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Research Article

ASSESSMENT OF ROOTING MEDIA FOR ENHANCING SURVIVABILITY AND PROFITABILITY OF AIR LAYERING IN LITCHI

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Abstract- Rooting percentage (86.83), survival percentage (91.69), number of primary roots (14.12), length of primary roots (5.43 cm), numbers of secondary roots (40.68) of litchi air layering were found to be maximum under the treatment IBA 5000 ppm + sphagnum moss (T_2) and were showed significantly superior over all the treatments [NAA 5000 ppm + sphagnum moss (T_1), sphagnum moss (T_3) and River bed soil as farmers practice (T_4)]. However, days to come leaf after detachment found to be early in T_2 (18.50) followed by T_1 (21.10), T_3 (22.28) and T_4 (27.60). All the treatments were significantly superior over farmers practice (T_4) in terms of rooting and survival percentage, number of primary and secondary roots, length of primary roots as well as days to come leaf after detachment. Higher economic efficiency (0.045) and sphagnum efficiency index (0.82.37) were found with the treatment IBA 5000 ppm + sphagnum moss (T_2) Similar results were found in case of net monetary returns (915.10 Rs/50 layering), B:C ratio (1.98), and net profit per layering(Rs 19.96) .These were significantly superior than rest of the treatments. Thus sphagnum moss along with 5000 ppm IBA should be practiced as rooting media for enhancing survivability and profitability of air layering in litchi (*var.* Shahi) under agro climatic zone II of Bihar.

Keywords- Sphagnum moss, Rooting media, Air layering, Litchi, Survivability and Profitability

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Introduction

Litchi cultivation provides livelihood security for a large population, especially in the state of Bihar [1]. In India, litchi is being cultivated in 84.20 thousand ha area with an annual production of 585.30 thousand million tonne and average productivity is 7.0 million tonne /ha. In Bihar, litchi is cultivated on 31.48 thousand million ha area with the production of 234.20 thousand million tonne and the productivity is 7.40 million tonne/ha [2]. Bihar is the leading state in litchi production contributing about 40% share followed by West Bengal (16%) and Jharkhand (10%) but productivity is lesser than that of West Bengal (11.10 mt /ha) and Jharkhand (10.0 m t /ha) due to unavailability of quality planting materials of litchi. Thus, availability of quality planting material of litchi is the major issues for enhancing productivity and profitability in Bihar. The shortage of genuine planting material coupled with the long juvenile period of litchis is one of the major constraints for mass multiplication. The most commonly practiced and commercial method of vegetative propagation in litchi is air-layering. Air-layering is done when leaves of the previous growth flush have proper maturity. Air layering can be done at any time of years as long as there is sufficient moisture, however more ideal results are reported in rainy and spring season. The principle of layering is to encourage development of newly emerge roots on a stem while the stem is still attached to the parent plant. Roots emerge on the aerial part of a plant after the girdling of stem at an angle and enclosed in a moist rooting medium at the point of injury in air layering. Air layers are usually made on wood of the previous season's growth. Auxins, especially 1-Naphthalene acetic acid (NAA) and Indole-3-butyric acid (IBA), are commonly applied to stimulate root growth of air layering. Cell enlargement, bud formation and root initiation are positively influenced by auxins. Growth and development of plants are affected by plant growth regulators due to metabolic and physiological responses. Various stem treatment leads to formation of adventitious roots during air layering, which causes wounding of a small part of the stem, that resulting in to the interruption of the downward movement of organic material such as carbohydrate, auxin and growth factor from the leaves and shoot tips. This material accumulates close to the treated area and rooting follows.

Thus earlier layering was done using clay soil having provision of watering however, the air-layer practiced now uses growth hormone and sphagnum moss (a nutrient mixed media). Sphagnum moss is a natural organic soil conditioner, which helps to regulate temperature, moisture and air around plant roots, creating ideal growing conditions. Sphagnum Moss aerates plant roots by loosening heavy clay soil. It saves water by absorbing and holding moisture and reduces leaching or runoff of nutrients presents in or added to the soil [3]. Considering the above facts, on farm trial was conducted to find out the effective and profitable rooting media for layering in litchi at farmers field and create new opportunity for self employment in nursery management of fruit crops.

MaterialsandMethods

The participatory verification and on farm trail were conducted on the farmer's field in the selected village (Chilmara and Sirsa) of Katihar district, Bihar. OFT on different rooting media for air layering in litchi (Var. Shahi) was conducted at the selected farmer's fields during monsoon 2014. There were four treatments *viz.* NAA 5000 ppm + sphagnum moss (T1), IBA 5000 ppm + sphagnum moss (T2), sphagnum moss (T3) and River bed soil as farmers practice (T4. The experiment was laid out in randomized block design (RBD) with ten replications (i.e. 10 farmer's fields). The critical input was provided by krishi vigyan Kendra, katihar

under administrative control of Bihar Agricultural University, Sabour (Bhagalpur). 50 layers were selected for each treatment. For that, 2000 shoots of pencil sized thickness (1.2 to 1.5 cm) were needed. The minimum and maximum temperature ranged between 10.610C to 26.56 0C and 21.64 0C to 38.90 0C respectively during April 2014 to march 2015

