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The Effect of Different Organic Sources on Growth and Yield of Sweet Potato

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KEYWORDS
Ipomoeabatatas L., Nitrogen, Phosphorus and Potassium.

Abstract:
The sweetpotato (Ipomoeabatatas L.) or Irish potato is originated in tropical South America which was cultivated for its tuber production throughout the India occupying an area of 1,34,880 ha with production of 16 38,840 MT. Whereas in Andhra Pradesh, sweet potato is cultivated in an area of 530 ha with a production of 10,910 MT (NHB, 2018). In this article we have focused on the effect of different organic sources supplied from organic manures, vermicompost, Arka microbial consortium i.e., Nitrogen, Phosphorus and Potassium on growth and yield of sweet potato was expressed in kg/ha by performing standard methodology. Among organic manures application of vermicompost @ 8.3 t/ha recorded maximum uptake of nutrients with 37.47 kg/ha 8.31 kg/ha and 27.16 kg/ha of NPK respectively. Thereby indicating the vital role of these sources in the transformation reaction of these three nutrients in the soil.

Introduction

The sweetpotato (*Ipomoeabatatas* L.) a member of Convolvulaceae family is one of the most important tropical food crops with versatile utility. It is a natural hexaploid (2n=6x=90) crop with a basic chromosome number of 15. It is probably originated in tropical South America. It is also known as Irish potato. The genus *Ipomoea* is important to humans for the beauty of its flowers (funnel- shaped) and for the tuberous roots. Sweet potato (*Ipomoea batatas* L.) is an herbaceous perennial but cultivated as annual, forms roots as it trails along the ground. The edible "potatoes" are enlarged food-storage portions of the roots. Its leaves are oval to lobed, and the flowers are pink to rose violet. Sweet potato is cultivated throughout the country for its tuber production, occupying an area of 1,34,880 ha with production of 16,38,840 MT whereas in Andhra Pradesh, sweet potato is cultivated in an area of 530 ha with a production of 10,910 MT (NHB, 2018). The cultivation of sweet potato in arid and semi-arid regions is mainly done in rainy season. But due to one or other reasons, farmers are not harnessing the desired production potential of the crop.The tubers are used as a subsidiary food after boiling, baking and frying and also form as an industrial raw material for the production of starch, alcohol, pectin etc. Besides energy provider, it is a good source of minerals and vitamins. More than this, the tubers are having a number of nutrient categories responsible for the health benefits like antioxidants, anti-inflammatory nutrients and blood sugar-regulating nutrients.There is an ample scope for organic production in tuber crops as they respond well to organic manures (Suja et al., 2012) especially in sweet potato as the orange fleshed varieties which are rich in carotene (Sreekanth, 2008) and plays a major role in alleviating the Vitamin A deficiency in children (Anderson et al., 2007). Very meager work has been carried out on the organic production of sweet potato in India. The present

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work was carryout in Krishna district of Andhra Pradesh.

Material and methods

Randomly collected plant samples (tubers and vines) were sun dried and oven dried to a constant weight in a hot air oven at 60°C and then ground into powder. Samples of different components of plants such as tuber, stem and leaf were kept separately in polythene packet for analysis.

Uptake of Nitrogen (kg/ha)

Total nitrogen in plant samples was determined by Kjeldahl's method as described by Jackson (1973). In this method 0.5 g of powdered sample was digested with 10ml of conc. H_2S0_4 in the presence of digestion mixture (K_2S0_4:$CuS0_4.5H_20$ in the proportion of 5:1) and distilled under alkaline medium. The liberated NH_3 was trapped in boric acid containing mixed indicator and titrated against standard 0.01 N H_2S0_4. The nitrogen content in the sample was expressed in kg/ha.

$$\text{Nuptake(kg/ha)} = \frac{\text{Nconcentration(\%)xDrymatteryield(kg/ha)}}{100}$$

Digestion of plant samples with di-acid mixture

A powdered, sample of 0.5 g was pre-digested with 10 ml of concentrated $HN0_3$ and again digested with 5 ml of di-acidmixture ($HN0_3$:$HCI0_4$ in 9:4 ratio). It was kept overnight for digestion and then heated until evolution of white dense fumes leaving colourless clear solution in the conical flasks. It was cooled and the volume was made upto100 ml with distilled water. The same sample was used for estimation of P and K (Jackson 1973).

