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Vegetative propagation of allspice

J. Rema*, P.A. Mathew and B. Krishnamoorthy
Indian Institute of Spices Research, Calicut 673 012

ABSTRACT

Allspice (*Pimenta dioica* (L.) Merr.) is a hard to root hardwood species indigenous to West Indies. Different methods of vegetative propagation namely cuttings, air layering, approach grafting and stooling were attempted. The effectiveness of various auxins and influence of season on rooting of cuttings and air layers has also been studied in the present investigation. All the propagation methods namely cuttings, air layering, approach grafting and stooling were successful in allspice with a maximum of 64.4, 73.3, 80 and 85% respectively. A combination of IBA and NAA at 2500 ppm prepared in charcoal was effective for allspice rooting.

Key words: Allspice, *Pimenta dioica,* vegetative propagation.

INTRODUCTION

Allspice (*Pimenta dioica* (L.) Merr.), also known as Jamaican pepper, is indigenous to West Indies. The flavour of allspice resembles a mixture of cinnamon, clove, nutmeg and black pepper. It is a hardwood species and is valued for its dried unripe but mature berries which is used as a spice. The leaves are aromatic and are used in the preparation of essential oils. The berries are used for the production of essential oils and oleoresin. Allspice is conventionally propagated through seeds, but the seeds loose their viability soon after harvest. Allspice being a polygamodioeous tree, identification of the functional male and female trees till they flower is difficult and hence, clonal propagation is essential to obtain uniformly high yielding trees. Very little work has been carried out on the clonal propagation of allspice. The objective of present study was to standardize successful clonal propagation techniques in allspice, either through cuttings, air-layering, approach grafting or stooling. The effectiveness of various auxins and influence of season on rooting of cuttings and air layers has also been studied.

MATERIALS AND METHODS

In the first experiment, cuttings were selected from 20-year old allspice tree grown in the field. The cuttings were collected and processed on the same day. Terminal shoots of allspice with two leaves and about 15 cm length were used for the study. There were six treatments namely, IBA 1000 ppm, IBA 2500 ppm, NAA 1000 ppm, NAA 2500 ppm, IBA 2500 ppm + NAA 2500 ppm and control. All the hormonal formulations were prepared in powdered formulations in activated charcoal and charcoal alone formed the control. A completely randomized design (CRD) with six treatments, six seasons and 3 replications per treatment were adopted with 15 cuttings in each treatment. The cuttings were given a 45 sec. dip in the respective hormone concentration and were planted in pure sand in polythene bags for rooting. Individual bags were further covered with another polythene bag to maintain humidity and increase temperature. The treatments were repeated at two-month interval for one year to study the effect of season on rooting. All the cuttings were evaluated for rooting percentage, number of primary roots, length of primary roots and number of secondary roots after one year. After evaluation of rooting, all the rooted cuttings were replanted in to potting mixture containing sand, soil and cowdung (3:3:1) and allowed to grow for 2 months to study the establishment.

The best treatment from fruit experiment was incorporated in second experiment during the next year to study the response of rooting of air layers. Healthy, uniformly sized allspice trees were selected and the shoots were air-layered about 15 and 45 cm below the shoot apex. A 2 cm wide ring of bark was removed and IBA at 1000 ppm, Seradix, IBA 2500 ppm + NAA 2500 ppm were applied to the portion where the bark was removed. All the hormonal formulations were prepared in powered formulations in activated charcoal. Air-layering with activated charcoal without the application of any hormone formed the control. All the layers were wrapped in moist coir dust and were further wrapped in polythene film to prevent moisture loss. Layering was done at 2 months intervals for one year. The experiment was conducted in a CRD with seven treatments, six seasons and with three replicates per treatment. Ten layers were made in each replicate. The observations were made after 9 months of air-layering. The successful ones were planted in potting mixture in pots after recording the observations. The data was statistically analyzed using Mstat C for both the experiments.

*Corresponding author's E-mail: rema@spices.res.in

Approach grafting was done on three different rootstocks belonging to the same family Myrtaceae namely, *Pimenta dioica*, *Syzygium jambolana* and *S. aromaticum*. Two-year-old seedlings of *Pimenta dioica*, *Syzygium jambolana* and *S. aromaticum* of uniform vigour were selected as rootstock. Approach grafts were made on 20-year-old trees. Allspice was also approach grafted on to 2-year-old seedling of *Pimenta dioica*. There were four treatments with five replications. 10 approach grafts formed one replicate and were observed for one year. Slice approach grafting was adopted. Healthy and vigorously growing high yielding and regularly bearing trees, free from disease and pest attack were chosen as mother trees for grafting. Healthy shoots of mother trees with a terminal bud, 15-20 cm long and measuring about 5 mm diameter were selected for grafting. Benches of convenient height were erected around the tree for holding the bagged rootstocks for grafting. The rootstock and mother tree were regularly watered. After the union, the stock above the union and the scion below the union were cut and the detached grafts were observed for their performance.

