Research on the Application of Culture Medium of High Quality Dendrobium Nobile and Organic Liquid Fertilizer

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Abstract: the Cultivation Substrate of Dendrobium Nobile Prepared in Different Places is Also Different, Therefore, the Optimal Substrate Formula and Nutrient Solution for Cultivation of Dendrobium Nobile Also Need to Be Screened and Optimized According to the Climate in the Cultivation Area. under Natural Conditions, Dendrobium Nobile Mainly Carries out Vegetative Propagation through Natural Tillering and Sexual Propagation through Seed Formation. in Order to Realize High-Efficiency Facility Cultivation of Dendrobium Nobile, Four Different Cultivation Substrates Were Prepared in Greenhouse with Granite Crushed Stone, Purple Sandstone Crushed Stone, Pine Bark and Pine Sawdust, and Three Different Nutrient Solutions Including Clear Water, Inorganic Compound Liquid Fertilizer and Organic Liquid Fertilizer Were Set Up, and a Total of Eight Treatments Were Carried out for Cultivation Experiments to Study the Effects of Different Substrates and Nutrient Solutions on the Growth of Dendrobium Nobile.

1. Introduction

Dendrobium Nobile is a Perennial Herb Belonging to Dendrobium of Orchidaceae, Which Has the Effects of Benefiting Stomach, Promoting Fluid Production, Nourishing Yin, Clearing Heat, Relieving Cough and Moistening Lung, and is a Traditional Precious Chinese Medicinal Material [1]. Modern Pharmacological Studies Believe That Dendrobium Has the Effects of Increasing Human Immunity, Dredging Blood Vessels, Resisting Cancer, Resisting Aging and Treating Cataract. under Natural Conditions, Dendrobium Nobile Mainly Carries out Vegetative Propagation through Natural Tillering and Sexual Propagation through Seed Formation [2]. Dendrobium Usually Grows on Large Tree Trunks or Rocks, Which Has Special Requirements for the Growth Environment. Land Cultivation Methods Cannot Survive. for Example, It Takes Three to Five Years for Dendrobium to Grow Vigorously on a Large Trunk or in a Stone Crevice, and the Effect is Slow. Dendrobium Nobile Has Strict Requirements on the Growth Environment. Its Distribution Area is Extremely Narrow and Its Natural Reproduction Rate is Low. in Addition, Due to Long-Term over-Excavation and Destruction of Ecological Environment, Wild Resources Are Gradually Depleted. China Has Listed Dendrobium Nobile as One of the Rare and Endangered Traditional Chinese Medicine Species [3]. Wild Dendrobium Nobile Has Been Listed as a Rare and Endangered Plant under the National Key Secondary Protection. Therefore, Vigorously Researching and Developing Artificially Cultivated Dendrobium Nobile Has Become a Method to Fully Utilize and Develop Dendrobium Nobile Resources [4].

Due to the rapid development of medicine, Dendrobium has been widely used in medicine and its demand is increasing, while the source of Dendrobium mainly depends on wild resources [5]. In recent years, scholars have also made more researches on the cultivation of Dendrobium nobile, such as selecting branches of different plant ages and different parts of Dendrobium nobile for cuttage test, research on suitable cultivation conditions, and research on wild-like cultivation technology of Dendrobium nobile test tube seedlings [6]. With the development of tissue culture technology, the seedlings needed for large-scale artificial cultivation have been solved. However, due to the favorable environmental conditions of Dendrobium nobile such as temperature, humidity, ventilation and drainage, the selection of cultivation substrate and nutrient solution for high-quality

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and efficient artificial cultivation is particularly critical [7]. There are many valuable and rich cultivation experiences among Chinese people, but they are not suitable for large-scale cultivation and solving the source problem of a large number of plants. Emerging plant tissue culture technology can supply a large number of test-tube plantlets in a short period of time, but the survival rate of test-tube plantlets transplanted out of bottles is low, which has been a major factor restricting the expansion of Dendrobium nobile production [8]. The cultivation substrate of Dendrobium nobile prepared in different places is also different, therefore, the optimal substrate formula and nutrient solution for cultivation of Dendrobium nobile also need to be screened and optimized according to the climate in the cultivation area.

2. Materials and Methods

2.1 Material Source and Material Selection

The Dendrobium nobile used in the experiment was introduced from Guangdong and planted in the provenance resource nursery of Quanzhou Shelly Biotechnology Co., Ltd. In order to reduce the experimental error, the test-tube plantlets all select plants with strong growth, developed root system, similar size and no obvious variation. The culture medium to be tested is granite crushed stone (particle size: 0.6-2.0 cm), purple sandstone crushed stone (particle size: 0.6-2.0 cm), pine bark (particle size: 0.6-2.0 cm) and organic compound medium.

