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Influence of machine generated potting mixture in the growth of black pepper (*Piper nigrum* L.) cuttings and *nutmeg* (*Myristica fragrans* Houtt.) seedlings in nursery

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Black pepper, the 'king of spices' is one of the important export earners to the country. Though the area and production of the crop is more in India, our productivity is very less (400 kg ha^{-1}). For the production of quality planting materials, use of good potting mixture is required. Potting media composed of farmyard manure (FYM): sand: soil in 1:1:1 proportion was reported to give better rooting in pepper at Sri Lanka (Yufdy and Hayani,1991). Potting mixture consisting of soil, granite powder and FYM (2:1:1) was standardized for raising healthy cutting in black pepper nursery (Thankamani *et a1.,* 2008b).

Before filling the potting mixture in polythene bags, the ingredients should be thoroughly mixed to obtain homogeneous mixture. Traditionally, potting mixture is filled in poly bags manually and this operation is tedious and time consuming. Therefore, a power operated continuous-run machine was specially designed and fabricated during 2010 in collaboration with Central Institute of Agricultural Engineering-Industrial Extension Project Centre, Coimbatore (Muthamilselvan *et al.*, 2012)

Trials on production of potting mixture using the developed unit was carried out in two seasons, July-September 2010 and January-March 2011 at ICAR-Indian Institute of Spices Research, Experimental Farm, Peruvannamuzhi, Kozhikode. Potting mixture produced mechanically by the developed unit was used for preparation of three treatment combinations *viz*. a) soil, granite powder and FYM (SGF 2:0:1), b) soil, granite powder and FYM (SGF 2:1:1) and c) soil, sand and FYM (SSF 2:1:1) compared with manually prepared potting mixture *i.e*., soil, granite powder and FYM (SGF2:1:l) as control The experiment was laid out in completely randomized design (CRD) with five replications. To initiate the experiment, polythene bags of size 20x10 cm size were filled with potting mixture as per the treatments. Runners of the black pepper variety IISR Thevam were collected and three noded cuttings were planted one each in polythene bags. All the bags were copiously irrigated and kept inside the semi-permanent nursery shed. In the nursery, plants were maintained as per the standard nursery practices (Thankamani *et al.,* 2008a). After three months of growth, observations on height, number of leaves and root growth were recorded. The experiment was repeated again during January-March, 2011.

In the case of nutmeg, potting mixture was prepared mechanically and the same treatment combinations were followed. Sprouted seedlings of nutmeg were planted in polythene bags of size 25x10 cm and the bags were kept in the same nursery. The seedlings were maintained up to six months in the nursery by following the standard

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package of practice recommended (Rajeev and Leela, 2005) and observations were recorded.

The physical properties of potting mixture *viz*., bulk density, water holding capacity and mechanical properties like fine sand content, coarse sand content, silt content, and clay content of the potting mixture prepared mechanically and manually were analyzed as per the standard procedures. Nutrient content of various ingredients used for potting mixture preparation were estimated by the procedures mentioned by Jackson (1978). The particle size distribution of both hand-made and machine made potting mixture was determined by sieve analysis (Richards *et al*., 1986).

Based on nutrient analysis, the soil contained nitrogen (N) 32 mg kg^{-1}, phosphorus (P) 11.5 mg kg^{-1}, potash (K) 50 mg kg^{-1} and magnesium 290 mg kg^{-1} and pH was 5.0. Granite powder had NPK content of 40, 35 and 800 mg kg^{-1}, respectively. The NPK content in sand was 20, 60 and 140 mg kg^{-1}, respectively with apH of 5.9. Farm yard manure, had NPK content of 120, 55 and 350 mg kg^{-1}, respectively.

Regarding bulk density, mechanically prepared and manually made potting mixture were on par (Table 1). Medium consisting SSF (2:1:1) had higher particle density (1.8) in mechanically prepared potting mixture compared to manually prepared one whereas manually prepared potting mixture had higher particle density (2.1) in a medium consisting of SGF (2:1:1).

Particle size distribution

The particle size distribution of manually as well as mechanically prepared potting mixture were on par. More proportion (81.8%) of desirable level of aggregate was achieved with machine made mixture compared in manual method (79.5%).

Table 2. Particle size distribution of mechanically and manually prepared potting mixture

Sieve opening (mm)	Cumulative weight			
	Mechanical		Manual	
	g	%	g	%
6.30	346	81.8%	425	79.5%
2.00	979		893	
0.70	1635		1589	
0.50	1726	18.2%	1832	20.5%
0.25	1840		1879	
0.11	1943		1913	
0.00	2000		2000	

The biometric observations recorded in black pepper for the two seasons are shown in Table 3. All the treatment combinations had significantly influenced the growth parameters of black pepper rooted cuttings. Height of the black pepper rooted cuttings varied from 16.2 to 20.4 cm, maximum height of 20.4 cm was recorded by the treatment SSF (2:1:1, mechanically prepared) that was on par with the treatment SGF 2:1:1 (mechanically prepared) followed by the treatment SSF (2:1:1 manually prepared). Number of leaves, number of roots and root length in all the treatments were on par except for SGF 2:0:1 (mechanically prepared).

In case of nutmeg, no significant difference was observed with respect to height and number of leaves produced (Table 4). Effect of various treatments was not significant regarding height and number of leaves in nutmeg seedlings.

