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Plant Allelopathy and Their Application in Gardens

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Abstract: The study of plant allelopathy is of extremely important research significance in agricultural and forestry production and management, as well as in ecological gardening applications in nature. Allopathies affects species composition in plant communities, It is one of the important factors affecting plant community succession. It is one of the important factors affecting plant community succession. In the application of garden landscape, the interaction and mutual restraint of communities are directly related to the final landscape effect. Therefore, by studying the effects of plants and garden applications, it is expected to provide reference value for garden landscape designers in the matching of garden landscape plants.

Keywords: Plant Allelopathy; Garden Applications; Plant Landscaping.

1. The Meaning of Allelopathy

German scientist Molish proposed the concept of plant allelopathy in 1937.[1] Allelopathy refer to the direct or indirect impact of one species (or organism) on another species (or organism) by releasing certain metabolites or chemicals into the environment. It is a promoting or inhibiting effect, also known as the xeno-inhibitory effect or xeno-inhibitory effect.[2]Molish H D.Der einfluss einer pflanze auf die andere, allelopathie [J].Jena: Verlag von Gustav Fischer, 1937.13-20.The interaction between plants or between plants and microorganisms affects the growth of plants, thereby affecting the formation, development and succession of communities.More studies have shown that its chemical effects are not limited to other plants, but even plants of the same species. This effect is part of the interspecific relationship and is a special form of survival competition. This phenomenon also occurs in intraspecific relationships, and is also called the interaction between plants.Therefore, when arranging garden landscape plants and selecting plant species, we must not only consider site conditions and ecological factors, but also consider the characteristics and allelopathic effects of the species, avoid direct competition, and rationally allocate plant species to form a reasonable structure and population. Stable composite plant communities.[3]

2. Characteristics of Plant Allopathy

2.1. Numerous Studies have Shown that There are Four Main Ways of Releasing Allelopathy

2.1.1. Volatilization

Some volatile alleles (mainly mushrooms) enter the environment through plant surfaces (stems, leaves, flowers). For example, the volatile substances produced by acacia, eucalyptus and sage can inhibit the growth of certain weeds around them, leaving them with bare ground around them.

2.1.2. Root Secretion

Many allelopathic substances compounds are secreted from the roots and have an impact on adjacent plants. Goldenrod, a member of the Compositae family in northern Japan, has a wide distribution and strong reproductive capacity, and can crowd out other weeds and replace them. Exudates from the roots of bromus, creeping wheatgrass and other plants also have chemical inhibitory effects.

2.1.3. Leaching

Due to the action of rain or fog droplets, allelopathic substances are leached from the plants and have an impact on surrounding plants. For example, the leachate from chrysanthemum leaves has an inhibitory effect on the understory plants in the forest.

2.1.4. Decomposition

Allelopathy are released from dead and decaying plant residues and exert histopathogenic effects on surrounding plants.For example,the allelopathic compounds of fern, such as caffeic acid and ferulic acid, are released from dead branches and leaves and inhibit the growth of other herbaceous plants.

2.2. Characteristics of Plant Allopathies

Allelopathy has both repulsive and promoting effects; is usually not fatal; has a limited range of influence in the environment, it is selective and specific. For example, juglone produced by black walnut inhibits apple trees, but does not inhibit the growth of pear, peach, and plum trees; when peach trees and fir treesare planted together, the peach trees cannot become useful.[4] Planting violets and grapes can extend the flowering period of violets and improve the quality of grapes. But the elms will wither the grapes...However, under environmental stress, the effects of allopathies tend to increase; the effects of allopathogenic substances are related to the concentration of allopathogenic substances; allopathogenic substances often contain a variety of components, and each component produces a compound effect; many allelopathic substances are not only effective against In addition to their functions, plants also have many other functions.

3. Garden Applications of Allopathiy

3.1. Forest Landscape Application

There is an area in Pennsylvania, USA, where the forest was cleared and planted with black cherries, red maples and

white ash. Despite 50 years of efforts, these trees have never survived. The reason is that the biomass of ferns, aster, goldenrod and other wild grasses in the area strongly inhibits the growth of these saplings until they die. In many communities, many plants tend to grow as a single species and do not allow outsiders to invade. Many desert plants exhibit distinct growth bands, and biomass clearly plays an important role in this growth pattern.

