.60	55.90
T_5	0.69	0.19	1.26	31.10	8.60	56.60
T_6	0.67	0.15	1.19	25.30	5.70	44.80
T_7	0.62	0.17	1.21	23.50	6.40	45.70
T_8	0.73	0.22	1.25	36.00	10.90	61.60
T_9	0.78	0.24	1.29	38.50	11.90	63.60
T_{10}-	0.66	0.18	1.22	26.50	7.20	48.90
T_{11}	0.61	0.2	1.23	25.20	8.30	50.70
T_{12} -	0.75	0.26	1.31	42.10	14.60	73.30
T_{13}	0.76	0.25	1.34	43.00	14.20	75.70
T_{14}	0.68	0.21	1.25	30.90	9.50	56.60
T_{15}	0.7	0.23	1.27	32.90	10.80	59.50
T_{16}	0.78	0.27	1.36	45.50	15.70	79.10
T_{17}	0.79	0.28	1.38	47.10	16.70	82.20
SEM(±)	0.04	0.01	0.04	2.22	0.58	3.04
CD (5%)	0.12	0.02	0.12	6.38	1.66	8.76
CV (%)	11.05	7.09	6	10.80	10.40	9.27

yield, the highest uptake of N, P and K was observed in 100% RDF (N in four splits) + vermicompost + azosprillum + PSB + KSB (47.1, 16.7 and 82.2 kg ha^{-1}, respectively). The increase in P and K uptake was due to the fact that nitrogen promotes phosphorus and potassium uptake with increased shoot and root growth, altered plant metabolism and increased P, K solubility and availability (Kafle *et al.,* 2016). In addition, application of organic fertilizers along with inorganic fertilizers provides multiple benefits of crop productivity and soil fertility (Zhang *et al*., 2016).

CONCLUSION

From this study, it is revealed that significant yield difference was observed with combined use of organic and inorganic fertilizers when compared with only inorganic fertilizers. Highest grain and stover yields were recorded significantly with application of 100%RDF (N in four splits) + vermicompost + azosprillum + PSB + KSB. Similarly, highest N P and K uptake was recorded with combined use of organics and inorganics.

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