Uptake of Phosphorus (kg/ha)

The total phosphorus content in plant sample was determined by taking a known volume of the di-acid digested samples by adopting the Vanadomolybdate phosphoric yellow color method as described by Jackson (1973). The intensity of yellow colour was read in spectrophotometer (Systronics UV-VIS Spectrophotometer 118) at 470nm. The phosphorus content in the sample was expressed in kg/ha.

$$P_2O_5\text{uptake(kg/ha)} = \frac{P_2O_5\text{concentration(\%) x Drymatter yield(kg/ha)}}{100}$$

Uptake of Potassium(kg/ha)

The total potassium content of the di-acid digested plant samples was estimated by atomizing the digested and diluted sample to a calibrated flame photometer under suitable measuring conditions as described by Jackson (1973). The potassium uptake was expressed in kg/ha.

$$K_2O\text{uptake(kg/ha)} = \frac{K_2O\text{concentration(\%) x Drymatteryield(kg/ha)}}{100}$$

Results and Discussion

Uptake of nitrogen (kg/ha)

The data pertaining to the uptake of nitrogen by the plant as influenced by organic manures and sprayings are presented in the Table 1. and Fig. 1.

The uptake of nitrogen by the plant varied significantly at different levels of organic manures. The maximum uptake of nitrogen (37.47 kg) was observed with the application of vermicompost (M2) which was on par with neem cake (M3) (37.36 kg) and the lowest uptake of nitrogen (34.92 kg) was recorded with the application of FYM (M1).

Sprayings also influenced the uptake of nitrogen by the plant. Application of Arka microbial consortium (F4) recorded the maximum uptake of nitrogen (39.39 kg) which was on par with jeevamruth (F3) (39.08 kg) and the lowest uptake of nitrogen (32.02 kg) was recorded with water spray (F5).

The interaction effect of different levels of organic manures in combination with sprayings was found to be highly significant. The maximum uptake of nitrogen (42.32 kg) was recorded with the application of vermicompost + Arka microbial consortium (M2F4) which was on par with the treatment combination neem cake + jeevamruth (M3F3) (40.28 kg). The combination of FYM + water spray (M1F5) recorded the lowest uptake of nitrogen (31.05 kg).

Uptake of Phosphorus (kg/ha)

The data pertaining to the uptake of phosphorous by the plant as influenced by organic manures and sprayings are presented in the Table 1 and Fig. 1.

The uptake of phosphorous by the plant varied significantly at different levels of organic manures. The maximum uptake of phosphorous (8.31 kg) was observed with the application of vermicompost (M2) and was on par with neem cake (M3) (8.18 kg) and the lowest uptake of phosphorous (7.82 kg) was recorded with the application of PYM (M1).

Sprayings also influenced the uptake of phosphorous by the plant. Application of Arka microbial consortium (F4) recorded the maximum uptake of phosphorous (8.38 kg) which was on par with jeevamruth (F3) (8.35 kg) and the lowest uptake of phosphorous (7.42 kg) was recorded with water spray (F5).

Phosphate solubilizing bacteria present in Arka microbial consortium would have caused more mobilization and solubilization of insoluble phosphorus in the soil and improved the availability of phosphorus which would have caused an increased uptake of phosphorus in plants. The increased growth might have helped in increased photosynthetic rate and more photosynthetic mobilization improved quality attributes in better source to sink relationship, better nutrient uptake, besides excellent physiological and biochemical activities. The results are in confirmation with findings of Tanwar et al. (2003).

The interaction effect of different levels of organic manures in combination with sprayings was found to be highly significant. The maximum uptake of phosphorous (9.20 kg) was recorded with the application of vermicompost along with Arka microbial consortium (M2F4) and was on par with the treatment combination neem cake + jeevamruth (M3F3) (8.75 kg). The combination of FYM + water spray (M1F5) recorded the lowest uptake of phosphorous (7.03 kg).

