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EFFECT OF DIFFERENT COMPOSTS ON THE FRUITING AND TUBER FORMATION OF WINGED BEAN-(*PSOPHOCARPUS TETRAGONOLOBUS* (L.) DC.)

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Five different manures were tried on winged bean to increase yield, particularly on fruit and tuber production.

Garbage compost prepared employing Beltsville Aerated Rapid Composting (BARC) technique was most efficient among all methods. Encouraging results were achieved on garbage composted by Chinese method and slurry obtained from cowdung, whereas "garbage compost" from windrow method (Indian method) and cowdung manure were less effective with regard to enhancing yield of winged bean tubers and fruits.

Increase in yield of fruits and tubers mostly depends on appropriate NPK and C/N values. It appears that NPK ratio of "garbage compost" prepared from BARC method was near the required ratio for winged bean cultivation.

Key words: Psophocarpus tetragonolobus, Composts, and NPK values.

INTRODUCTION

Winged bean plant is a tropical legume with high protein (30-42%) and edible oil contents (15-20%) [1] and looks like a pole bean which is a mass of twining stems and leaves climbing to heights of 4m or more, with white, blue, deep purple or pinkish flowers. It produces edible seeds, pods, leaves and root tubers. Protein is rich in lysine – 80% of total amino acid content (without tryptophane). The seeds are rich in tocopherals (vitamin E), an antioxidant that increases vitamin A, used in human body deficiency common in tropical countires. Winged bean has high yield potential, and yields up to 2.5 tons seeds/ha. have been reported [2,3]. The tubers also contain high amount of protein, 8-20 percent, on dry weight basis [4,5]. vitamin A is found in winged bean leaves, which are cooked like Spinach, and the tender shoots are cooked with flowers. High protein content has made winged bean an important and significant plant in the protein gap areas of the tropical world.

Efforts have been made to introduce winged bean at Faisalabad without success [6], whereas cultivation of TP_2 variety was successfully accomplished at Karachi [7].

Effect of different organic composts, prepared in the laboratories, on the yield of green pods and tubers are reported here. Degree of nodulation which increases soil fertility through nitrogen fixing bacteria has also been investigated.

MATERIALS AND METHODS

Seeds of TP_2 variety of winged bean were selected and locally produced germ plasm was used in these experiments. The weight and size of the seeds ranged between 0.5460-0.5785 mg. and 0.9 cm – 1 cm respectively. Earthen pots of 45 cm diameter and 50 cm length were used to determine the exclusive effect of different compost. Before sowing, the seeds were rubbed with sand paper (zero number) to increase the rate and uniformity of emergence. The seeds were subsequently soaked in tap water for 4 hours before sowing [8]. Five seeds per pot were sown at a distinaces of 18 cm. Since it has been reported that when grown on trellis it produced about three times as many pods and 2.72 times as much dry seeds [9,10], winged bean plants were grown on uniform trellis structure. Six sets of 4 replicates each were prepared from American compost, Chinese compost, Indian compost, and Biogas slurry, Cow dung manure mixed with sweet earth and control (without any fertilizer). The different composts were dried and weighed before the pots were filled. Weeds were manually removed when needed and pots irrigated daily. Time taken and percent germination in different composts and control was noted.

Domestic garbage refuse was collected from communal bins, from low socio-economic areas. The organic contents were estimated between 55-59% [11]. Organic vegetable matter was composted by three differ-

ent techniques [12,13] two rural (Chinese method, windrow or Indian method) and an urban/mechanical method (Beltsville Aerated Rapid composting or American method). Biogas slurry was obtained from digesters operating on buffalo dung and manure was procured locally.

Samples of garbage compost, cowdung manure, biogas slurry and soil were separately weighed, dried in an oven at 55^{o} for moisture content. Ash content and organic matter of the samples were also determined. Fat was separated by Soxhlet extraction with petroleum ether (B.P. 40-60^{o}) and fibre contents of the fruits were analyzed according to prescribed methods [14]. Carbon values were computed from measured organic matter [15], nitrogen was estimated by semi micro Kjeldhal method, and crude protein evaluated by multiplying the total nitrogen with the factor 6.25. Phosphates were estimated by colorimetric analysis [16] and potassium according to the Bhide [17].

