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STUDIES ON BIODEGRADABLE ORGANIC FERTILIZING POTS AND CROP ESTABLISHMENT

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Uniform and healthy growth in seedlings is a critical step. Mortalities and growth set-back due to transplantation failure is a common phenomenon. Availability of farmyard manure and agro-wastes in abundance has been taken into consideration for making different categories of biodegradable organic pots. Pots trials were conducted to determine the effect of different ratios of farmyard manure and agrowastes on the growth of plants. A histogram has also been provided to show the comparative growth of plants after six months set and biodegradation in the soil. The best result was achieved in 40% farmyard manure pots as compared to 35 and 30% farmyard manure pots. These pots yielded the greatest number of seedlings. The C/N ratio in 40% composition was found favourable as it represented the balanced pH and organic matter. In control set the growth of plants was stunted, under nourished and chlorotic.

Key words: Biodegradable organic pots, Crop establishment, *Casuarina equisetifolia.*

Introduction

Recent experiments have shown that organic pots made from different composts and agro-industrial wastes could strongly be enough and durable for a period of 3-6 months [1]. Better use of biomass available in the form of agricultural wastes and residues can help to fulfill the requirements for producing more food and saving expenditure on fuel and fertilizers. Unproductive means of waste disposal can be replaced by methods that boost crop yields, save energy and improve the environment [2-3].

Organic pots have several advantages over other methods of crop establishment, including minimal losses at the time of transplantation, uniformity in plant size and faster establishment. They also provide nutritional requirements for healthy growth. Since these pots are biodegradable, they are set in the soil alongwith plants [4-5]. With experience, the average farmer should have no problem in producing good quality seedlings grown in organic pots. The growth of *Casuarina equisetifolia* was tested in pots made with farmyard manure as a principal component.

Materials and Methods

Various compositions of farmyard manure and pulverized agricultural residues were used as principal/active and binding materials respectively. To obtain the desired results the material was prepared in uniform grades.

Farmyard manure was used as principal ingredient while rice hulls, dried leaves of maize, banana and paper pulp were used as filler and binding materials. All ingredients were sun-dried at temperatures between 38-42°C which minimised the number of micro-organisms [6]. Farmyard manure is a good potential source of trace elements for plant nutrients. Paper pulp was prepared by soaking the pieces of old news papers in water for 10-15 days and homogenized paste was made by mixing it manually. It was dried, powdered and soaked to be used in making pots. Bone, blood meal and powder of seaweed mixture were added as slow releasing fertilizers. In an endeavour to obtain uniformity in the soil mixture for making organic pots, a bulk sample of different ratios of material was dried and then put through a machine mixer, so that it could be sieved through mesh no.60. Maintaining uniformity of ingredients is the key to success in making suitable organic pots.

A composite sample of soil material was taken to determine the physicochemical properties. Clay, silt and sand contents were determined by Bouyoucos hydrometer [7]. The pH was determined in a soil to water ratio on pH meter using glass electrode and electrical conductivity on conductivity meter. Concentration of micronutrients was determined on Atomic Adsorption (Hitachi Z-8000 coupled with Zeeman's correction) employing DTPA extraction method [8]. Organic matter was determined by dichromate method [9].

The physicochemical properties of the soil show that it contained sand 70.50, clay 9.3 and silt 10.3% and its texture was loamy sand. The pH and organic matter % in different ingredients have been incroporated in Table 1. DTPA extract of the ingredients contained many micro trace elements such as Mn, Cu, Zn, B, Mo and Fe and their concentrations have been incorporated in Table 2.

Different permutations and combinations were used as indicated in Table 1. A hand operating machine was designed and fabricated for making organic pots (Fig.1). The moulded pots were sun-dried for a period of 4-8 days and tested against durability and climatic and watering conditions. A set of control pots was kept for comparison and have only clay and agro-industrial wastes and was devoid of any nutritional supplement. Four replicates of each category of pots were made and experiments were repeated in three consecutive years 1989-1991 before conclusions were drawn. The experiments were carried out in the months of April to September each year and temperature and humidity percentage of the same have been incorporated in Fig.2.

Organic pots were filled with sterilized compost and riverbed soil. Seeds of *Casuarina*, a nitrogen fixing tree for adverse sites, were sown in all pots. The seeds started germinating after sowing between 2-3 weeks in each category of pots. The growth of *Casuarina* in different categories of pots has been shown in a histogram (Fig. 3).The data collected on the growth was statistically analyzed by using variance technique and latin square design at 1 and 5% level of probability.

Casuarina equisetifolia Frost & Frost has been widely used as a sea side ornamental tree and to stabilize coastal sand dunes because it thrives in sand and saline conditions. The outstanding ability of *Casuarina* to grow vigorously in poor soil is due partly to their unusual symbiosis with an actinomycete, *Frankia*. The amounts of nitrogen fixation is roughly comparable to the amounts fixed by legumes with their *Rhizobium* symbionts [10,11]. Factors involved in drying and biodegradation of organic pots under the soil and other details have been discussed and are given in Table 3.