Table 1. Comparison of basic properties of potting mixture

Property		Soil: sand: FYM(SSF)@ 2:1:1		Soil: granite powder: FYM (SGF) @2:1:1	
		Manual potting	Machine potting	Manual potting	Machine potting
Physical	Bulk density (g cm^{-3})	1.1	1.1	1.1	1.1
	Particle density (g cm^{-3})	1.8	1.8	2.1	1.8
	Water holding capacity (%)	35.5	31.5	37.4	36.8
Mechanical	Fine sand content(%)	32.3	34.3	21.9	23.1
	Coarse sand content (%)	35.9	33.8	29.4	27.1
	Silt content (%)	30.5	30.6	44.4	44.1
	Clay content (%)	1.3	1.3	4.3	5.7

Table 3. Influence of potting mixture on growth parameters of black pepper rooted cuttings after 3 months of growth

Treatments	Height (cm)			No. of leaves			No. of roots			Length of roots (cm)		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
SGF (2:0:1)	16.4	15.9	16.2	3.1	3.2	3.2	12.6	15.0	13.8	7.4	9.0	8.2
SGF (2:1:1)	18.1	21.3	19.7	4.2	3.7	3.9	20.6	18.4	19.5	14.8	13.0	13.9
SSF (2:1:1)	18.9	21.9	20.4	4.2	3.9	4.0	20.8	20.0	20.4	15.4	14.2	14.2
SGF Manual (2:1:1)	19.0	18.0	18.3	3.9	3.5	3.7	19.2	19.0	19.3	12.8	13.8	13.8
Mean	18.1	19.2		3.9	3.6		18.3	18.2		12.6	12.5	
CD(0.05)T	1.9			0.4			2.2			2.1		
CD(0.05)S	NS			0.3			NS			NS		
CD(0.05) T x S	2.7			0.6			3.1			2.9		

S1-Season1; S2- Season 2.

Table 4. Effect of potting mixture on growth of nutmeg seedlings

Treatments	Height (cm)	No. of leaves
SGF 2:0:1 (mechanical)	16.7	4.0
SGF2:1:1 (mechanical)	19.4	8.0
SSF 2:1:1 (mechanical)	18.4	8.0
SGF2:1:1 (manual)	18.2	7.0
CD(0.05)NS	NS	

An ideal potting mixture should have good tilth, porosity, adequate water and nutrient holding capacity and uniform particle size distribution. In the present experiment, sieve analysis of the potting mixture indicated that particle size distribution of machine generated potting mixture was 81.8 per cent whereas in the conventional method it was 79.5 per cent. These properties of mechanically prepared potting mixture were on par with conventional potting mixture. One of the added advantages of mechanically prepared potting mixture is thorough mixing and better sieving when compared to conventional method. Similar observation was made by Richards *et al.,* (1986) in the potting mixture prepared for pine. Number and length of roots of the black pepper plants in mechanically produced potting mixture was on par with manually prepared potting mixture. Better root growth resulted in better growth and absorption of nutrients of rooted black pepper cuttings. This indicated that no adverse effect on growth was observed in black pepper plants raised in mechanically produced potting mixture.

Growth parameters of black pepper like height, number of leaves and root growth were on par either in sand or granite powder as component of potting mixture medium. The performance of black pepper rooted cuttings was good in either sand or in granite powder as one of the ingredient in potting medium (Thankamani *et al.,* 2008b). It was noticed that growth of rooted black pepper cuttings was poor in the medium involving SGF (2:0:1). Potting mixture with poor porosity and aeration would affect root growth and proliferation negatively and resulted in reduced growth (Shiralipour *et al.,* 1992). This could be due to lack of proper aeration and hardening of the medium. Effect of various treatments was not significant regarding height and number of leaves. In case of nutmeg seedlings the treatments had no significant effect on the growth parameters. The results indicated that potting mixture prepared mechanically was suitable for growing nutmeg seedlings prepared using either sand or granite powder. Abirami *et al*. (2010) observed that maximum height and number of leaves of nutmeg seedlings in potting mixture prepared either sand or granite powder as one of the medium.

Cost economics of filling potting mixture prepared mechanically for black pepper was worked out considering depreciation, repair and maintenance cost, operator wages, and electricity consumption. The machine capacity was 100 kg h^{-1} which denotes 1600 bags of 500 g capacity can be filled in a day of 8 hour by engaging two labourers whereas 300 to 350 bags could be filled in the conventional method. Cost of mechanical filling of 1000 bags comes to ₹ 502 and was found to be cheaper when compared to manually filled bags which costs around ₹ 1633. The savings worked out to be 69 per cent in cost and 81 per cent in time.

Table 5. Comparison of potting mixture prepared mechanically over manual method for black pepper

Item	Machine (8 hours)	Manual (8 hours)
Number of bags filled	1600	600
Quantity of potting mixture (kg)	800	148
Cost of filling 100 bags (₹)	502	1633
Cost saving with potting machine over manual method (%)	69.4	
Time saving with potting machine over manual method (%)	81	
Cost of machine (₹)	9500+tax	
Life (years)	10	

Improved growth parameters were observed in the case of black pepper cuttings raised in mechanically prepared potting mixture. No inhibition in growth of nutmeg seedlings was observed either in mechanically made potting mixture or in manually prepared potting mixture. In case of black pepper, 1600 nos of bags (20x10 cm) could be filled mechanically with cost saving of 69 per cent and time saving of 81 per cent. To conclude, potting mixture prepared mechanically could be used for raising black pepper rooted cuttings as well as nutmeg seedling.

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