RESEARCH ON THE TECHNIQUES FOR CUTTING OF CINNAMOMUM BALANSAE

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SUMMARY

Cinnamomum balansae is an endemic, rare species of tree in Vietnam, was rated level EN by IUCN, VU by the Vietnam Red Book – 2007 and classified as group IIA by Decree 32/2006/NĐ-CP. Besides its natural regeneration capacity is very limited so conservation and development for this species are facing a big challenge of seedling shortages. Therefore, study of breeding *Cinnamomum balansae* is extremely necessary. The vegetable breeding technology for *Cinnamomum balansae* by branch cutting in Ben En National Park gave good results. Using AIA and ABT1 chemicals in different concentrations showed that: The highest rate of rooting of the cuttings after 60 days belongs AIA 1.5%, reaching 65%, followed by ABT1 1.5% and AIA1.0% with 60% for both. Growth stimulants are also a positive effect on the quality of the roots. In which AIA at concentrations of 1.0%, 1.5% and ABT1 1.5% always give the roots the best quality. The study results also confirm that the growth rate in the nursery stage is relatively slow, after 6th months of taking care, *Cinnamomum balansae* can meet the standards of being exported from the nursery, however it is recommended to lengthen the time in the nursery until the 10th month to train the trees to ensure the quality and survival rate for afforestation.

Keywords: Branch cutting, Cinnamomum balansae, export from the nursery, growth, roots, vegetable breeding technology.

I. INTRODUCTION

Cinnamomum balansae Lecomte is an endemic species of Vietnam, distributed in narrow range but it has special value in many aspects: In the stem, roots and leaves,there are Sarsi essential oils, which are very popular in medicine and religion; seeds contain fatty oils which can be used in food; wood is good, with no termites and has smell of camphor so it is often used to make household items and fine arts. These particularities have made *Cinnamomum balansae* into the object of illegal logging in numerous places, a rare species, belonging to Endangered (EN) group in IUCN – 2013, Vulnerable (VU) in Vietnam Redbook – 2007 and group IIA – Decree no. 32/2006/NĐ-CP. In order to conserve and develop this rare species, in 2014, Bến En National Park was assigned to conduct the project " *Cinnamomum balansae* Lecomte conservation and development in Bến En National Park" by Thanh Hóa People's Committee. After 3 years of implementing the inventory and monitoring, it is shown that there is no *Cinnamomum balansae* regeneration under canopy trees in the forest of Ben En NP, this is a huge problem for the existence and development of this species. Meanwhile, there are still a few initial researches on vegetable breeding and seeding techniques for *Cinnamomum balansae* species, however, the results were not high and have not been summarized into specific instructions. Hence, continuing researching on vegetable breeding technique for this species in order to summarize and develop technical guidelines is very important and necessary. This article presents a summary of the results clonal breeding for *Cinnamomum balansae* species to supplement the scientific basis, popularizing techniques for the expansion of seedling production to serve the *Cinnamomum balansae* conservation and development not only in Ben En National Park but also other regions with the same.

II. MATERIALS AND METHODS

2.1. Materials

The study materials are healthy young

branches, on the under 15-year-old mother trees which has been rejuvenated.

2.2. Methods

2.2.1. Collecting and processing the Cinnamomum balansae vegetable breeding

Using sharp scissors to cut the branches of 40-50 cm long, dip it in clean water and place in a plastic bag, seal tight to avoid dehydration. The cutting stems have the length from 7 – 10cm, only 1/3 of the leaf area of the top 2 leaves are kept; the cutting stems without flowers and fruits are chosen. The stems after cutting are dipped in the rooting stimulants and raise in the clean sand right in this day. Seting automatic mist spray mode with frequency 180 - 210 min/time spray, spray each time for 20 seconds. The cuttings are resistant to worms, diseases, ants and insects by spraying Dipterrex and Daconil.

2.2.2. Experimental setup performance

- Setting up the experiment: Two types of chemicals were used: AIA and ABT1, each with three concentration levels (0.5 - 1.5%), each concentration for 20 cuttings, the total is 120 cuttings. Control formula is 20 cuttings.

- Monitoring growth in the nursery: Arrange three growth plots in the nursery stage, each plot has 30 trees.