Twenty-year-old trees were detopped at a height at 2 feet from the ground level just before the start of monsoon to study the response of allspice to stooling. Detopping was done to facilitate production of juvenile shoots. A ring of bark was removed from the base of the newly emerged shoots and IBA 500 ppm was applied. This was repeated on all the newly emerged shoots. The shoots were mounted with pure sand so as to cover the hormone applied region with the sand. The mount was watered daily. Observations on rooting were taken after one year.

RESULTS AND DISCUSSION

Rooting of cuttings was observed in allspice in all the months for all treatments. Significant variation was observed in the rooting of allspice cuttings during different months using various hormonal treatments. Rooting percentages varied form 6.6 to 64.4%. Among the various treatments, IBA 2500 ppm + NAA 2500 ppm and IBA 1000 ppm were found to be significantly superior to other treatments. A rooting of 64 and 56% was obtained during February and December respectively by application of a combination of IBA and NAA at 2500 ppm each. The next best result was obtained by treating with IBA 1000 ppm during December with a rooting of 48.8%. Cuttings rooted the best during December and February months and the lowest rooting was observed during August. It takes about 10-12 months for rooting of allspice. The allspice cuttings can remain unchanged for months in a humid chamber without rooting and may root even beyond this period. Keeping the cuttings for rooting during December was ideal for primary root production. Number of secondary roots was more during February planted cuttings followed by December. In general, the length and production of primary roots were more when cuttings were kept for rooting in December (Tables 1,2,3 & 4). All the rooted cuttings survived after transplanting into bigger pots in potting mixture. Pre-treatment with auxin combinations, environmental manipulations, physiological status of cuttings, season (Hartmann and Kester, 6), maturity of cuttings (Halliwell, 5) etc. are reported to influence rooting in tree crops. The high amount of tannins and phenolic compounds present in the plant may be hindering the formation of

Table 1. Rooting of allspice cuttings as affected by auxin treatments.

Treatment	February	April	June	August	October	December
NAA 1000 ppm	22.2	19.9	17.7	11.1	13.3	19.9
	(28.1)	(26.3)	(24.2)	(18.8)	(20.9)	(25.6)
NAA 2500 ppm	17.7	28.8	15.5	8.8	6.6	42.2
	(24.6)	(32.1)	(23.1)	(17.2)	(14.9)	(40.4)
IBA 1000 ppm	24.4	28.8	44.4	11.1	28.8	48.8
	(29.2)	(32.2)	(41.8)	(19.2)	(32.3)	(44.3)
IBA 2500 ppm	31.1	19.9	37.7	8.8	8.8	31.1
	(33.8)	(25.2)	(37.8)	(17.2)	(17.1)	(33.7)
NAA 2500 ppm +	64.4	33.3	24.4	13.3	33.3	55.5
IBA 2500 ppm	(53.5)	(35.2)	(29.2)	(20.9)	(35.2)	(48.2)
Control	31.1	26.6	17.7	15.5	19.9	31.1
	(33.3)	(30.9)	(24.8)	(23.1)	(26.3)	(33.3)

CD ($P<0.05$) Month = 4.08; Treatment 4.08; Month x treatment = 9.99.
Values in parentheses indicates transformed values.

Table 2. Number of primary roots in allspice cuttings.

Treatment	February	April	June	August	October	December
NAA 1000 ppm	1.50	1.53	1.40	1.67	1.97	2.43
NAA 2500 ppm	2.00	2.00	2.00	1.00	2.17	2.47
IBA 1000 ppm	1.67	2.76	1.33	1.77	1.83	2.20
IBA 2500 ppm	1.60	1.67	1.33	1.93	1.73	2.00
NAA 2500 ppm + IBA 2500 ppm	1.50	1.43	1.27	1.67	1.13	1.77
Control	1.80	1.00	1.10	1.77	1.77	2.00

CD (P<0.05) Month = 0.421; Treatment = NS; Month x treatment = NS.

Table 3. Length of primary roots in allspice cuttings.

Treatment	February	April	June	August	October	December
NAA 1000 ppm	8.3	10.3	5.5	6.3	7.7	18.7
NAA 2500 ppm	8.6	7.3	7.1	19.5	15.1	12.2
IBA 1000 ppm	5.9	8.3	12.1	9.3	11.4	19.0
IBA 2500 ppm	9.8	7.2	9.1	10.4	9.2	10.0
NAA 2500 ppm + IBA 2500 ppm	6.8	15.0	11.8	7.5	10.2	13.8
Control	9.5	9.6	8.7	11.9	7.4	8.3

CD (P<0.05) Month = 2.14; Treatment = NS; Month x treatment = 5.25.

Table 4. Number of secondary roots in allspice cuttings.