Uptake of Potassium {kg/ha)

The data pertaining to the uptake of potassium by the plant as influenced by organic manures and sprayings are presented in the Table 1 and Fig. 1.

The uptake of potassium by the plant aired significantly at different levels of organic manures. The maximum uptake of potassium (27.16 kg) was observed with the application of vermicompost (M2) and was on par with neem cake (M3) (26.80 kg) and the lowest uptake of potassium (26.43 kg) was recorded with the application of FYM (M1).

Sprayings also influenced the uptake of potassium by the plant. Application of Arka microbial consortium (F4) recorded the maximum uptake of potassium (27.84 kg) which was on par with jeevamruth (F3) (27.25 kg) and the lowest uptake of potassium (24.97 kg) was recorded with water spray (F5).

The interaction effect of different levels of organic manures in combination with sprayings was found to be highly significant. The maximum uptake of potassium (29.62 kg) was recorded with the application of vermicompost + Arka microbial consortium (M2F4) which was on par with the treatment combination neem cake + jeevamruth (M3F3) (29.21 kg). The combination of FYM + water spray (M1F5) recorded the lowest uptake of potassium (24.22 kg).

Vermicompost and vermiwash treatments improve the micronutrient levels in the soil (Jaikishaun et al. 2014). The carbon content in vermicomposted soil found to release the nutrients slowly into the soil and thereby aiding the plants to absorb the available nutrients (Ansari and Sukhraj 2010). Incorporation of organic manures provide conducive physical environment mainly by improving bulk density of soil (Arriage and Lowery, 2003) which helps in better absorption of nutrients from soil as well as from nutrient sources. The reason being that the application of vermicompost had favored the activity of soil microflora physical conditions besides supplementing the nutrients (Saravaiya et al. 2010) and build up of major nutrients insoil where the plots treated with vermicompost. The improvement in soil conditions might have enhanced the ability of sweet potato plant to draw more nutrients from larger area and greater depth. The application of liquid organics resulted in higher uptake of N, P and K by tomato plants than those which received the RDF (Magray et al., 2011). The higher uptake of nutrients may be due to Zn solubilizing organism (Bacillus sp.) present in the liquid biofertilizer that had a favourable effect on the availability of N, P and K, thereby indicating the vital role of these organisms in the transformation reaction of these three nutrients in the soil.

Conclusion

Based on the results among organic manures application of vermicompost @ 8.3 t/ha recorded maximum uptake of nutrients with 37.47 kg/ha 8.31 kg/ha and 27.16 kg/ha of NPK respectively. Similarly, application of Arka microbial consortium @ 7.5 l/ha recorded maximum uptake of nutrients with 39.39 kg/ha, 8.38 kg/ha and 27.84 kg/ha of NPK respectively and the combined effect of application of vermicompost @ 8.3 t/ha coupled with Arka microbial consortium @ 7.5 1/ha resulted in increased nutrient uptake by the plant (NPK @ 43.32 kg/ha, 9.20 kg/ha, 29.62 kg/ha).

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Table 1. Effectoforganicsourcesofnutrientsonleafarea(cm^2)at30,60,90DAPandatharvestof sweetpotato*(Ipomoeabatatas*L.)

Organic Manures Foliar sprays	Leafarea(cm^2)															
	30DAP				60DAP				90DAP				AtHarvest			
	M1	**M2**	MJ	**Mean**	**M1**	**M2**	M3	**Mean**	**M1**	**M2**	MJ	**Mean**	**M1**	**M2**	MJ	**Mean**
F1	51.44	52.03	51.92	51.80	95.03	98.78	96.25	96.69	134.93	136.90	136.72	136.18	158.99	161.53	159.25	159.92
F2	52.58	52.16	52.40	52.38	97.13	96.69	95.25	96.36	136.51	137.54	135.20	136.42	160.96	158.17	159.46	159.53
F3	50.73	53.02	53.88	52.54	96.70	96.54	99.06	97.43	135.47	135.57	138.40	136.48	158.64	158.87	164.68	160.73
F4	52.27	**57.46**	52.76	**54.16**	98.07	**101.47**	96.86	**98.80**	136.53	**141.28**	137.33	**138.38**	163.25	**169.31**	160.26	**164.27**
F5	38.82	42.28	41.33	40.81	89.21	90.91	90.60	90.24	130.77	133.99	132.15	132.30	157.01	157.95	157.74	157.56
Mean	49.17	**51.39**	50.46		95.23	**96.88**	95.60		134.84	**137.06**	135.96		159.77	**161.17**	160.28	

