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REVIEW

A Review of Research Directions and Research Methods of Farmland Weeds

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ABSTRACT

Farmland weeds are an important part of farmland ecosystems. Research on farmland weeds is one of the major research fields in agricultural ecology. It is of great significance for achieving high yield, high quality and high efficiency in agriculture. In recent years, research on farmland weeds has focused on investigation of weed communities, research on weed seed banks, and research on weed control. These three research directions complement each other. Among them, the investigation work of weed communities and the research of weed seed banks are helpful for us to grasp the occurrence of farmland weeds more accurately and provide references for the control of farmland weeds. This article summarizes the research directions of farmland weeds in recent years (weed community investigation, weed seed bank, weed control) and the research methods used, provide reference value for the follow-up research work of farmland weeds, and provide theoretical support for promoting the development of rural ecological industry and building beautiful villages.

1. Introduction

Farmland weeds refer to plants growing in farmland that are harmful to the main food crops, generally non-cultivated wild plants or plants that are useless to humans, mainly herbaceous plants. This concept is relative. For example, dandelion is not a weed when it grows in a field where the main medicinal plant is grown; but when it grows in a corn field, it becomes a weed. The biological characteristics of field weeds are as follows: multiple propagation methods, strong reproduction and regeneration, the life cycle of weeds is generally shorter than that of crops, seeds fall with maturity, strong resistance to stress, and high photosynthesis efficiency. The main hazards of farmland weeds are: competing with crops for nutrients, water, sunlight and space, obstructing field ventilation and light transmission, increasing local climate temperature, and some are intermediate hosts of pests and diseases, promoting the occurrence of pests [1]; Parasitic weeds directly absorb nutrients from crops, thereby reducing crop yield and quality [2-3]. Therefore, the research on farmland weeds is of great significance to agricultural production. This article mainly discusses the research directions and ecological research methods of farmland weeds in recent years from three aspects: weed community survey, weed seed bank, and weed control.

2. Weed Community Survey and its Research Methods

2.1 Investigation of Farmland Weed Communities

Farmland weed community survey is to investigate the occurrence of weeds (species, distribution, density, dominance, etc.) in farmland. Through investigation, we can

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grasp the occurrence of farmland weeds. The above work can not only accumulate data for weed prediction, but also help to detect exotic weeds in time, prevent biological invasion, and provide a certain theoretical basis for scientific and effective weed control. In recent years, surveys of weed communities have found that artificial measures (agronomic measures such as fertilization and irrigation) and natural factors (season, light, temperature, water, etc.) will affect the structure of weed communities [4]. Among them, the seasonal and temporal and spatial succession of weed communities have attracted much attention [5].

2.2 Research Methods of Farmland Weed Community Investigation

(1) Sampling method, sampling amount, sampling time

Weeds in farmland are distributed randomly. In order to make sampling more representative, sampling method is very important. The sampling method of farmland weed community survey is mostly based on the size and shape of farmland or experimental plots, and appropriate sampling methods are adopted. Most of them are small-support multiple-point methods, among which "W" sampling and five-point sampling are the most commonly used.

Sampling volume refers to the size of the sample square, which is also determined by the conditions of the test site, most of the sample squares are 1m×1m, 50cm×50cm [6-8].

The sampling time is slightly different according to the research object and the research content. Some samples are taken before the weeds bloom, some are based on the growth period of the main crops, and some are taken every certain number of days (for example, 25 days) throughout the growth period until the harvest period. Sometimes sampling is done during specific periods, such as before and after raising geese [7-8].

(2) Data analysis method

The basic data density, abundance, abundance, and dominance are calculated using calculation formulas. Species diversity is expressed by different indexes: Berger-Parker abundance (Pi), Shannon evenness index (J) and Shannon-Wiener diversity index (H), Simpson dominant concentration (C), Sorensen community similarity coefficient (V)), the abundance of species (S) represents [6,9-10].

3. Research on Weed Seed Bank and its Research Methods

3.1 Farmland Weed Seed Bank

The litter found in the above ground of the farmland and all the weed seeds that survive in the soil are collectively referred to as the soil weed seed bank. The weed seeds in the soil do not meet the germination conditions of some seeds due to various reasons such as temperature and moisture. Therefore, they exist in the soil in the form of a seed bank, forming a soil weed seed bank [11]. The study of weed seed banks can clarify the succession of weed communities, which is of great significance for the prediction and control of weeds [12]. In recent years, the dynamics of weed seed banks under different agronomic measures, different natural conditions and different soil physical and chemical properties have been studied [13-14].

3.2 Research Methods of Farmland Weed Seed Bank

(1) Sampling method, sampling amount, sampling time

The distribution of seeds in the soil is extremely uneven in the horizontal and vertical directions. In order to obtain samples with higher accuracy, the sampling method is the basis of the experiment. There are three most commonly used sampling methods, the random method, the transect method, and the small support multiple point method [15]. The random method of sampling may make the sample square too single; the small support multiple point method is more cumbersome in actual operation, and it is also more difficult to implement. The sample line method is the most commonly used method among the three methods. This method is not only easy to operate, but also representative of sampling. Therefore, the sample line method is often used in the experiment.

