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RESEARCH ARTICLE

Effect of Organic production on growth and productivity of Sweet Potato (*Ipomoea batatas* L.) under Poplar based Agroforestry system

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Abstract

Field experiments was conducted during the kharif seasons of 2012-14 at the forest nursery and research center, College of Forestry, Allahabad Agriculture Institute, Deemed University, Allahabad, on growth and productivity of *Ipomoea batatas* under poplar based Agroforestry system. The experiment was laid out in shade (under trees) condition with 7 treatment replicated thrice in Randomized Block design. A sweet potato variety known as Pusa Red was used for the study. The vine cutting of 15 cm length with 4-6 nodes of Pusa Red variety of sweet potato were planted in spacing 45cm × 60cm. Nitrogen, Potash, and Phosphorus was applied in form of organic manure Farm yard Manure, Vermicompost, and Neemcake. T₃ (vermicompost) recorded highest survival percent, length of vine, number of branches/vine, shoot fresh weight, shoot dry weight, tuber yield/plot, number of tuber per plot under poplar trees. The maximum Gross return was noticed in T₃ with Rs. 99204.00. The maximum Benefit cost ratio was noticed in T₃ with 1:1.37

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INTRODUCTION

Organic manure is a one of the most important inputs for increasing the productivity of crop (Anon, 1997). In order to obtain good yield, modern varieties of different crops require relatively high quality of fertilizer compared to the traditional varieties. Organic manures are natural products used by farmers to provide nutrients for the crop plants. Organic matter in turn releases the plant nutrients in available from for the use of crops. They provide organic acids that help to dissolve soil nutrients and make them available for the plants. The compost prepared by using earthworms is called vermicompost. It is now-a-days regarded as a very important component of the organic farming package. It is easy to prepare, has excellent properties and is absolutely harmless to plants. The vermicompost contains 1.0-1.5 per cent of Nitrogen, 1.8-2.2 per cent of phosphorus and 1.0-1.5 per cent of potassium.

Poplar commonly known for its fast-growing is deciduous tall tree with a fairly straight and slim trunk, rather open crown composed of a few large branches and attaining a height of 15 m. The branches are more or less angled or almost winged. Most of the poplar wood is used in the match box and plywood industry (Chaturvedi et. al., 1993). The species is suitable for making general purpose plywood, marine plywood, and concrete shuttering plywood. It is also considered suitable for the manufacture of artificial limbs, sports goods, and for structural false ceiling, and partition etc. It has also been found suitable as line supports for overhead electric pole and telecommunication lines. The white furniture made out of poplar wood is becoming popular in country (Tandon, 1991).

Sweet Potato is a wonderful gift of nature. The sweet potato is a dicotyledonous plant that belongs to the family Convolvulaceae. Its large, starchy, sweet-tasting, tuberous roots is an important tuber crops. The young leaves and shoots are sometimes eaten as greens. (Abidin, 2004). A part of the tuber harvest is used in India as cattle fodder. Sweet potato based soup are popular in China during winter. In Japan it is used as sweet potato couch spirit. Pusa red is popular variety used for eaten after simply boiling in pressure cooking (Zhang et. al., 1998). Although Pusa Red Variety of sweet potato is one of the important tuber crops in India, the actually yield of this crops is lower

than potential yield. Of the various factor responsible for low yield is lack of soil fertility (Elias et. al., 1991). Therefore the research was under taken to standardized an organic fertilizer and to determine the profitability of different content for farmers.