2.2.3. Trees care in the nursery

The cuttings have 2 or more roots with length $\geq$ 2.5 cm were raised in the soil containers. Those containers were packed in polyethylene bags having the size of 9 cm x 10cm, bottoms and drainage holes around. The soil inside the containers contains: 94% soil +5% manure +1% superphosphate.

The cuttings after raising in the containers were covered with 50% of the light, watered continuously until 30 days before being exported from the nursery then watering was limited, trees streching out and covers removal gradually were conducted until 15 days before the exporting day then the covers were completely removed.

Every month, root inspection was conducted, moving the tree to another container when its roots grow out of the container. Regularly inspecting pests and diseases, soft rot diseases, Anthracnose fungi preventive spraying were conducted.

2.2.4. Data collection and analysis

- Collect death rate and rooting status data of *Cinnamomum balansae* in 60 days.

- Collecting the growth data:

+ In the first 3 months after raising in containers, only survival rate measuring was conducted.

+ From the 4^{th} to the 10^{th} months: measuring the survival rate, D_{00}, H_{full}, evaluate the growth and pests status.

The survey data was analyzed by SPSS16.0 Excel according to conventional statistical methods.

III. RESULTS

3.1. Rooting rate

Tracking results of rooting ability of *Cinnamomum balansae* after 60 days for 2 chemicals AIA, ABT1 having the concentrations of 0.5%, 1.0% and 1.5% were shown in table 3.1.

Table 3.1. Results of raising *Cinnamomum balansae* after 60 days

Formula	Concentration (%)	Number of cuttings	Rooting		Scar tissue developing		Dead	
			N	%	N	%	N	%
AIA	0.5	20	6	30	0	0	14	70
	1.0	20	12	60	0	0	8	40
	1.5	20	13	65	4	20	3	15
ABT1	0.5	20	7	35	0	0	13	65
	1.0	20	11	55	3	15	6	30
	1.5	20	12	60	2	10	6	30
Control Formula	0	20	2	10	0	0	18	90

The data collected in Table 3.1 shows that:

- The AIA gives the rooting rate of 30 - 65%.The highest rate belongs to concentration 1.5% with the rate of 65%, followed by the concentrations 1.0% and 0.5% with the rates of 60% and 30% respectively.

- The ABT1 gives the rooting rate of 35 – 60%. The highest rate belongs to concentration 1.5% with the rate of 60%, followed by the concentrations 1.0% and 0.5% with the rates of 55 % and 35% accordingly.

- The control formula had only 2 cutting with roots developing and the death rate reached 90%.

Figure 3.1. *Cinnamomum balansae* treated by ABT1 (1) and AIA (2) after 60 raising days

Thus, although ABT1 has a lower ratio than AIA at the same concentration, the difference is not significant. Except at 0.5% concentration with low rooting rate, the other two concentrations have a rooting rate of more than 50%. With a rare native species, the difficult ability of flowering and fruiting and the natural regeneration by seeds is limited as *Cinnamomum balansae*, the AIA and ABT1 chemicals in concentrations from 1.0 to 1.5% result in rooting rate from 60 to 65% is quite high.

3.2. Roots quality

In parallel with rooting rate, the root quality is also one of the most important criteria for stem cutting.

Root quality is evaluated by the following criteria: average number of roots, average length of roots and the length of longest root. The result is described in table 3.2.

Table 3.2. Root quality of *Cinnamomum balansae* cutting after 60 days

Formula	Concentration (%)	Average number of roots	Average length of roots (cm)	Length of longest root (cm)	The highest number of roots in 1 cutting
AIA	0.5	2.5	3.5	7.0	3
	1	3.5	3.5	8.0	5
	1.5	3.5	5.0	13.5	6
ABT1	0.5	2.4	3.0	6.5	3
	1	3.0	4.0	8.0	4
	1.5	3.1	4.5	11.0	6
Control Formula	0	1.1	0.9	1.7	2

In table 3.2 we can see that: For the cuttings treated with rooting stimulants, the average number of roots ranged from 2.5 to 3.5 roots / cutting, with an average length of 3.5 to 5.0 cm, the longest roots are from 6.5 - 13.5 and most roots from 3.0 to 6.0 roots, depending on the concentration of the chemical. If all four quality criteria were included, then AIA and ABT1 at 1.5% had the best root quality, followed by 1.0% and finally 0.5%. There are also quality differences between the two stimulants, where AIA always has better root qualities than ABT1 but the difference is not clear. Only the control formula gave the lowest root quality with an average root number of 1.1 cm and the highest number was only 2 roots/cutting.