Data collected on yield of crop were statistically anlayzed by using analysis of variance technique and Latin Square Design at 1 and 5% level of probability.

RESULTS AND DISCUSSION

The present investigations were undertaken to study effects of composts prepared from garbage, biogas slurry, cow dung manure and soil on winged bean. Hundred % germination of seeds was observed in all types of composts, biogas slurry and cow dung manure against 60% germination in control (Soil only). The seeds started germination after 7 days in control, and 4-5 days with different composts (Fig. 1).

Table 1 and 2 shows chemical analysis of different composts and soil before and after cultivation of winged bean respectively. As per recommendations, the pH values could ranged from 4.3-8.0 and according to A.A. Duncun, most of the crop thrives well in soils with pH 8.0 [4]. Initial pH however, ranged from 7.15-7.9 in the control and in different composts before cultivation, whereas, this reduced to 6.95-7.3 range after harvesting (Table 2). It is, therefore, evident that the alkalinity decreases slightly with th cultivation of winged bean in different composts. The organic matter present in different composts ranged between 18.7-61.4% before cultivation. Compost prepared through BARC method gave the highest yield i.e. 148 gm. fruits per plant and the organic matter of soil also changed from 26.8 to 19.26%. This could be due to possible conversion of complex organic materials into simpler forms by employing BARC technique. These simpler forms of elements would have been assimilated by the plants

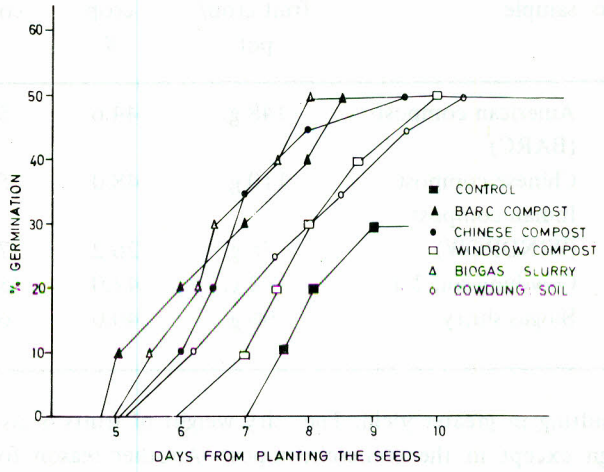

Fig. 1. Showing seed germaination of winged bean in different types composts.

Table 1. Chemical analysis of different types of composts as compared to control (virgin soil) before the cultivation winged bean

S. No.	Sample of compost used	pH	Organic matter%	Ash %	Carbon %	Nitrogen %	C/N ratio	K %	P %
1.	Control (virgin soil)	7.95	3.85	61.6	34.2	0.34	100	2.0	0.10
2.	American compost (BARC)	7.20	26.8	73.2	14.9	1.05	14.1	0.65	0.46
3.	Chinese compost	7.15	30.0	70.0	16.6	1.30	12.8	3.0	0.42
4.	Indian compost (WINDROW)	7.70	18.7	81.3	10.4	1.22	8.52	1.12	0.42
5.	Cowdung soil 2:1	7.5	23.8	76.2	22.7	0.85	26.7	1.25	0.31
6.	Biogas slurry	7.4	61.4	38.6	38.0	2.3	16.6	1.42	0.54

Table 2. Chemical analysis of different types of composts as compared to control (virgin soil) after harvesting of winged bean.

