Study of Humic Acid Organic Liquid Mulching Film on Promoting Green Agriculture Development

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Abstract. Mulching film is an important measure to promote agricultural production income and increase, the current widely used plastic mulching film has high stability, difficult to decompose, resulting in "agricultural white pollution", the development and application of degradable mulching film has become a solution. This case focuses on the study of organic multifunctional liquid mulching film with humic acid as the main raw material, which plays a unique role in promoting biological activity and soil improvement, the application of "liquid" spray film, the integration of fertilizer, pesticides, mulching film in one multi-functional comprehensive effect, to clarify its functional characteristics, alternative feasibility and the promotion of green agricultural development, and put forward the existing problems and countermeasures. This paper provides technical support and practical demonstration for the elimination of exogenous pollutants in farmland, and looks forward to the broad application prospects of this liquid mulch film in environmental protection and other aspects.

Keywords: Plastic mulch; humic acid; biomass liquid mulch; green agriculture.

1. Introduction

Mulching is an important measure to increase agricultural production and income. China has the largest agricultural mulching area in the world. However, the plastic (polymer compound polyethylene) film widely used at present has the problem of high stability and difficult decomposition. In addition, the recovery rate of plastic film in China is low, the residual film fragments cause the soil structure to stiffen, affect the growth of crop roots, and seriously harm the ecological environment. The degradation of residual film fragments forms soil microplastic particles, which will migrate under the action of plant roots, biological and mechanical disturbances, thus posing a threat to food quality, food safety and human and animal health under the action of food chain migration [1]. Therefore, the development and promotion of degradable environmental protection film to solve the "agricultural white pollution" is imminent. At present, the properties of photodegradable and biodegradable mulching films developed at home and abroad are not satisfactory. Due to the differences in application environmental conditions and the low general moderation of different crops at different growth stages, there are problems such as poor controllability of degradation rate, low tensile strength, easy decline in strength, high cost, low awareness and acceptance of farmers, which are difficult to popularize and apply [1]. In addition, the actual degradation effect and ecological environmental effect are still a big disagreement, especially the different types of mulching film on soil temperature and humidity, crop growth and yield and other aspects of the in-depth study, how to ensure that pollution prevention and control and extensive sustainable use is the key link in the development of degradable environmental protection mulching film.

This case studied the promotion effect of mulching film on agriculture, the pollution hazards brought by plastic mulching film, analyzed the types and degradation principles of biomass degradable mulching film, proposed the unique biological activity promotion effect and soil improvement effect of humic acid, focused on the introduction of humic acid as the main organic raw material of biomass liquid nutrient mulching film, and innovatively applied "liquid" spray film technology. The multifunctional effect of fertilizer, pesticide and mulching film in one body illustrates the advantages of its alternative performance to plastic mulching film. This study provides research direction and environment-friendly feasible measures for eliminating exogenous pollutants

in farmland and will play an important role and far-reaching significance for effectively promoting crop growth, improving yield and quality, conserving soil and developing green agriculture.

2. Influence of Mulching Film on Agricultural Production and Pollution Hazards

2.1. Promoting Effect of Mulch Film on Agricultural Production

Mulching film is the film covered on the surface of cultivated land in agricultural production. The application of mulching film can effectively use the solar radiation heat and reduce the evaporation of soil water, reduce the volatilization of fertilizer and the loss of leaching and melting. Some studies have shown that the fertilization effect can be improved by about 1/3. Mulching film has achieved remarkable results in retaining soil water, maintaining soil microecological environment, inhibiting weed growth, and preventing pests and microbial diseases [2]. Mulch promotes early seedling growth and rapid growth, significantly improves crop yield, water and nutrient utilization, and effectively provides unique conditions suitable for crop growth. Mulch plays an irreplaceable role in expanding planting area, improving cultivated land environment, and increasing agricultural yield and income.

2.2. Pollution Problems Caused by Plastic Mulch

Mulching film technology has been rapidly promoted and applied in China since it was introduced by Japan in the 1970s. According to the data of the National Bureau of Statistics, it is expected that by 2024, China's mulching film coverage area will reach 330 million mu, and the usage amount will exceed 2 million tons, making it the country with the largest mulching film coverage area in the world [3]. The low density polyethylene film widely used in China is extremely stable, and the film thickness above 0.02mm is the limit required by developed countries, while the agricultural film thickness used in China is thinner than that of developed countries such as Europe and Japan, and the film is not easy to recycle, and the aging and fragmentation rate are fast, thus accelerating the formation of microplastics [4]. Residual film fragments cannot be degraded in the soil, nor can they be absorbed and utilized by crops, forming a barrier layer, which obstructs the flow of water, gas and fertilizer in the soil, resulting in soil structure compaction, affecting the growth of crop roots and seriously endangering the ecological environment. In particular, residual film forms soil microplastic particles, which migrate under the action of plant roots, biological and mechanical disturbances. Furthermore, food quality, food safety and human and animal health are threatened under the action of food chain migration. It has become an urgent task to solve the damage caused by residual film to soil pollution and ecological environment [1].