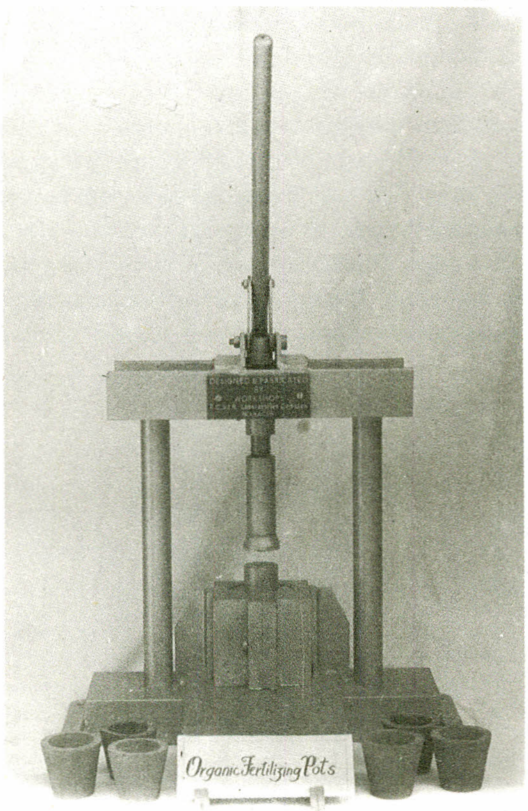

Fig. 1. Hand operating machine for making biodegradable organic fertilizing pots.

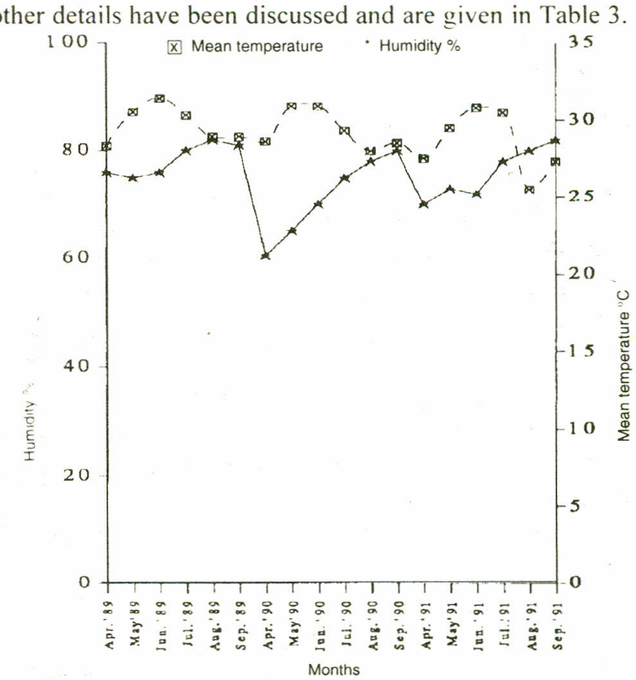

Fig. 2. Temperature and humidity % in the months of April-September 1989-1991.

TABLE 1. DIFFERENT COMPOSITIONS USED FOR MAKING ORGANIC FERTILIZING POTS.

Category of pots	Principal ingredients	Binding materials % Soil/ clay	Paper pulp	Maize leaves dried	Banana leaves dried	Rice hulls	Nutritional ingredients % Bone meal	Blood meal	Seaweeds	pH of material used	Organic matter of material	C/N ratio of material
1.	Control (0)%	30	10	20	20	20	0	0	0	8.0	4.5	100
2.	Farm yard manure (40%)	20	10	20	0	0	1	1	8	7.0	26.5	15
3.	Farm yard manure (35%)	25	10	0	20	0	1	1	8	7.2	23.5	17
4.	Farm yard manure (30%)	30	10	0	0	20	1	1	8	7.5	22.5	20

Results and Discussion

Uniform achievement of healthy stand of seedlings is a difficult task in maximizing crop production. The grower does not earn anything if there is gap in the crop due to seed or transplant failure. However, transplant failures also reduce the uniformity of the crop. Growing seedlings in the organic pot offer several benefits as has already been discussed in the introduction.

The farmyard manure was used in different ratios with a mixture of various binding materials as shown in Table 1. Minor trace elements have great impact on the growth and yield of plants. These elements have different role in life of plants. The trace elements composition (ppm) in different ingredients used for making pots have been presented in Table 2. The organic matter also has the important ability to adsorb soluble nutrient such as nitrogen and potassium which would be lost by leaching in soils. It also acts as a stimulant to soil micro-organisms. After decomposition of organic matter in the soil, ammonia is released and HN_4 ions are oxidised to NO_3 which are assimilated by plants.