Material And Methods

The experiment was conducted in Randomized Block Design having seven treatments with three replication at research farm of College of Forestry, Allahabad which is located at 28°52' N latitude and 81°50'E longitudes and in 98 m above m.s.l. Average annual rainfall is 1100mm. Effect of different organic manure of Sweet potato production was studies under seven year old poplar plantation with spacing of row to row 9m and plant to plant 3m. The plantation consists poplar trees of G48 clones with an a average height of 13.10m. The plantation offered partial light condition since the canopy was not fully closed due to longer spacing between rows of trees. The vine cutting of 15 cm length with 4-6 nodes of Pusa Red variety of sweet potato were planted in spacing 45cm × 60cm. The experiment was conducted with seven treatments viz., T₁-control, T₂- Farm Yard Manure, T₃- Vermicompost, T₄- Neem Cake, T₅- 50% Farm Yard Manure +50% Neem cake, T₆-50% Farm Yard Manure +50% Vermicompost, T₇-50% Neem cake+Vermicompost. N, P₂O₅, and K₂O were applied in organic form viz., Vermicompost, Farm yard manure and Neem cake was given at basal dressing. Weeding and hoeing were done as per requirement. The parameter such as survival per cent (%), length of vine (cm), number of branches/vine, shoot fresh weight(g), shoot dry weight(g), number of tuber per plant and tuber yield q/ha were calevated. The data was subjected to statistical analysis of variance ANOVA. Test of significance of treatment difference was done on the basis of F test (Gomez and Gomez, 1984).

Results And Discussion

Table 1: Effect of different treatments of sweet potato on bud sprouting, length of vine, number of branches/vine.

Treatments	Bud sprouting	Length of vine	Number of branches/vine
T ₁	49.43	57.71	4.50
T ₂	68.69	97.54	9.76
T ₃	73.39	105.24	11.92
T ₄	53.45	81.22	8.46
T ₅	65.60	93.31	8.46
T ₆	62.50	89.25	8.76
T ₇	63.02	82.15	8.07
F- test	S	S	S
S. Ed. (±)	0.023	0.589	0.615
C. D. (P = 0.05)	0.048	1.215	1.270

Growth and Productivity of Sweet Potato

The effect of bud sprouting, length vine and number of branches/vine are presented in Table 1. The result revealed that almost all the observation recorded showed significant difference (p=0.05) with all the treatment. The maximum bud sprouting (73.39%), length vine (105.24cm) and number of branches/vine (11.92) was recorded in T₃, which was statistically different from all the treatments. Minimum bud sprouting (49.43%), length of vine (42.21cm) and number branches/vine (4.50) was observed in T₁.

Similar to the other growth & yield parameter in of sweet potato, shoot fresh weight, shoot dry weight, number of tuber per plot and tuber yield/plot are present in Table 2. The results revealed that almost all the parameters showed significant difference (p=0.05) with all the treatment. Maximum shoot fresh weight (151.06g), shoot dry weight (52.12g), number of tuber per plot (33.52 kg/plot) and number of tuber yield/plot (105.24kg) was recorded in T₃. However minimum shoot fresh weight (52.13g), shoot dry weight (19.53g), number of tuber per plot (11.54 kg/plot) and number of tuber yield/plot (57.71kg) was observed in T₁.

This indicates that crops grown for their roots and are benefited from organic manure. It is not only as a source of nutrients but also provides good root extension and tuber bulking. World wide, manure has been used as a source of organic manure to improve soil bulk density creating a conducive environment for crops like sweet potato (Arriaga and Lowery, 2003), water stable soil aggregation microbial biomass and activity (Gunapala & Scow, 1998), and crop yield (Nyiraneza and Snapp, 2007).

Table 2: Effect of different treatments of sweet Potato shoot fresh weight, shoot dry weight, number of tuber per plant, tuber yield.