3. Biomass Degradable Mulch Film

In order to solve this "agricultural white pollution", degradable film came into being, the main components of the natural environment can be completely degraded by microorganisms and materials, with traditional PE film moisture conservation, warming and weed control functions, no need to manually recycle after use, can be directly tilled in the soil, and in the soil to achieve self-degradation. As an efficient and environmentally friendly solution, biomass degradable mulching film has become the current development trend.

3.1. Principle of Biomass Film Degradation

Biodegradable mulch film is a biodegradable material as the main component, adding the appropriate proportion of starch, cellulose no environmental harm inorganic filler, functional additives, etc., through blow molding or casting industry production of biodegradable films. At present, the main biodegradable materials are polybutylene adipate terephthalate (PBAT), polylactide (PLA), polymethyl ethyl carbonate (PPC) and polyhydroxyfatty acid ester (PHAs), etc., which are

degraded through the joint action of water, light, heat and microorganisms in nature. Inorganic matter, water and carbon dioxide are the final products of biodegradable mulching film, and their degradation rate is significantly faster than that of plastic mulching film, which can reduce environmental pollution and avoid residual hazards [5].

3.2. Types of Biomass Mulch Film

Biomass degradable mulching film according to the type of raw materials, can be divided into animal based, such as protein, amino acid mulching film; Plant based, such as chitosan base film, sodium alginate base film, humic acid mulch film, starch base film, etc. [6]. The cost of biomass mulching film is high, which is 2-3 times that of plastic mulching film, while the tensile strength is insufficient, the degradation process is uncontrollable, and the stability is greatly affected by external conditions, which restricts the large-scale application and promotion. In the past few years, the replacement rate of biodegradable plastic film in China will be about 3% in 2021.

4. Humic acid multifunctional liquid mulch

Scientific and technological innovation around the world has always promoted the continuous progress of biodegradable plastic film, from 1973 British scientist Griffin took the lead in proposing and making biodegradable starch PE, to the early 1980s, British researchers invented polyβ-hydroxybutyrate (PHB, is a kind of PHAs) extraction and purification method made of film, Make PHAs renewable bio-polyester widely used, and then to the early 1990s, China began to invest in PHAs biodegradable plastics research, and achieved many research and development results in PBAT, PHAs and other degradable materials, during this period, China's scientific and technological personnel teachers naturally achieved "biological humic acid" important results, As a huge reserve of organic resources widely existing in nature to be developed and utilized, humic acid is highly respected and has great development space and application value in advocating ecological agriculture construction, pollution-free agricultural production, green food, environmental protection agricultural facilities and other aspects.

4.1. Humic Acid Can Promote Crop Growth and Soil Improvement

Humic acid is an organic substance produced by the long-term decay of animal and plant remains. It is widely found in soil, coal mines, rivers, lakes, seas, brackish waters, peat and other natural areas [7]. It is an organic resource inseparable from human beings and has not been fully exploited and utilized. This green production means with magical biological activity and multi-functional comprehensive effect can improve the yield and quality of agricultural products, increase production and income, enhance crop resistance, stimulate root growth and development, and improve the utilization rate of fertilizers and pesticides, enhance soil fertility, and effectively control soil pollution [8]. Humic acid is a natural macromolecular organic matter, mainly composed of aromatic structure and a variety of highly active chemical functional groups, with a huge specific surface area of 2000m2/g. Studies have confirmed that the humic acid + Bacillus bacilli test for treating contaminated soil can improve the main indexes of soil physical and chemical properties after treatment, effectively activate phosphorus and potassium nutrients in soil, reduce nitrogen loss, reduce the input of compound fertilizer, and have significant effects on treating contaminated soil and increasing production [9]. Soil closely related to crop growth, years of continuous cultivation and blind mass application of chemical fertilizers and pesticides, salt concentration, pest and disease intensification, crop yield, quality decline, and even cause crop cannot grow, how to widely apply humic acid to soil improvement, promote crop growth and green agricultural development has practical needs and strategic significance.

4.2. Humic Acid Multi-functional Degradable Liquid Mulch

Humic acid multifunctional degradable liquid mulch (hereinafter referred to as liquid mulch) is a kind of liquid substance composed of humic acid (BFA), modified inorganic carbon black mixture and a variety of additives. The substance sprayed to the surface of the soil, can quickly form a thin layer of black and brown protective film, connected with the soil particles, forming an ideal soil closed aggregate body, prevent the volatilization of soil water, at the same time can make rainwater, pesticides, nutrients fully penetrate into the soil layer. After low temperature oxidation and microbial action, the substance began to degrade gradually at about 40-60d after spraying, degraded into humic acid in 2-3 months, and turned into high-quality soil amendment after being pressed into soil. This liquid mulch not only has the function of warming, water retention and seedling preservation of plastic mulch, but also has strong adhesion ability. It can spray "pesticide", "fertilizer" and "mulch" into a film, connecting soil particles into an ideal aggregate, which becomes humic acid after decomposition, completely solving the problem of plastic mulch pollution to soil and environment.