The sample size of the sample square refers to two aspects: the size of the sampling area and the size of the sampling depth. At present, there has been no definite standard for the size of the sampling volume. For the sampling volume, there are three methods that are often used: a large number of small sample methods, a small number of large sample methods, and a sub-sample method of sub-unit samples within a large unit. The large-quantity sample method has the highest reliability among the three sampling methods. There are many specifications for the sampling area. The most commonly used specifications are 1m×1m, 50cm×50cm. In addition, there are 100cm×50cm, 10cm×10cm, 20cm×20cm and other specifications. In actual operation, it is determined according to the specific needs of the experiment and the characteristics of the community. The sampling depth is generally 10cm, which can be divided into 3 layers [16-17], 0~2, 2~4, 4~10cm, and some also adopt the layering method of 0~2, 2~5, 5~10cm. Part of the experiment needs to continue sampling from deeper soil layers (10-15cm, 15-20cm) [13,18-19], and there will only be a very small amount of active seeds in the deeper soil.

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Sampling time is very important, because it is related to the effect of the experiment and affects the result of the experiment. The sampling time is different mainly depending on whether to study the long-term soil seed bank or the instantaneous soil seed bank. The largest soil seed bank sampling time should be October.

(2) Identification method of seed bank

After the samples are retrieved, the species composition and density of the soil seed bank must be clarified, and the species identification and activity determination of the seeds must be carried out [11]. There are generally two methods for species identification, physical separation and seed germination.

There are two main physical separation methods: floating concentration method and mesh screening method. The effect of the floating concentration method and the mesh screening method [20] is not obvious, it is very difficult to separate the seeds, and the separated seeds may be viable, may die, or may be in the process of decay, so it is necessary to identify their viability, the process is also more difficult [11].

The seed germination method [18] is a method of cultivating the treated substrate soil and observing after the seed is retrieved. In the process of seed identification, the experimenters found that the seed germination method can save the step of identifying vigor, and the identification of seedlings is much easier than the direct identification of seeds [11]. Therefore, more than 90% of the identification methods use the seed germination method [15,21]. However, the germination conditions required for different seeds are different, so the types and numbers of seeds that may be obtained by the germination method are lower than the actual situation [11].

The two identification methods have their own advantages and disadvantages, and can complement each other. Therefore, in current practical applications, direct separation and seed germination methods are combined.

4. Weed Control Research and its Research Methods

4.1 Farmland Weed Control

Farmland weed control is to prevent and control the occurrence of field weeds through chemical, physical, biological, and integrated control methods. Farmland weeds have seriously endangered the high-yield, high-efficiency, and high-quality production of crops, and research on weed control is imperative. Although there are various weed control methods, with the development of the time, people have higher and higher requirements for food safety. Therefore, the research on weed control must keep pace with the time. At the end of the last century, the widespread use of chemical herbicides brought a series of environmental and safety issues [22]. Therefore, people began to study methods such as biological control, ecological control and integrated control, as far as possible to effectively control weeds while reducing environmental hazards [23-24].

4.2 Research Methods of Farmland Weed Control

(1) Classification of control methods

The current control methods of weeds are mainly divided into seven types: artificial weeding, mechanical weeding, physical weeding, plant quarantine, chemical weeding, biological weeding and integrated control. Manual weeding and mechanical weeding [25] are relatively primitive weeding methods, which mainly rely on manpower, animal power or mechanical traction plus farm tools to weeding, which are time-consuming and labor-intensive, and are not highly efficient. They are not suitable for intensive planting and intercropping. Physical weeding [25-27] mainly uses water, light, heat and other physical factors to weed, such as fire, flooding, and high-temperature weeding with plastic mulch. These methods may pollute the environment. Chemical weeding [28-30] is a more common method used in recent decades, with quick results and high efficiency, but the problem of pesticide residues is more serious, which not only affects food safety, but may also cause harm to other crops. Plant quarantine is a preventive measure to prevent the long-distance spread and invasion of exotic weeds. Biological weed controls [31-32]. Use insects, livestock, pathogenic microorganisms [32] and competitive replacement plants and their metabolites to control weeds, such as raising fish and ducks in rice fields, or raising geese in corn fields. Grass, this method is ecologically friendly and has a long-lasting effect, but the research is difficult and progress is slow. Comprehensive control [33] is to control weeds in combination with farming methods and various control measures, such as biological control plus straw mulching to control weeds. This method is more flexible in application and effective, but it is difficult to implement.

(2) Identification method of control effect

The control effect identification is mainly divided into two aspects, one is the safety investigation, and the other is the weeding effect investigation [34-39]. Safety investigation mainly adopts morphological observation method combined with laboratory analysis method for identification. The weeding effect is mainly to observe the field weeds every day after the application of the medicine to record the symptoms and death rates of different weeds. The sampling method usually adopts the method of small

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support and multiple points to calculate the control effect and fresh quality control effect of the plant.

5. Conclusions

The direct or indirect damage of farmland weeds to field crops has aroused people's interest in his research. However, with the deepening of research and the increasing requirements of people for environmental quality and food safety, the research on weed control has shifted from a single, inefficient, and environmentally unfriendly to efficient, ecological, lasting, and Comprehensive. Weed investigation and seed bank identification have laid a solid theoretical foundation for weed control and provided data and theoretical basis for weed control. At present, the ecological research methods adopted by the Farmland Weeds Research Institute are relatively simple, and breakthroughs and innovations are urgently needed.

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