S. No.	Sample of compost used	pH	Organic matter%	Ash %	Carbon %	Nitrogen %	C/N ratio	K %	P %	Yield of fruit crop/plant (mean of 5 plants)
1.	Control (virgin soil)	7.30	3.81	96.15	2.14	3.7	0.57	0.65	0.1	No fruiting
2.	American compost (BARC)	6.95	19.26	80.74	10.98	3.2	3.43	0.57	0.2	148 g.
3.	Chinese compost	6.35	25.45	74.55	14.76	1.3	7.42	1.1	0.65	110 g.
4.	Indian Compost (WINDROW)	7.20	17.77	82.23	10.3	1.3	11.87	0.62	0.36	78 g.
5.	Cowdung soil 2:1	6.35	9.09	90.97	5.05	3.06	1.65	1.17	0.12	72 g.
6.	Biogas slurry	6.05	46.62	53.38	25.9	1.73	14.97	0.02	0.2	98 g.

Table 3. Chemical analysis of winged bean fruit using different composts.

S. No.	Compost sample	Yield of fruit crop/ pot	Dry wt. of crop %	Moisture content %	pH of fruit	Organic matter %	Ash %	Organic carbon %	Nitrogen %	Protein %
1.	American compost (BARC)	148 g.	44.6	55.4	6.35	94.87	5.13	52.17	4.87	32.44
2.	Chinese compost	110 g.	48.0	52.0	6.35	95.90	4.10	53.28	4.83	30.19
3.	Indian compost (WINDROW)	78 g.	26.2	73.8	6.35	95.20	4.80	52.88	4.65	29.1
4.	Cowdung soil 2:1	72 g.	42.0	58.0	6.35	95.20	4.80	52.84	5.11	31.98
5.	Biogas slurry	98 g.	40.0	60.0	6.40	94.84	5.16	52.68	5.27	32.00

resulting in greater yield. The dry weight of fruits is also high except in the chinese compost. Another reason for higher yield in BARC compost could also be due to the fact that it produces more bacterial nodulation, healthy leaves and haulms. It seems apparent that the increased leaf surface area enhanced photosynthesis and consquently more starch accumulation and hence increased yield. This also enhanced protein content in fruits i.e. 32.44% (Table 3). It was observed that in control no fruiting occurred because the soil had more clay and the required air water relationship was not satisfactory. Scanty nodulation of roots could be another reason for unhealthy plants and no fruiting in the control.

The C:N ratio of the compost is in fact important determinant of its immediate utility in crop production. If the C:N ratio is too high, i.e. above 20:1, the danger of nitrogen deficiency or nitrogen "robbing" becomes threatening [18]. Nitrogen robbing is shown by stunted growth and a chlorotic condition as observed in control plants where the C:N ratio is almost 100, which is too high (Table 1). The C:N ratio in different composts ranged between 8.52-26.7 before the cultivation of winged bean, and it decreased to 0.57-14.97 at the time of harvesting. This may be due to the utilization of carbon which is a source of energy and nitrogen conversion into bacterial protoplasm in the soil and compost. When the bacteria associated with compost die and decompose, the nitrogen becomes available to the plants.

Results on weight of tubers per plant in control were not encouraging as essential elements like phosphate was very low (Table 4). Compost prepared through BARC method and cowdung soil composition yielded maximum tubers i.e. 210 g. per plant. Like other root crops. winged bean needs high potassium content for tuber development. Though percentage of potassium was high in control but low yield of tuber 90 g. per plant was due to imbalance ratio of NPK and unstabilized C/N values.

It is evident from (Table 3) that difference in yield of winged bean on 5 composts was highly significant over control and that efficiency of all five composts used in the

Table 4. Chemical analysis of root tubers obtained from different type of composts and soil (virgin) used as control.

S. No.	Sample of compost used	Yield of tuber/plt.	Dry weight of tuber %	Moisture contents %	pH	Organic matter %	Ash %	Organic carbon %	Nitrogen %	Protein %
1.	Control virgin soil	90 g.	40	60	5.75	92.44	7.56	51.36	2.60	16.0
2.	American compost (BARC)	210 g.	29.3	70.7	5.45	96.0	4.0	53.20	2.57	16.2
3.	Chinese compost	141 g.	32.0	68.0	5.25	97.02	2.98	53.90	2.58	16.1
4.	Indian compost (WINDROW)	147 g.	29.8	70.2	5.30	87.78	12.22	48.76	2.58	21.5
5.	Cowdung soil 2:1	180 g.	33.4	66.6	5.25	89.70	10.30	49.83	3.43	16.3
6.	Biogas slurry	210 g.	28.6	71.4	5.25	83.45	16.55	46.36	3.50	21.9