2.2 Experimental Method

The test-tube plantlets of Dendrobium nobile are removed from the culture bottle for cultivation, and the environment such as humidity, illumination and nutrition have undergone drastic changes. In order to make the test-tube plantlets better adapt to the environment, this experiment makes the test-tube plantlets easier to adapt to the environment and simulates the wild growth environment of Dendrobium nobile for transplanting through a special seedling training method.

2.2.1 Plantlet Hardening

The screened test-tube seedlings are placed in a greenhouse with a temperature of 20-32 DEG C and a light intensity of 1500-2500xl for 2 weeks to exercise in a closed bottle. When the young stems show light purple red and the leaves turn into thick green, the bottle cap is loosened to allow air to enter but not uncover. In this way, after hardening the seedlings for 3 days, the bottle cap will be uncovered and the seedlings will be hardened in the shade for 3 days or so, then the seedlings can be taken out of the bottle and transplanted.

2.2.2 Transplant

The root of Dendrobium nobile has a special spongy structure, so the selection of transplanting medium is very important. In the experiment, 3 different substrates were selected for transplanting comparison. After the substrates are proportioned, 0.5% potassium permanganate is used for disinfection one day before transplanting.

2.2.3 Test

A total of 6 treatments, 3 repetitions, a total of 18 cells were set up and randomly arranged. See Table 1 for matrix configuration and nutrient solution application for each treatment. The thickness of the substrate is 10 cm, and the nutrient solution is sprayed on the leaves twice a month.

Table 1 Test Treatment

Processing number	Matrix			Nutrient solution
	Component	Mixture ratio	Laying method	Type
1	Pine bark, granite	4:1	Blend	No fertilizer (clear water)
2	Pine bark, granite	4:1	Blend	Inorganic compound liquid fertilizer
3	Pine bark, purple sandstone	4:1	Blend	Inorganic compound liquid fertilizer
4	Pine bark, granite	4:1	Blend	Organic liquid fertilizer + water
5	Organic matrix, purple sandstone	4:1	Blend	Inorganic compound liquid fertilizer
6	Organic matrix, purple sandstone, organic matrix	2:2:1	Layered	Inorganic compound liquid fertilizer
7	Organic matrix, purple sandstone	4:1	Blend	Organic liquid fertilizer + water
8	Organic matrix, purple sandstone, organic matrix	2:2:1	Layered	Organic liquid fertilizer + water

2.2.4 Cultivation Management

After transplanting, the temperature in the greenhouse shade should be controlled at about 25℃, the light should be 800-1000xl, no water should be used for the first three days, and water should be sprayed twice or three times a day starting from the third day to keep the humidity within 75%-85%. Foliar fertilizer will be sprayed one month later.

3. Result Analysis and Discussion

The growth of Dendrobium nobile roots requires good ventilation, humidity and no water accumulation. The ventilation and moisture retention properties of the cultivation substrate directly affect the growth of Dendrobium nobile.

3.1 Effects of Different Treatments on Germination Number of Dendrobium Nobile

Field observation records (Table 2) show that the cultivation substrates of treatments 1, 2, 3 and 4 have poor moisture retention and are easy to dehydrate and dry. The leaf color of Dendrobium nobile during growth is weaker than other treatments and its growth potential is poorer. The number of sprouts per cluster in treatment 8 was the highest, averaging 10.4, followed by treatment 6, 9.7, while the number of sprouts in other treatments ranged from 7.0 to 8.7. The difference between treatment 8 and treatments 1, 5 and 7 reached a very significant level, and the difference between treatment 8 and treatments 2, 3 and 4 reached a significant level, but the difference between treatment 8 and treatment 6 was not significant. The results showed that the organic compound substrate+purple sandy rock layered substrate configuration was conducive to the sprouting of Dendrobium nobile.

3.2 Effects of Different Treatments on the Longest Root System of Dendrobium Nobile

From the results of investigation and statistical analysis in Table 2, it can be seen that there is no significant difference in the longest root system among the treatments. Except that the values of treatments 1, 5 and 7 are small, the effects of other treatments on the longest root length of Dendrobium nobile are not different. The longest root system of treatment 8 is the longest, reaching 20.2cm, which may be more suitable for the growth of Dendrobium nobile root system.

Table 2 Effect of Different Treatments on Leaf Color, Germination and Root Length of Dendrobium Nobile

Processing number	Leaf color	Number of sprouts in a single cluster	Maximum root length /cm
1	Yellowish	7.0	18.1
2	Yellowish	7.9	20.0
3	Yellowish	8.1	18.9
4	Green	8.1	18.3
5	Thick green	7.2	17.5
6	Thick green	9.5	19.8
7	Thick green has luster	8.1	17.5
8	Thick green has luster	9.8	20.2

3.3 Effects of Different Treatments on Stem Diameter of Dendrobium Nobile

Stem diameter is often used as an important indicator of Dendrobium nobile growth. Table 3 shows that the differences between treatments 5, 6, 7 and 8 and treatments 1, 2, 3 and 4 are extremely significant, while the differences between treatments 5, 6, 7 and 8 are not significant. The results showed that adding a proper amount of pine sawdust in the substrate could significantly promote the stem hypertrophy of Dendrobium nobile.