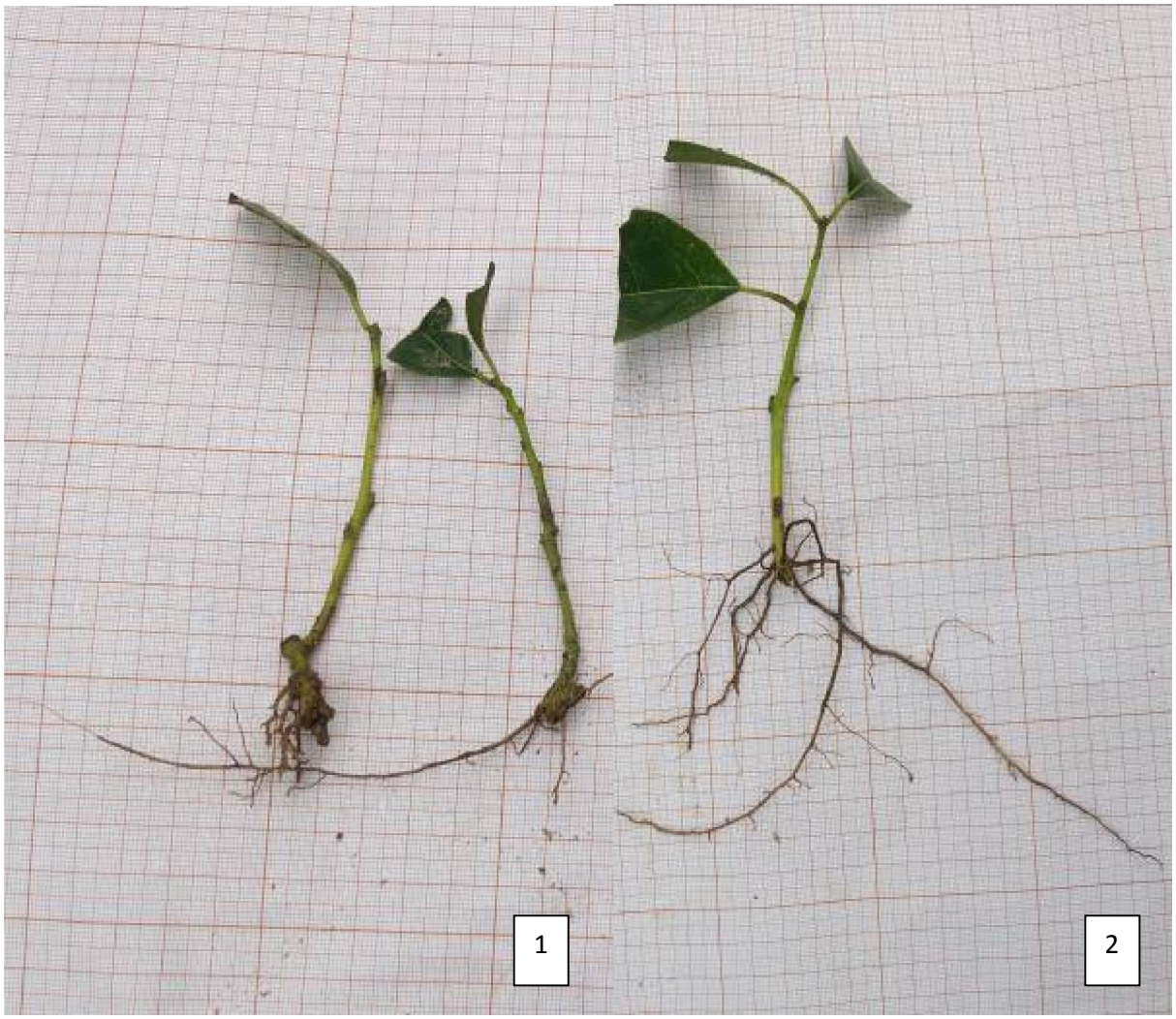

Figure 3.2. Roots of *Cinnamomum balansae* treated by ABT1(1) and AIA(2) after 60 nursing days

3.3. Result of growth monitoring in the nursery

3.3.1. Survival rate

After 1 month raising the cuttings, the data of survival rate in 10 months was collected, the result is in the table 3.3.