	SE(m)±	CDat5%	SE(m)±	CDat5%	SE(m)±	CDatSo/o	SE(m)±	CDat5%
M	0.32	0.92	0.34	0.98	0.37	1.07	0.30	0.88
F	0.41	1.20	0.44	1.27	0.48	1.38	0.39	1.14
M x F	0.71	2.07	0.76	2.20	0.83	2.40	0.68	1.97

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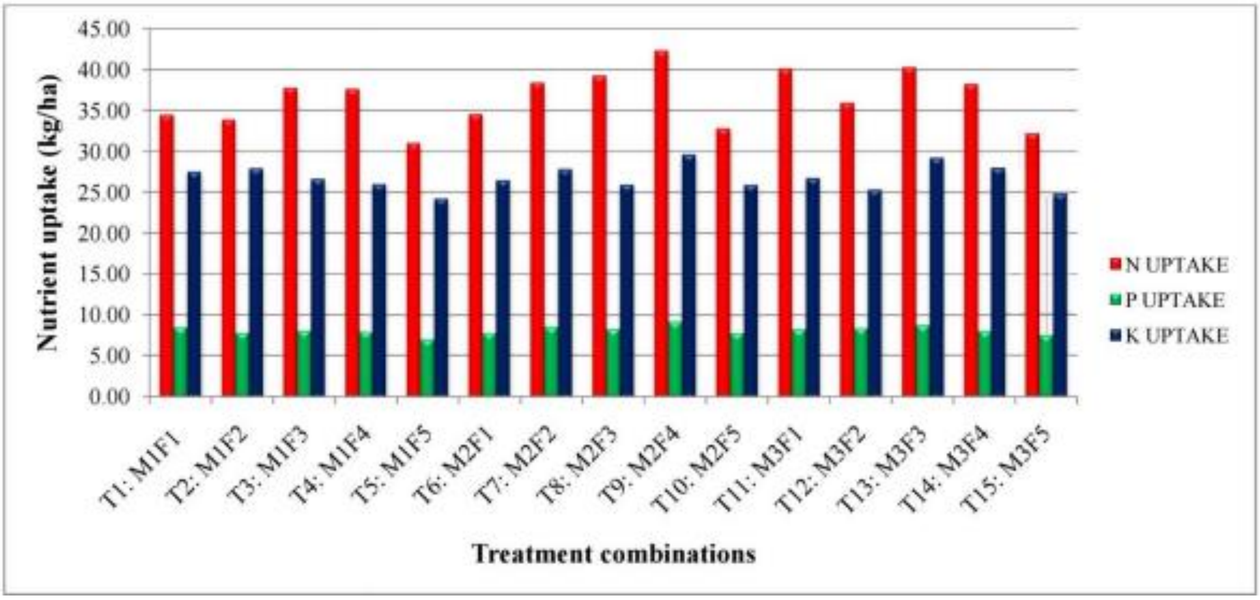

Fig. 6: Effect of organic sources of nutrients on uptake of nutrients (kg/ha)

T1 - M1F1: FYM +Seaweed extract
T2- M1F2: FYM +Humic acid
T3- M1F3: FYM +Jeevamruth
T4- M1F4: FYM +Arka microbial consortium
T5- M1F5: FYM +Water spray
T6- M2F1: Vermicompost +Seaweed extract
T7- M2F2: Vermicompost + Humic acid
T8- M2F3: Vermicompost +Jeevamruth
T9- M2F4: Vermicompost +Arka microbial consortium
T10- M2F5: Vermicompost +Water spray
T11- M3F1: Neem cake +Seaweed extract
T12- M3F2: Neem cake +Humic acid
T13- M3F3: Neem cake +Jeevamruth
T14- M3F4: Neem cake +Arka microbial consortium
T15- M3F5: Neem cake +Water spray