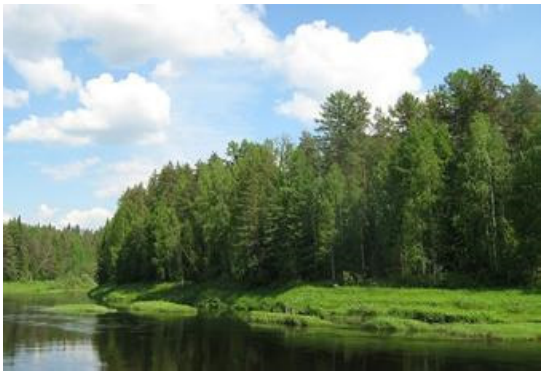

Figure 1. Forest landscape A

Figure 2. Forest landscape B

3.2. Wetland Landscape Application

Wetland is the transition zone between water and land. In its vegetation succession, people have always only paid attention to the role of water factors, but ignored the role of allelopathic effects in vegetation succession.The overflow of aquatic plants in rivers and lakes often blocks the flow of irrigation channels and reduces the water quality of rivers. Using aquatic plants for biological control and prevention can clear pond aquatic plants.Such as cow felt or needle-leaf arrowhead, which are important manifestations of the role of otherness in this aspect.

Eutrophication of waters leads to the growth of algae.[5] At present, some recreational water, especially swimming pools, are commonly treated with copper sulfate in order to control algae growth. However, the effect of this agent is short-lived, and it is a pollutant itself, so it should not be applied multiple times. If the biochemical chemicals of plants are used to treat it, This can fundamentally solve the problem; in addition, the use of beneficial plant combinations can improve wetland productivity. The swamp wetlands of the Zoige Plateau in the Aba Tibetan Autonomous Region of Sichuan are seriously degraded. A combination of beneficial plants can be tried to restore the wetland landscape.

Figure 3. wetland landscape A

Figure 4. wetland landscape B

3.3. Agricultural Landscape Application

Landscape architect Yu Kongjian once designed the rice field landscape at Shenyang University of Architecture and Technology. Leading a revolution in the landscape world.A large number of farmland landscapes followed.Therefore, applying the principle of allelopathic effects to the landscape can achieve better results. Some countries in the world, such as Japan, South Korea, Thailand, Egypt, etc., have studied rice germplasm resources to control the growth of weeds and found that some rice varieties can control the growth of weeds to varying degrees.Fully research and explore these useful resources.It is of great significance to increase rice yield, suppress weeds, and achieve sustainable development of agriculture, and provides a good foundation for the construction of agricultural landscapes. For example, wheat root exudates can inhibit the growth of corn and oats; aqueous extracts of barley, rye, wheat, and oats can inhibit the growth of wheat roots. In addition, the study of the inhibitory effect of crops on weeds is of great significance in agriculture. The use of mutual inhibition to control weeds is one of the important directions of research, and it is also a new trend in the current biological control of weeds.

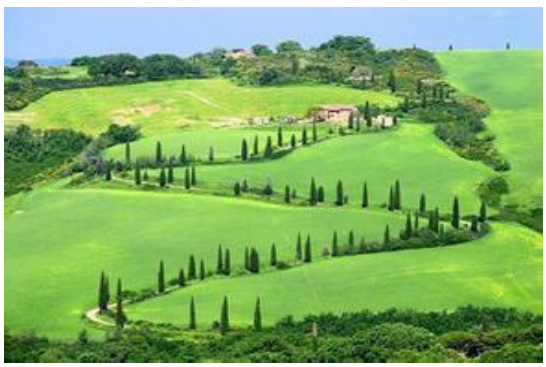

Figure 5. Agricultural landscape A

Figure 6. Agricultural landscape B

3.4. Plant Community Application

3.4.1. Community Mutualism

Research has found that the secretions of some plants have positive effects on neighboring plants. For example, research has found that the root exudates of Tilia can promote the growth of English oak, European ash and white willow; the root exudate of black locust significantly promotes the growth of Beijing poplar; walnuts and hawthorn promote each other, and the yield of hawthorn is higher than the yield per unit; chestnut and pine mutual promotion, etc. The role of mutual generation also has certain implications for landscape designers. We can identify mixed forest tree species through the mechanism of histopathology. Through the mixed planting of several coexisting tree species, plant growth can be promoted, rapid growth can be achieved, and ideal landscape effects can be created faster.