Table 3.3. Survival rate of *Cinnamomum balansae* during the nursing time

Nursing time	Survival rate					
	Plot I		Plot II		Plot III	
	Number of trees	%	Number of trees	%	Number of trees	%
1	27	90	28	93.3	28	93.3
2	24	80	27	90.0	25	83.3
3	23	77	26	86.7	25	83.3
4	21	70	23	76.7	22	73.3
5	21	70	23	76.7	22	73.3
6	21	70	23	76.7	22	73.3
7	18	60	20	66.7	19	63.3
8	18	60	20	66.7	19	63.3
9	18	60	20	66.7	19	63.3
10	18	60	20	66.7	19	63.3

The table 3.3 reveals that: Survival rate of *Cinnamomum balansae* decreases by nursing time. This is a fact in the production process because the longer the nursing time is, the more changing the containers is, that leads to the increase of death rate. But it is mandatory in seedling production because only when seedlings are well trained, they will be able to adapt to harsh conditions at the plantation site.

The results show that the survival rate of *Cinnamomum balansae* among measurement plots is not much difference, only from 3.3 to 6.7%, and the survival rate after 10 months of nursery is from 60% this shows that the production of vegetable breeding technique for *Cinnamomum balansae* meets the requirements of mass production and can be applied to a multi-purpose, rare and very low self-regenerating ablility species like *Cinnamomum balansae.*

3.3.2. Growth in the nursery

H_{full} and D_{00} are very important indicators of nursing, only trees that do not have worms or diseases can grow well. Moreover, evaluation of growth rate plays an important role in choosing the care methods so it directly affects the economic efficiency in the production and trading of seedlings.

Growth monitoring result of *Cinnamomum balansae* in the nursing stage was summarized in table 3.4.

Table 3.4. Growth of Cinnamomum balansae after 10 months in the nursery

Nursing time	Average growth in plots					
	Plot I		Plot II		Plot III	
	H_{full}	Doo	H_{full}	Doo	H_{full}	Doo
4	33.31	0.31	35.99	0.34	36.14	0.33
5	35.22	0.33	37.94	0.36	37.81	0.36
6	36.95	0.36	39.82	0.38	39.62	0.38
7	39.01	0.39	41.55	0.41	41.47	0.41
8	40.21	0.41	42.96	0.45	42.83	0.44
9	41.76	0.44	44.66	0.49	44.82	0.48
10	43.57	0.48	46.53	0.52	46.68	0.51
Average growth	**1.47**	**0.02**	**1.50**	**0.03**	**1.51**	**0.03**

Table 3.4. shows that: After 10 months in the nursery, *Cinnamomum balansae* has H_{full} = 43.57 – 46.68 cm, D_{00} = 0.48 – 0.52 cm, growth rates H_{full} and D_{00} are only 1.47cm – 1.51cm /month and 0.02 cm – 0.03 cm/month accordingly. Thus, although *Cinnamomum*

balansae is a native species that grows quite fast in the natural conditions but in the nursing stage, the growth rate is also very limited.

3.3.3. Rate of exporting trees from the nursery

To determine the number of seedlings can be used for afforestation, The project had calculated the rate of trees exported from the nursery with the standards of: H_{full}= 30 – 50 cm and D_{00} = 0.3 – 0.5 cm. The results show that height standard is not a problem for *Cinnamomum balansae* species because after 04 raising months, the living trees have H_{full}> 30cm, however, it takes 06 months to meet the standard of D_{00}. The results are shown in table 3.5.