Treatment	February	April	June	August	October	December
NAA 1000 ppm	23.8	10.2	15.8	11.0	10.0	15.4
NAA 2500 ppm	21.5	11.3	8.0	11.0	14.4	18.6
IBA 1000 ppm	11.6	10.0	12.0	21.5	16.2	19.2
IBA 2500 ppm	20.4	13.7	16.9	9.6	10.9	13.5
NAA 2500 ppm + IBA 2500 ppm	20.5	15.0	8.9	9.8	17.7	17.7
Control	21.6	13.6	10.1	8.6	7.9	13.3

CD (P<0.05) Month = 3.05; Treatment = NS; Month x treatment = 7.46.

roots in allspice and use of charcoal to absorb the excess inhibitory compound has aided in rooting even without hormonal treatments. Application of charcoal to the cut surface to remove phenolics and other compounds which inhibit rooting were reported in many woody plants (Blomme and Venwezer, 3).

Rooting was observed in all the months in all the treatments. However, variations in rooting were observed with different hormones and different months. October and December were found to be the best months for rooting of air layers. IBA 2500 ppm + NAA 2500 ppm (at 15 and 45 cm) and IBA 1000 ppm (15 cm) was found to be ideal for rooting as in the case of cuttings. IBA 2500 ppm + NAA ppm (at 15 cm) in charcoal was found to be best treatment with 73 and 63% rooting during December and October respectively (Table 5). IBA in combination with NAA was reported to be ideal for air layering in clove a tree crop belonging to the same family of that of allspice (Chezhiyan *et al.*, 2). Studies on air-layering in Maharashtra indicated that rooting is a slow process taking 18-24 months and January was the best season for air layering with 100% success on 11 year old tree. (Haldanker *et al.*, 4). However, in the present study rooting was observed maximum during October-December. The age of the tree and location would also play a role in rooting. Least rooting was observed during April-June whereas May and August gave least rooting in Maharashtra. The time taken for rooting was reduced in the present study probably due to the use of growth regulators and charcoal. The percentage rooting was lower than that of the earlier study probably due to the age of the tree.

Table 5. Air-layering in allspice as affected by auxin treatments.

Treatment	February	April	June	August	October	December
IBA 1000 - 15 cm	30.0	16.6	26.6	46.6	53.3	60.0
	(28.1)	(19.2)	(30.8)	(42.8)	(46.9)	(50.8)
IBA 1000 - 45 cm	16.6	10.0	20.0	40.0	43.3	33.3
	(23.9)	(18.4)	(26.1)	(38.9)	(41.2)	(34.9)
Seradix - 15 cm	26.6	10.0	13.3	16.6	33.3	30.0
	(30.8)	(15.0)	(21.1)	(23.9)	(35.0)	(33.0)
Seradix - 45 cm	10.0	10.0	3.3	13.3	20.0	16.6
	(15.0)	(18.4)	(6.1)	(21.1)	(26.1)	(19.2)
IBA 2500 + NAA	50.0	30.0	16.6	56.6	63.3	73.3
2500 ppm - 15 cm	(45.0)	(28.1)	(23.9)	(49.2)	(52.8)	(59.0)
IBA 2500 + NAA	46.6	23.3	20.0	43.3	33.3	53.3
2500 ppm - 45 cm	(43.1)	(27.3)	(26.1)	(40.9)	(34.1)	(47.0)
Control	13.3	3.3	6.6	16.6	26.6	30.0
	(21.1)	(6.4)	(12.3)	(19.9)	(30.0)	(28.0)

CD (P<0.05) Month = 7.44; Treatment = 8.04; Month x treatment = NS.

It has been observed that juvenile trees root easily than mature ones.

Grafting of mature and juvenile scions of allspice on its own rootstock (*P. dioica*) was successful with 56 and 80% respectively. The union of juvenile scions takes about 6-7 months where as mature plants take about 10-12 months for graft union. No union was observed between the rootstocks of *S. jambolana* or *S. aromaticum* with mature trees. The successful grafts showed 100% establishment in pots. Approach grafting of allspice was reported with 90 percent success in Jamaica (Chapman, 1). Approach grafting on related species like *S. jambolana* or *S. aromaticum* was not successful in the present study.

In expreiment on response of allspice to stooling, adventitious root production was observed in 85% of the shoots when the mount was removed after 8 months. The rooted shoots were separated and transferred to polybags and kept in the nursery. Though rooting percent is better than other methods of propagation, this method is more cumbersome when compared to other methods. Stooling, which is successfully practised in a related genus namely, *Psidium guajava* was effective in allspice. The physiological status of the shoots would have helped in easy rooting while stooling. The physiological status of the cuttings play a major role in enhancing the rooting and accelerating root growth in juvenile plants. The rooting was easier in this method probably due to the juvenile shoots which were used for stooling.

All the propagation methods namely, cuttings, air-layering, approach grafting and stooling were successful in allspice with a maximum of 64.4, 73.3, 80 and 85% respectively.

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