3.4 Effects of Different Treatments on Plant Height of Dendrobium Nobile

Plant height is the most direct reflection of the growth of Dendrobium nobile. From the survey results in Table 3, it can be seen that there are obvious differences in the plant height growth of Dendrobium nobile under different treatments. Among them, the differences between treatments 4, 5, 6, 7, 8 and 1, 2, 3, between treatments 6, 7, 8 and 4, and between treatments 7, 8 and 5 all reached extremely significant levels. The plant height of treatment 8 was the highest, reaching 19.5cm, followed by treatment 7, reaching 18.8cm. But there is no significant difference between them. It is indicated that the growth of Dendrobium nobile plant height can be significantly promoted by mixing or layering organic compound matrix+purple sandstone matrix and applying organic liquid fertilizer with appropriate concentration.

Table 3 Effects of Different Treatments on Leaf Color, Germination and Root Length of Dendrobium Nobile

Processing number	Stem thick / cm	Plant height / cm	Single bundle weight / g
1	0.49	6.5	8.9
2	0.50	7.1	10.2
3	0.53	7.3	11.5
4	0.53	11.5	16.1
5	0.59	13.5	22.8
6	0.62	15.2	25.9
7	0.62	18.8	27.2
8	0.61	19.5	30.3

3.5 Effects of Different Treatments on Fresh Weight of Dendrobium Nobile Single Bundle

From the results in Table 3, the average fresh weight of single clump of treatment 8 was 30.3g at the highest, and the differences between treatment 8 and treatments 1, 2, 3, 4, 5, 6 and 7 reached extremely significant levels. The results showed that the organic compound substrate+purple sandstone layered substrate configuration, followed by appropriate concentration of organic liquid fertilizer, is conducive to the growth of Dendrobium nobile, with good growth and highest yield.

4. Conclusions

According to the observation and statistics of transplanting survival rate and growth of Dendrobium nobile tube plantlets, the substrate in the ecological environment of artificially simulating wild Dendrobium nobile has great influence on its growth. Mixed matrix contains rich nutrients and is an important source of nutrient supply for plants. One of the main characteristics of

soilless culture with organic solid fertilizer is to give full play to the fertilizer supply function of the culture substrate by applying solid organic fertilizer. With the infiltration of irrigation water, various nutrients contained in the matrix and solid fertilizer are continuously dissolved to fully meet the needs of plant nutrition. The types of cultivation substrates, laying methods and nutrient solutions affect the growth and development of Dendrobium nobile. The cultivation substrate should be mainly composed of raw materials with good permeability, supplemented by appropriate amount of loose materials with strong water and fertilizer retention capacity, so as to ensure appropriate water and humidity and obtain the best growth rate.

References

[1] Lu J J, Kang J Y, Ye S R, et al. (2014). Isolation and characterization of novel EST-SSRs in the showy dendrobium, Dendrobium nobile (Orchidaceae). Genetics & Molecular Research Gmr, Vol. 13, no.1, pp. 986-91.

[2] Zhou X M, Zheng C J, Wu J T, et al. (2016). A new phenolic glycoside from the stem of Dendrobium nobile. Natural Product Research, Vol. 31, no.9, pp. 1-5.

[3] Zhang X, Hao L, Hong K, et al. (2014). Growth, dendrobine content and photosynthetic characteristics of Dendrobium nobile under different solar irradiances. Plant Omics, Vol. 7, no.6, pp. 461-467.

[4] Yan W, Niu Z, Zhu S, et al. (2015). The complete chloroplast genome sequence of Dendrobium nobile. Mitochondrial DNA, Vol.27, no.6, pp.1-3.

[5] Zhou X M, Zheng C J, Wu J T, et al. (2016). Five new lactone derivatives from the stems of Dendrobium nobile. Fitoterapia, Vol. 115, pp. 96-100.

[6] Rosa Y B C J, Ramos F Z, Souza R G D, et al. (2014). Luminosity on development and flowering of Dendrobium nobile Lindl. Revista Brasileira De Horticultura Ornamental, pp. 79-84.

[7] Lu T L, Han C K, Chang Y S, et al. (2014). Denbinobin, a Phenanthrene from Dendrobium nobile, Impairs Prostate Cancer Migration by Inhibiting Rac1 Activity. The American Journal of Chinese Medicine, Vol. 42, no.6, pp.1-16.

[8] Zhang W, Wu Q, Lu Y L, et al. (2017). Protective effects of Dendrobium nobile Lindl. alkaloids on amyloid beta (25-35)-induced neuronal injury. Neural Regeneration Research, Vol. 12, no.7, pp. 1131-1136.