Causes of the Bryophyte Diseases and Research on Treatment

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Abstract: Bryophytes are featured with high temperature resistance and drought, s eugenic bryophytes can form the unique landscapes. Since numerous advantages were discovered, bryophytes have become ornamental plants in gardens, so they are transplanted into greenhouses to cultivate in a large scale. Unfortunately, diseases seriously restrain the development potential of bryophytes as economic crops. For this reason, this paper regards the bryophyte cultivation base as the research sampling region, studies the bryophyte diseases, identifies pathogens, proposes countermeasures on causes of diseases, and provides a reference for cultivating bryophytes.

1. Introduction

Bryophytes are tiny categories with relatively simple structure in the green plant circles. Their number ranks only second to higher plants of spermatophytes. According to morphological differences, they can be divided into hepatucae, anthocerotae and bryopsida. Bryophytes often grow in the warm and moist environment, such as dank stone facing, soil surface or tree trunks. They have the fasciculate habits and often form bryophyte community to form the unique visual landscapes. Due to tiny body, their structure is simpler than other higher plants. Therefore, corresponding to spermatophytes, bryophytes can adapt to the wider habitats. Moreover, the function of preserving soil and water under the extremely hostile environments is developed. The application of bryophytes has the spacious prospect for three-dimensional afforesting [1]. In recent years, artificial culture of bryophytes in greenhouses becomes the important resource of using bryophytes to do vertical planting, but pathogens seriously affect cultivation and breeding of bryophytes to restrain scale cultivation of bryophytes to some extent, resulting in extremely high costs of using bryophytes to make landscapes As a result, this paper selects the seedling base as a pilot site to explore disease pathogens of bryophytes in different categories, analyzes the reasons for diseases of bryophytes as economic crops, proposes prevention strategies, and provides a reference for cultivating large-scale bryophytes with manual work.

2. Materials and methods

2.1. Sampling

By using an artificial cultivation bryophyte greenhouse in our province as the investigation site, the author collects disease specimens of hypnum plumaeforme, racomitrium japonicum, and brachythecium plumosum and records the severity of plant diseases and insect pests through visual inspection, including severe, mild, general, and less.

2.2. Detection of Diseases(pests)

(1) Separation: the consistent disease expressions are selected. The method of directly cutting plant tissues is used or the method of extracting plant tissue juice for attenuation and separation is used to separate from diseases (pests) from plants.

(2) Purification: the method of plate streaking and attenuation coating is adopted to purify the isolated bacteria. After purification, it is inoculated to the test tube slant medium for further detection.

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(3) Detection: At present, detecting diseases (pests) of bryophytes often uses the anti-rifampin marking method. Such a method is relatively simple, but such a method is inaccurate in quantitative determination. Moreover, it is easy to show up antibiotic shield phenomenon. Nowadays, lots of gene sequences in many microorganisms are measured and inputted into the international gene database. By measuring 16S rDNA sequence of unknown microorganisms and making a comparative analysis, classification can be identified rapidly and effectively. As a result, the method of molecular biology can be used for qualitative and quantitative detection, but the costs are relatively high and it spends a long time.

3. Results and analysis

3.1. Experimental results

Through investigation, it can be observed that there are 322 hypnum plumaeforme specimens. The disease (pest) occurrence rate is 18.32%. There are 289 racomitrium japonicum specimens with disease (pest) occurrence rate of 10.32%. There are 257 brachythecium plumosum specimens with the disease morbidity of 11.28%, showing that occurrence rate of diseases in the artificial culture process of bryophytes in greenhouses is relatively high, see Table 1.

Table 1 Statistical Table of Bryophyte Samples with Diseases

Bryophytes	**Collection point**	**Occurrence degree**	**Sample size**	**Occurrence rate %**
Hypnum plumaeforme	Germination stage	More, severe	32	9.94%
	Sprout period	General, severe	11	3.42%
	Growing period	Less, general	9	2.80%
	Mature period	Less, general	7	2.17%
	Total		**59**	**18.32%**
Racomitrium japonicum	Sprout period	More, severe	20	6.92%
	Growing period	General, general	3	1.04%
	Mature period	General, severe	5	1.73%
	Rest period	Less, general	2	**0.69%**
	Total		**30**	10.38%
Brachythecium plumosum	Germination stage	General, severe	15	0.62%
	Sprout period	General, severe	7	2.72%
	Growing period	Less, severe	4	1.56%
	Mature period	Less, general	3	1.17%
	Total		**29**	**11.28%**

Through purification culture, we finally extract 4 pathogens from three bryophytes. Through literature review and pathogen directory, three pathogens can be confirmed, including Fusarium sp., Pylenchus sp., and Botrytis sp. Another type is undefined. It is preliminarily identified as Rwinia sp.

3.2. Mechanism resulting in plant diseases

Firstly, diseases(pests) can generate the substances that restrain plant growth, such as Botrytis sp. The in-depth analysis of fermentation products indicate that this bacterium can generate the regulating substances of plant growth and restrain growth of bryophytes. Secondly, diseases(pests) in bryophytes will generate a protease, which destroys chitinase and dextranase of bryophytes, s that antifungal capacity of plants will be reduced. Thirdly, competing for nutrient substances with bryophytes results in insufficient nutrition supply of bryophytes, so that plants are present in pathosis.