Table 3.5. Rate of exporting trees from the nursery after 10 months

Nursing time	Rate of trees exported from the nursery					
	Plot I		Plot II		Plot III	
	Number of trees	%	Number of trees	%	Number of trees	%
4	16	53	22	73	20	67
5	18	60	23	77	21	70
6	21	70	23	77	22	73
7	18	60	20	67	19	63
8	18	60	20	67	19	63
9	18	60	20	67	19	63
10	18	60	20	67	19	63

Reality shows that when only based on H_{full} and D_{00}, after 6 raising months, the rate of trees exported from the nursery is highest, with the rates are 70%, 77% and 73% for plots 1, 2 and 3 accordingly. However, for the trees can be able to adapt well to the harsh climate in the plantation area, it is important to continue the plant training until the 10th month. Therefore, the project continued to monitor *Cinnamomum balansae* on the plots until the 10th month and after 10 months, the rate of *Cinnamomum balansae* exported from the nursery using vegetable breeding technology is 60%, using seeding technology is 63 - 67%. This is a fairly high rate and can be used for production.

Figure 3.3. Qualified *Cinnamomum balansae* for afforestation

IV. CONCLUSION

From the results of monitoring the vegetable breeding process for *Cinnamomum balansae*, we conclude that:

First: *Cinnamomum balansae* is a species with the ability to produce seedlings by vegetable breeding technique for mass production, meeting the needs of conservation and development of the market.

Second: The highest percentage of rooting of vegetable breeding technique for *Cinnamomum balansae* after 60 days belongs

to AIA 1.5%, makes up to 65%, followed by ABT1 1.5% and AIA 1.0%, reaching 60%. Growth stimulants also have positive effects to roots quality. In which, AIA at the concentrations of 1.0%, 1.5% and ABT1 at 1.5% always give the best roots quality. This result meets the requirements of mass production of rare plant species, especially *Cinnamomum balansae.*

Third: Growth rate of *Cinnamomum balansae* during the nursery stage is relatively slow, but after 6 months being taken care of, *Cinnamomum balansae* meets the standards for exporting out of the nursery. However, to ensure the quality of seedlings, there is a need to lengthen the time of plant training in the nursery until the 10th month.

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NGHIÊN CỨU KỸ THUẬT GIÂM HOM LOÀI VÙ HƯƠNG (*Cinnamomum balansae* Lecomte)

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TÓM TẮT

Vù hương (*Cinnamomum balansae* Lecomte) là loài đặc hữu, quý hiếm của Việt Nam, được danh lục đỏ Thế giới năm 2013 xếp vào nhóm nguy cấp (EN), Sách đỏ Việt Nam – 2007 xếp vào nhóm sẽ nguy cấp (VU) và Nghị định 32/2006/NĐ-CP nhóm IIA. Bên cạnh đó khả năng tái sinh tự nhiên của loài Vù hương hết sức hạn chế do đó công tác bảo tồn và phát triển loài đang đối mặt với những thác thức lớn khi thiếu hụt nguồn giống. Vì vậy việc nghiên cứu tạo giống loài Vù hương là hết sức cần thiết. Kết quả nghiên cứu tạo giống loài Vù hương bằng giâm hom ở VQG Bến En đã cho những kết quả rất khả quan. Với việc sử dụng các hóa chất AIA và ABT1 ở các nồng độ khác nhau cho thấy: Tỷ lệ ra rễ của hom Vù hương sau 60 ngày cao nhất thuộc về công thức AIA 1,5%, đạt 65%, tiếp đến là ABT1 nồng độ 1,5% và AIA nồng độ 1,0%, đạt 60%. Các chất kích thích sinh trưởng cũng có tác dụng tích cực đối với chất lượng bộ rễ. Trong đó AIA ở các nồng độ 1,0%, 1,5% và ABT1 nồng độ 1,5% luôn cho bộ rễ có chất lượng tốt nhất. Kết quả nghiên cứu còn khẳng định, mức độ tăng trưởng của Vù hương trong giai đoạn vườn ươm tương đối chậm, sau 6 tháng chăm sóc, Vù hương có thể đạt tiêu chuẩn xuất vườn nhưng cần duy trì thời gian trong vườn ươm đến tháng thứ 10 để huấn luyện cây nhằm đảm bảo chất lượng và tỷ lệ sống cho công tác trồng rừng.

Từ khóa: Giâm hom, rễ, sinh trưởng, Vù hương, xuất vườn.

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