4.3. Main Functional Characteristics of Liquid Film

4.3.1 Better water retention performance

The liquid film combines with the soil to form a black and brown multi-component, polymer chemical protective layer, and forms a closed body to prevent the volatilization of water in the soil, and at the same time can make rainwater, pesticides, nutrients, etc., fully penetrate into the soil. Hydrophilic groups such as alcohol hydroxyl group, phenol hydroxyl group, carboxyl group and carbonyl group on humic acid ionize and combine with water molecules to form hydrogen bonds after contact with water, absorb water and thus increase soil moisture content and improve soil water and fertilizer retention ability.

4.3.2 More adequate heat absorption and insulation

The black humic acid in the liquid mulch can absorb sunlight in the whole band, rapidly increase the ground temperature, continue to absorb heat and keep the seed germination and growth.

4.3.3 Soil cultivation has strong rooting effect

Humic acid flocculation makes the liquid mulch film have strong adhesion ability, which can connect loose soil particles into ideal aggregates, regulate soil water, fertilizer, gas, heat and other conditions, improve soil exchange capacity, reduce soil bulk density, increase soil porosity, promote soil microbial activity, and form a good water stability aggregate structure, thus improving soil fertility. Promote plant root growth and increase yield and income.

4.3.4 Drug reduction, fertilizer saving, nutrition and multi-functional integration

Herbicides are added to liquid mulch film to achieve co-loading of herbicide pesticides, and changing the spraying method of pesticides can reduce the dosage of pesticides, extend the effective time of pesticides, and achieve the effect of reducing drug residues and protecting ecological environment. After air oxidation and microbial decomposition, it is naturally degraded into humic acid fertilizer, and becomes a soil amendment after turning into soil.

4.3.5 Green, fully degradable and environmentally friendly

Liquid mulching film is made of humic acid as the main material, blended and modified with degradable water-soluble polymer resin, crop starch, etc., and achieved complete and thorough degradation through photobiological dual degradation.

4.3.6 Save manpower and material resources, widely applicable

There is no need to put seedlings manually, but it can emerge naturally, saving a lot of manpower and material resources; Field film spraying is easy to operate and is not limited to landforms and landforms. It is widely applicable to the early mulching film covering of arid, saline-alkali, sandy soil,

alpine region and hilly farmland, as well as engineering slope protection, water collection engineering, channel seepage prevention, sand fixation afforestation and tree anti-freezing fields [10].

4.4. Demonstration Application Effect of Liquid Mulch

At present, humic acid liquid mulch film has completed the technology development, is in the experimental demonstration stage, related products have been in China's Liaoning Province dozens of pilots (a total of about 200 acres) for test demonstration. Preliminary test data show that this product has excellent performance on peanut, garlic, onion, waxy corn, strawberry, potato and other root crops [10]. Taking peanut planting as an example, a comparative experiment was conducted between liquid mulching film, bare land and plastic mulching film. The experimental results showed that spraying liquid mulching film, compared with spraying water and plastic mulching film in bare land, had obvious effects on increasing temperature, water and fertilizer 15-20 days after application, especially on increasing seedling emergence rate, number of nodules, yield per mu and yield increase rate [11]. After the product is mixed with conventional herbicide, the amount of herbicide can be reduced by about 30%. After fruit harvesting, the average yield per mu is more than 6-8% [10].

4.5. Future Outlook

Although the liquid film performance is outstanding, but at this stage there are high production costs, supporting equipment is not perfect, farmers use enthusiasm is not high, government guidance and support is not in place and other problems, need to further strengthen the whole society to develop green agriculture environmental awareness, industry-university-research cooperation, large-scale production and supporting equipment development. In particular, we should strengthen government planning, regulation of plastic film environmental protection standards, policy support and promotion training, and take effective measures to promote and apply them. It is believed that its huge application value and development potential is expected to become a new opportunity and new challenge for upgrading and iteration in the field of mulch, and it is still necessary to further study and develop this liquid mulch in the regulation of saline-alkali land, tree planting anti-freezing, road slope protection, sand fixing afforested, sand storm and other environmental protection projects, which will bring new solutions and broad prospects.

5. Conclusion

This research is a new direction, new technology and new product for innovative development of biodegradable mulching film, exploring the development and utilization of humic acid, an organic resource with huge reserves, especially its biological activity promotion and soil improvement function in the agricultural field, and innovating the application of "liquid" film spraying technology to effectively integrate the multi-functional comprehensive effect of mulching film, fertilizer and pesticide. It provides demonstration and application verification and proposes the feasibility of replacing plastic mulch, which provides technical support and practical demonstration for eliminating exogenous pollutants such as residual film and herbicide in farmland. At the same time, liquid mulch has the characteristics of compound efficiency and ecological cleaning [10], which can effectively achieve crop yield increase and income increase and comprehensive utilization of resources. The implementation of this project has strategic significance for promoting black land protection and high-quality agricultural development and will be an important innovation measure to promote the sustainable development of green agriculture.

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