Preparation of rooting media and air-layer: For preparing rooting media of IBA 5000 ppm, 50 mg IBA was weighed and mixed thoroughly with 10 g of lanoline in a Petri dish. Similarly, for 5000 ppm NAA, 50 mg of chemical mixed with 10 gm lanoline. A healthy terminal branch with a thickness 1.2-1.5 cm was selected for preparation of the air-layer. A ring of bark measuring 2.5 cm width is removed from the branch at the point just below the attachment. Selected shoot were ringed and left for one week. Ring is made by removing the bark from 45-50 cm below the apical growth so that woody portion is exposed due to rubbed of cambium layer. For air layering the sphagnum moss shocked over the night. Then it was squeeze properly to remove the excess water before use on the layer. Rooting hormone is used as paste on upper portion of ring and Cover the wound with two handful of moist sphagnum moss, which creates a football like mass (6" long and 4" wide). A layer of moist sphagnum moss is placed and wrapped with polythene sheet (size 20 x 25 cm) of 400 gauges and tied properly at both ends to ensure supply of optimum moisture for development of roots. After 50-60 days, the adequate root system was developed. When fibrous roots developed and were clearly visible half cut was given and after 7 days, the shoots were detached from mother plant with the help of secateurs. After detachment air layered and rooted shoots were transplanted in poly bag treatment wise separately in partial shade. At the time of planting excess vegetative growth was removed to maintain balance between the top and newly emerged roots. Need based irrigation was done to facilitate better establishment and growth. Beds were kept weed free. Litchi layers become ready for field planting in 4-5 months. The trunk and rooted area was not buried more than 2.5-5 cm below the level of the soil in the poly tube. Poly tube with newly transplanted air-layered plants was placed in a shaded area for about two weeks with a light weight plastic bag placed over the plant to retain humidity until the plant begins to put out new growth The economics were worked on the basis of prevailing market prices of inputs and outputs. The experiment data was subjected to statistical analysis by using the Analysis of variance technique as suggested by [4].

Results & Discussion

Rooting percentage- Different rooting media significantly affected the growth of air-layer. Rooting percentage [Table-1]. showed significant variation (47.53 to 86.83 %) due to rooting media. The maximum Rooting percentage (86.83 was recorded with the treatment IBA 5000 ppm + sphagnum moss (T2) which was significantly superior over all the treatments [NAA 5000 ppm + sphagnum moss (T1), sphagnum moss(T3) and River bed soil as farmers practice (T4)]. More rooting may be due to enhanced hydrolysis of nutritional reserves under the influence of auxin as reported by [5]. Exogenous application of IBA markedly improved the regeneration of roots in comparison to NAA. The greater effectiveness of IBA over NAA may be due to its non-toxic nature in a wide range of concentration and was effective in promoting rooting of large number of plant species. Significant increase in rooting percentage due to combination of IBA and sphagnum moss has also been reported by [6] as well as [7].

Survivability Percentage- The air-layer raised by the application of IBA 5000 ppm + sphagnum moss gave significantly higher survival percentage (91.69 Which was significantly superior over T1 (77.32) ,T3 (69.22) and T4 (50.28) .There was more survival percentage of 14.37 , 22.47 and 41.41 as compared to T1, T3 and T4 respectively [Table-1]. The increase in survival percentage may be due to profuse and thinner root produced by the application of different treatments. Thinner root system increased water absorption capacity, which reduced mortality rate in the nursery. Finding of the trial was in close conformity with findings of [8] in pomegranate, [9] in mango as well as [10] in litchi

No. of primary and secondary roots- Both primary and secondary roots were significantly influenced by different rooting media [Table-1]. The maximum value of primary and secondary roots were recorded with T2 (14.12 & 40.68) and was found in order of T1 (11.33 & 33.38), T3 (8.17 & 24,29) and T4 (6.60 & 15.60) respectively. IBA 5000 ppm + sphagnum moss (T2) was significantly superior over all the treatments in terms of number of primary and secondary roots. The increase in number of both of primary and secondary roots may be due to accumulation of carbohydrates, enhanced protein synthesis and greater accumulation of rooting co-factors. Rooting co-factors react with auxin and a large number of roots were produced. Positive response of the rooting media was also observed by [11, 12, 6, 10] in litchi. Similar views related to secondary root were also expressed by [13] in mango and [14] in plum.

Length of primary roots (cm)- Different rooting media also has significant effect on length of primary roots [Table-1]. All the treatments [NAA 5000 ppm + sphagnum moss (T1) IBA 5000 ppm + sphagnum moss (T2), sphagnum moss (T3)] were significantly superior over farmers practice (T4). The maximum length (5.43 cm) was recorded in T2 and Minimum length of primary roots was recorded in T4 (2.05 cm) treated layer. The increase in length of roots may be due to increase in level of auxin concentration. Auxin elongated the length of primary and secondary roots. IBA in higher concentration causes antagonistic effect on secondary roots. The same viewed were expressed by [15] as well as [10] in litchi.