Table of anova

Source of variation	df	Sum square	Mean square	Calculated F value
Rows	4	2.01	0.5025	
Column	4	0.598	0.1495	
Treatment	4	18850.48	4712.62	5592.9
Error	12	10.112	0.8426	

Theoretical F.05 Value (4.12 df) = 5.87
F.01 Value (") = 14.24

LSD 0.05 = 0.426
0.01 = 0.5957

study is different from one another. However, compost prepared through BARC method is most suitable for the cultivation of winged bean. It is said that this method of composting is an improved technology in which the organic matter present in the compost is converted into simpler form to be easily assimilated by the plants, resulting in higher yields.

Biogas slurry and compost prepared by chinese method gave better results, however, WINDROW method was not very effective because the general plant growth was comparatively poor. This may be due to the fact that WINDROW system had low organic matter due to the process of nutrients leaching into the soil through water, which was sprinkled quite often during processing to prevent drying of the refuse mass.

REFERENCES

1. S. Srikantha and J. W. Erdman, JOACS, Vol. 61, No. 3, March (1984).
2. F. Pospisil, S.K. Karikari and E. Boamah - Mensah, World Crops, **25**, 260 (1971).
3. *Underexploited Tropical Plants with Promising Economic Value* (Nat. Acad. Sci., Washington D.C., U.S.A., 1981).
4. *The Winged Bean, A High Protein Crop for the Tropics* (Nat. Acad. Sci. Washington D.C. U.S.A., 1975), pp. 56-61.
5. *Tropical Legumes: Resources for the Future* (Nat. Acad. Sci., Washington D.C. U.S.A., 1984)., p. 34.
6. T. N. Khan and M. Aslam, Public Department Agron. University, Western Australia, Nedlands 6009, Western Australia (1981).
7. S.I. Ahmed, M.S. Solangi and A. Jehan, Pakistan J. Sci. Ind. Res. Vol. **28**, No. 4 (1985).
8. Wong Kai Choo, The Second International Winged Bean Variety Trials; The winged Bean Flyer: Vol. 4, No. 2, (1982).
9. M. P. Braga, Preliminary Observations Concerning the Winged Bean in Amazonas, The Winged Bean Flyer, 4, 2, Dec. (1982).
10. F. Pospisil and B. Halava, *The Effect of Supports on the Production of Seeds and Roots in "Chumbu" Cultivar of Winged Bean Under the Conditions of Hanoi (Vietnam) Winged Bean:* An annotated bibliography. 11. AIBA/SEARCA College, Laguna 3720, Philippines (1982).
11. G. S. Sinnatamby, *Solid Waste Management in Orangi,* (Report B.C.C.I. Community Development Project, United Nations C.H.S. – HABITAT, 1984).
12. K.R. Rabbani, R. Jindal, H. Kuboto and L. Obeng, Composting of Domestic Refuse, Environmental Sanitation Reviews, E.N.S.I.C. – Bangkok (1983).
13. Food, Fuel and Fertilizer from Organic Wastes, Report of an Adhoc Panel of the Advisory Committee on

Technology Innovation, Board of Sc. & Tech. for International Development. 94-101, Washington D.C. (1981).

14. Technical Bulletin No. 27, The Analysis of Agricultural Wastes, Ministry of Agricultural, Fisheries and Foods Regulations, 75 (F. A. O.) H.M.S.O. (1968).
15. Interdepartmental Committee on Utilization of Organic Wastes, Interim Report No. 2, Engg. 6, No. 11 and 12. Newzealand (1951).
16. A.I. Vogel, *A Text Book of Quantitative Inorganic Analysis*, (John Willey & Sons., New York, 1987).
17. A.D. Bhide and Sundaresan, Solid Waste Management in Developing Countries, INSDOC Report 81, (1983).
18. Environmental Sanitation Reviews, No. 10/11, 85 October ENSIC, Thailand (1983).