4. Causes for plant diseases and insect pests

4.1. The growth environment of bryophytes are suitable for the development of plant diseases and insect pests

The culture environment of hypnum plumaeforme with the big pattern and relatively fast growth and reproduction speed is 20-30℃ and humidity is 70-90%. The culture environment of racomitrium japonicum with the stronger drought resistance ability is 25±1℃ and humidity is 50-60%. The culture environment of brachythecium plumosum that grows in wet soil or rock thin soil should use the spraying device above 90%. The temperature is 27-32℃, showing the growth condition of bryophytes includes high temperature and high humidity. This exactly is the “best condition” for multiplication and spread of diseases (pests)[3]. Under the large-scale artificial reproduction, “natural enemies” of bryophytes in the natural circles are vacant. There are no methods to control quality of bryophytes, so bryophytes with diseases are easy to “infect” other bryophytes. Furthermore, without the strict quarantine for plant diseases and insect pests, the approach and chance of spreading plant diseases and insect pests will be dramatically increased, resulting rapid expansion of diseases.

4.2. Frequent transfer of bryophytes

At present, greening construction development in urban communities and parks has the relatively fast speed. The greening area is dramatically increased year by year. The greening varieties are more diversified. Moreover, most of bryophytes are introduced outside without quarantine. Or quarantine is improper, so some foreign plant diseases and insect pests will be brought to the local places. In this way, plant diseases and insect pests carried by newly introduced bryophytes may leave the source area to enter into the new environment. After they adapt to the local climatic conditions, they will rapidly breed and spread to form the new harms.

4.3. Insufficient nutrient substances

From growing seedlings to enlarging cultivation, artificial culture of bryophytes has environmental change. Ventilation and translucency in greenhouses are relatively poor. With the induction of dense lights, the normal ecosystem of bryophytes is disordered. During the process of expanding culture of bryophytes, soil environment has malnutrition. However, research findings show that bryophytes are insensitive to general nutrient substances, including nitrogen, phosphorus and potassium. As a result, even increasing fertilizers to cultivate bryophytes doesn’t develop the expected effect. Furthermore, nutrient occupation in soils of different areas is different, but the instruction of bryophyte culture can’t strictly observe the additional strategy of nutrient substances for different areas and environments.

5. Prevention measures

According to sampling findings, it can be observed that even if wild bryophytes have the strong antibacterial ability, but after immigrating to greenhouses, disease occurrence rate is still high. Disease occurrence rate of hypnum plumaeforme is maximum. During the growth period of bryophytes, germination stage and sprout period are high-incidence periods for bryophyte diseases. Perhaps, the self-resistance system of bryophytes in this stage isn't formed and it is relatively weak. Perhaps, sterilization in tissue cutoff treatment is not enough and it concentrates on outbreak in the appropriate culture conditions for diseases(pests) carried by bryophytes. From the perspective of bryophyte pathogen categories, bacteria are primary prevention objects for diseases. Moreover, the occurrence rate of pathogens in different categories of bryophytes is almost consistent without the statistical difference. As a result, during the process of artificial culture planting in the future, it is necessary to take prevention measures as early as possible, for fear of large-area outbreak of diseases, so as to improve product quality and output and increase economic benefits.

5.1. Countermeasure of cultivation and breeding

After collecting abundant specimens, they are transplanted to the resource areas of 1-3m2 according to the size of gametophyte. The culture medium should be confirmed according to the natural growth substrate of specimens. The cultivation substrate pH value is controlled in neutral as a whole. Through artificial ploughed fallow treatment, appropriate watering is maintained to remain moisture of surface soil[4]. The growth observation of bryophytes should be conducted on the basis of mastering the breeding process in details, so as to serve for summarizing the growth principles and breeding disciplines. For the plant samples of the same category, the growth development stage in different areas is roughly the same. However, the development process often has the close relation with environmental conditions. As a result, observation in the growth period is the important bass for cultivation effect period. Meanwhile, researchers can fully master the morphological characteristics of test plants on the basis of long-term observation, so that it is possible to use artificial intervention measures to form the special cultivation effect.

5.2. Additional nutrition measures

Large-scale cultivation of bryophytes has considerable successful examples at home and abroad, but individual growth of bryophytes is generally slow. Moreover, it is less sensitive to nitrogen, phosphorus and potassium or other common plant nutrients, so that bryophyte has the considerable distance from actually used ecological recovery products. Moreover, it is easy to be encroached by pathogens in the artificial cultivation process. Many researchers show that reasonable addition nutrition can improve breeding speed of bryophytes and enhance the resistivity[5].

5.3. Disease treatment

Firstly, it is necessary to give property to prevention and predict plant diseases and insect pests. According to features of plant diseases and insect pests in previous years, it is necessary to predict plant diseases and insect pests in advance and inspect them regularly. Once there are symptoms of plant diseases and insect pests, it is essential to take prevention measures in time and avoid further development. It is necessary to reinforce physical prevention and combine with habits of diseases and pests to induce or create the environment that is unfavorable for survival of diseases and pests. For example, bryophytes should be trimmed and leaves with plant diseases and insect pests should be cut off to prevent from spreading them. Meanwhile, air humidity and temperature should be controlled. Multiplication and spread of plant diseases and insect pests should be avoided, while guaranteeing growth of bryophytes. Thirdly, pathogen nematode prevention should be used. Pathogen nematode can be parasitic in plant diseases and insect pests. It is the nematode to result in pathopoiesis or death of pests and germs. To control the categories and number of plant diseases and insect pests will have a good effect. Parasitic plant diseases and insect pests will be present in poor growth, reduction of fertility, and malformation.

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