Days to come leaf after detachment:- The data pertaining to the days to come leaves after detachment as a result of different treatment has been resulted significantly. Investigation on the days to come leaves after detachment varied from 18.50 to 27.60 .Analysis of the data [Table-1] indicated that early leaf initiation (18.50 days) was recorded in T2 and maximum days (27.60) in leaves initiation observed in farmers practices. All the treatments were significantly superior over control in respect of early leaf initiation. Early leaf development may be due to a uniform spread and number of primary and secondary roots system who absorbed sufficient nutrient and water resulting in quick establishment of layers, better morphological growth and leaves. This result was supported by [16].

Table-1 *Rooting and survival percentage, No. of primary and secondary roots, length of primary roots and days to come leaf after detachment of litchi layering as influenced by different rooting media.*

Treatments	Rooting (%)	Survival (%)	No. of primary roots	Length of primary roots(cm)	No. of Secondary roots	Days to come leaf after detachment
NAA 5000 ppm + sphagnum moss (T_1)	70.74	77.32	11.33	4.50	33.38	21.10
IBA 5000 ppm + sphagnum moss (T_2)	86.83	91.69	14.12	5.43	40.68	18.50
sphagnum moss(T_3)	58.93	69.22	8.17	3.60	24.29	22.8
River bed soil as farmers practice (T_4)	47.53	50.28	6.16	2.05	15.60	27.60
SEm ±	1.10	0.91	0.21	0.12	0.37	0.23
CD (p= 0.05)	3.17	2.69	0.59	0.33	1.08	0.67

Profitability

Economics of litchi layering were influenced by different rooting media. Economic analysis [Table-2] showed that the highest cost of production of 50 layering was incurred on IBA 5000 ppm + sphagnum moss (Rs 460.20) followed by NAA 5000 ppm + sphagnum moss (Rs 429.60), sphagnum moss (Rs 410.60) and farmers practice (Rs 363.36) Maximum cost of production in T2 was due to cost of IBA and sphagnum moss. Cost of production was least in farmers practice (T4) due to no expenditure on IBA and sphagnum moss. The highest net returns of Rs 915.10

were realized from T2, which was superior to rest of the treatments. Maximum net returns in treatment T2 was due to highest percentage of rooting and survival of litchi layering whereas minimum net returns was due to poor rooting and poor development of primary and secondary roots which results minimum survival of layering. Positive response of growth regulators and sphagnum moss in rooting and survival was also reported by [17] in guava [8] in pomegranate The highest B:C ratio (1.98) was obtained with IBA 5000 ppm + sphagnum moss, followed by NAA 5000 ppm + sphagnum moss (1.69). The highest

B: C ratio in T2 was mainly due to higher survival percentage of litchi layering. The existing system (River bed soil as farmers practice) had the lowest B: C ratio (1.45). This might be due to poor survival percentage of litchi layering. Similar, result was found in case of net profit per layering (Rs 19.96).This was superior to rest of the treatments

Economic efficiency and sphagnum efficiency index

Both economic efficiency (EE) and sphagnum efficiency index (SEI) are measure of the efficacy of the particular treatment when compared with control treatment. If value of EE and SEI are more means better the efficacy of applied input. Thus, both parameters act as an indicator of economic viability and profitability. Economic efficiency computed by subtracting the number of survival layer of control (farmer) plot from respective treated plot and then divided by cost of cultivation of respective treated plot. For determination of sphagnum efficiency index, subtracting the number of survival layer of control (farmer) plot from respective treated plot and divided by number of survival layer of control (farmer) plot and then multiplied by 100. Comparisons between the treatments on economic efficiency and sphagnum efficiency index showed marked differences [Table-2]. It revealed that T2 had the highest economic efficiency (0.045) and sphagnum efficiency index (82.42) followed by T1 (0.031 & 53.78) and T3 (0.023 & 37.67). Therefore, sphagnum moss along with 5000 ppm IBA should be recommended as rooting media for enhancing survivability and profitability of air layering in litchi (*var.* Shahi) in the agro climatic zone II of Bihar.

Table-2 *Economics of litchi air layering as influences by different rooting media*

Treatments	Cost of production per 50 layer (Rs)	Gross monitory return of survival layer (Rs)	Net monetary return of survival layer(Rs)	B:C ratio	Economic efficiency	Sphagnum efficiency index	Production cost per layering (Rs)	Net profit per layering (Rs)
NAA 5000 ppm + sphagnum moss (T_1)	429.6	1159.80	730.20	1:69	0.031	53.78	8.59	18.88
IBA 5000 ppm + sphagnum moss (T_2)	460.20	1375.35	915.10	1:98	0.045	82.37	9.20	19.96
sphagnum moss(T_3)	410.60	1038.30	627.70	1:52	0.023	37.67	8.21	18.13
River bed soil as farmers practice (T_4)	363.36	754.20	390.84	1:07	-	-	7.26	15.54

Conflict of Interest: None declared

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