The highest percentage of organic matter was available to the pots having 40 percent farmyard manure. The ratio of carbon to nitrogen gives a lead to the decomposition progress. The agro-industrial residues which are used as binding materials in the experiments contain little nitrogen and have high C/N ratio (100) as in control set of pots. The C/N ratio depends upon the availability of nitrogenous material in the soil. It is maintained in the soil receiving compost. It also determines the immediate utility in crop production. If nitrogen is not available to the crop the C/N ratio would be too high i.e. above 20:1. Nitrogen deficiency is manifested by stunted growth of the plants [12,13]. The best growth of the plant was observed in the 40% farmyard manure (C/N ratio-15). The C/N ratio is directly proportion to organic matter as shown in Table 1.

The cumulative effect of principal and binding ingredients on the growth of the plants after six months burial in soil has been shown in a histogram (Fig.3). The growth was noted after every week. The best results were obtained in pots having 40% farmyard manure as compared to 35 and 30%. The height of plants was 80 cm in 40% farmyard manure combination. In other sets the seedlings attained 70, 65, and 65 cm height respectively. There was no mortality rate recorded in any set of experiments. The slow releasing fertilizers boosted the growth of *Casuarina* plants. In control set the organic matter was low and C/N ratio was high. The growth of plants was stunted under-nourished and chlorotic. Table 3 shows different constraints against which organic pots were tested. The drying time depends upon the material used in making the pots. In control set, the heavy clay with a low level of organic matter was used in which water adsorbing capacity was slow. The drying period was maximum (6-7 days) in control pots because of non-porosity of clay with

TABLE 2. TRACE ELEMENTS COMPOSITION (PPM) IN DIFFERENT INGREDIENTS USED IN MAKING ORGANIC POTS.

Source (Dry substance)	Mn ppm	Cu ppm	Zn ppm	B ppm	Mo ppm	Fe ppm
Farmyard manure	400	50	78	20	-	-
Seaweeds (mixture)	52	-	75	-	-	0.17
Maize (leaves)	30	7	16	6	0.2	0.2
Banana (leaves)	40	10	12	4	0.1	-

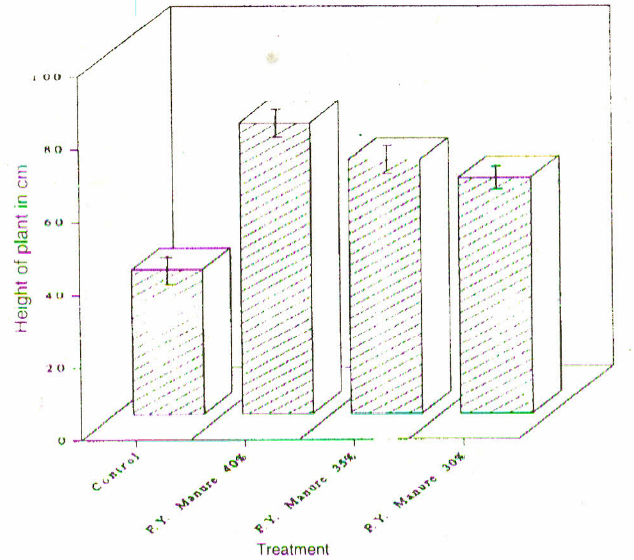

Fig. 3. The comparative growth of *Casuarina* seedlings in different categories of biodegradable organic pots after six months burial.

TABLE 3. DIFFERENT FACTORS IN DRYING AND BIODEGRADATION OF ORGANIC POTS.

Category of pots	Principal ingrediants	Drying period (days)	Day temp. (34-36°C)	Relative humidity	Watering period	Biodegradation period under soil (days)
1.	Control	6-7	35°	54.0	daily	90 days.
2.	Farmyard manure 40%	3-4	35°	52.5	daily	25 days.
3.	Farmyard manure 35%	4-5	36°	53.5	daily	35 days.
4.	Farmyard manure 30%	5-6	34°	56.0	daily	45 days.

water retention capacity. The pots with 40% farmyard manure had the shortest drying period (3-4 days) due to high porosity of the material. The drying period used other two combinations i.e. 35 and 30% farmyard manure was 4-5 and 5-6 days respectively. To all sets of pots, irrespective of different combinations, water was given daily and they remained intact for 3 months with *Casuarina* seedlings. No cracks were observed in any set of pots. When the seedlings attained a height of 15 cm the pots were set in the soil to observe the biodegradation period. The pots with 40% farmyard manure biodegrated in 25 days. The other sets of pots biodegradated after 35 and 45 days respectively. In control the pots biodegrated after 90 days.

In conclusion, the present experiments have shown that the organic pots with 40% farmyard manure with less hard clay were most suitable for the growth of plants and provided balanced nutrients for their healthy growth. It also took shorter period for disintegration in the soil.

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