Treatment	Shoot fresh weight	Shoot dry weight	No. of tuber per plot	Tuber yield kg/plot
T ₁	52.13	19.53	11.54	24.64
T ₂	136.43	41.42	23.65	78.88
T ₃	151.06	52.13	33.52	82.67
T ₄	105.01	32.49	21.71	71.73
T ₅	112.64	33.41	19.83	72.52
T ₆	126.32	36.25	21.98	73.13
T ₇	118.93	34.21	23.16	68.42
F- test	S	S	S	S
S.Ed. (±)	0.642	0.642	0.897	0.897
C.D.(P=0.05)	1.326	1.326	1.851	1.851

Growth performance of Poplar tree under agroforestry systems

The growth performance of poplar tree was recorded in the month of July and December and its per cent increase was calculated (Table 3). T₃ showed maximum per cent increase for tree height and diameter at breast height (3.96%) respectively whereas, maximum per cent increase in volume of wood (22.70%) was also recorded in T₃. T₁ showed minimum per cent increase for tree height (1.82), Diameter at Breast height (3.00) and for volume of wood (14.97)

Table 3: Growth performance of Poplar tree under agroforestry system.

Treatment	Tree height (m)			Diameter at Breast height (cm)			Wood volume (m ³ ha ⁻¹ year)		
	July	Dec.	Per cent increase	July	Dec.	Per cent increase	July	Dec.	Per cent increase
T ₁	13.00	13.30	1.82	10.90	11.10	3.00	2.12	2.42	14.97
T ₂	14.30	14.72	3.00	13.30	13.76	3.82	3.54	3.74	20.50
T ₃	14.00	14.55	3.96	10.10	10.48	3.96	3.83	4.83	22.70
T ₄	13.40	13.78	2.14	10.80	11.35	3.50	2.26	2.64	18.14
T ₅	13.40	13.75	2.24	13.10	13.46	3.60	3.42	3.68	19.10
T ₆	14.10	14.42	2.32	10.80	11.10	3.00	2.69	3.69	19.20
T ₇	13.30	13.60	2.10	12.10	12.50	3.20	3.33	3.92	18.32

Economics of the system

The maximum Cost of cultivation was observed in T₄ with Rs. 72071.36 followed by T₇ with Rs. 55488.03 and the minimum cost of cultivation was noticed in T₁ Rs. 28893.60. The maximum Gross return was noticed in T₃ with Rs. 99204.00 followed by T₂ with Rs 93732.50 and the minimum Gross return was noticed in T₁ with Rs 29568.00. The maximum Net return was noticed in T₃ with Rs 57299.30 followed by T₂ with Rs 52785.07 and the minimum Net return was noticed in T₁ Rs 674.40. The maximum Benefit cost ratio was noticed in T₃ with 1:1.37 followed by T₂ with 1:2.29 and the minimum Benefit cost ratio was noticed in T₁ with 1:2.02. Thus, the finding clearly suggests that agroforestry systems are always beneficial than any other tree less landscape. The intercropping for the study was worked out and found that organic manure fetched more net income per hectare. The present investigations confirm the finding of Athani and Imamsaheb (2011).

Table 4: Economics of different treatment and benefit cost ratio for cultivation of Sweet potato under Poplar based agroforestry system.

Treatment	Variable cost (Rs/ha)	Rental value of land (Rs/ha)	Total Cost of cultivation (Rs/ha)	Gross return	Net return (Rs. ha ⁻¹)	Benefit-cost ratio
T ₁	25893.60	3000	28893.60	29568.00	674.40	1:1.02

T₂	37946.93	3000	40946.93	93732.00	52785.07	1:2.29
T₃	38904.70	3000	41904.70	99204.00	57299.30	1:2.37
T₄	69071.36	3000	72071.36	86076.00	14004.64	1:1.19
T₅	47509.14	3000	50509.14	87024.00	36514.86	1:1.72
T₆	38425.81	3000	41425.81	88656.00	47230.19	1:2.14
T₇	52488.03	3000	55488.03	82104.00	26615.97	1:1.48

Conclusion

Sustained soil and soil fertility in Agroforestry system for higher crop yield and better quality can be achieved through integrated organic nutrient management. Pusa Red variety of Sweet potato in combination with Vermicompost is recommended to the farming under poplar based Agroforestry system because this variety significant enhance higher yielding with maximum cost benefit ratio.

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