3.4.2. Community Interaction

Cloves, mint, laurel, etc. can secrete a large amount of aromatic substances, which can inhibit the growth of some adjacent plants; birch, pine and spruce cannot be intercropped; the volatile oil of juniper contains ether and trichlorotetracane, which can cause other Tree respiration weakens, stops growing, and appears toxic. Many woody plants have antagonistic effects on other plants, such as some species of oak, juniper, eucalyptus, pine, and fir. Their leaves and roots can produce antagonistic substances that inhibit the growth of other surrounding plants. many flower plants like

1） Certain plants of Solanaceae, Brassicaceae, and Rosaceae cannot be planted together; 2 Volatile substances secreted by the bark and flowers of acacia, hyacinth, and plum can also inhibit the growth of certain plants; 3 Cloves, narcissus, and Lily of the valley should not be planted together, otherwise the lilacs will Rapid wilting, even if the two flowers are 20m apart, lilacs will wilt; 4 Planting elm leaf or intercropped cabbage in the vineyard will cause the grapes to wilt; 5 Black walnuts will defeat pine trees and various herbaceous plants; 6 Elm trees will defeat white birch # oak trees ; 7 Pine trees defeat spruce; 8 Peach trees defeat tea trees; 9 Orange trees defeat eucalyptus; 10 Bamboo defeats sesame. It is not suitable to plant flowers near fruit trees. With this knowledge, landscape designers can not only avoid the losses caused by the mixing of mutually exclusive plants, but also use the principle of allelopathic effects to carry out reasonable planting.[5]

4. Applications of Plant Allopathies and Problems to be Solved

4.1. Application of Plant Allopathies

Plant allelopathic effects are widely used in weed suppression and invasion of alien species. In recent years, more and more weed controllers have become interested in plants that release natural compounds because they are biodegradable, have a short half-life, and are therefore safer than synthetic compounds that are less harmful to the environment. No damage[6-7].So people began to artificially synthesize some non-polluting herbicides by isolating and extracting other herbicides. At this time, the industrial production of herbicides began to rise.[8] In addition, invasive weeds, algae, etc. can also be controlled by other herbicides. To inhibit algae, for example, placing barley straw in eutrophic water bodies can effectively inhibit algae etc.[9]

Plant alleles also have a wide range of applications in the prevention and control of agricultural pests.[10] "The alleles secreted by plants can not only affect surrounding plants, but also affect surrounding insects." For example, planting castor on soybean field ridges can effectively Control bean chafers. At the same time, extracting substances harmful to insects in plants for production and spraying them into the fields is also an effective way to prevent and control insect pests. The allelopathic substances secreted by plants themselves can achieve the purpose of self-protection by regulating the behavior of herbivorous insects and natural enemies.

Plant allelopathic effects have also been applied to the rational layout of agricultural crops. The release and secretion of some plant allergenic substances in agriculture is one of the main reasons for the yield reduction of continuous cropping crops. For example, both rice and soybeans themselves have autotoxic effects, but if soybeans and rice are rotated, their autotoxic effects can be overcome and rice yields can be increased. There are many such applications, such as garlic and pea rotation, which can eliminate obstacles to continuous cropping of peas.

4.2. Unsolved Issues Regarding Plant Allelopathy Effects

As the role of allelopathic is increasingly valued, more and more studies have been conducted on its role. However, many research methods still have flaws. Kong Chuihua pointed out in his article that "the allelopathic substances studied in the study of plant allelopathic effects must have a suitable way to enter the environment and do not contain secondary metabolites that change in the plant body." In many simulation experiments, donor plants will be cut into sections and soaked. The secondary metabolites contained in these soaking liquids are also likely to be secondary metabolites that change in the plant. Moreover, in many experiments, the extract liquid is Organic solutions are also inconsistent with the natural state, and the results measured in this way are obviously inaccurate. Moreover, most of the research is completed in the laboratory, which is very different from the wild environment, so the experiments made There may also be considerable errors. Therefore, strengthening field research on the effects of other senses and improving research methods will greatly improve the consistency between research and reality.

5. Summarize

Studying the other sensory effects of plants and giving full play to their role in community construction, agricultural production and management, prevention and control of water pollution, prevention and control of pests and diseases, and improvement of landscape environment have practical guiding significance for improving garden ecological design.

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