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# High-yield Cultivation Techniques of Drip Irrigation under Ground Membrane for Cotton

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**Abstract** Yuepuhu County in Xinjiang has a long history of cotton planting and is a national high-quality cotton base county. In 2002, it was appraised by the Ministry of Agriculture as the "Hometown of High-yield Cotton Production in China", with an annual cotton planting area of about 43 000 ha. Traditional cotton planting has disadvantages such as waste of water resources, low water use efficiency, easy breeding of diseases and insect pests, and unfavorable ground temperature recovery at the seedling stage. In order to solve the low water use efficiency in cotton planting in Yuepuhu County, reduce the occurrence of diseases and insect pests, promote sustainable cotton production, and improve the economic benefits and local ecological benefits of cotton planting, Yuepuhu County promoted the application of the resource-saving technology drip irrigation under ground membrane cotton comprehensive cultivation technology mainly promoted by the Ministry of Agriculture. This paper mainly discusses the disadvantages of traditional cotton planting, the main technical content of drip irrigation under ground membrane technology, the problems found in the practice process and the solutions, so as to make cotton growers in Yuepuhu County better understand the planting technology under plastic film, and to better promote the development of cotton industry in Yuepuhu County and the surrounding regions.

**Key words** Under ground membrane, Drip irrigation, High yield, Application

## 1 Drawbacks of traditional cotton irrigation methods

Traditional irrigation methods mainly include border irrigation, flush irrigation, and flood irrigation. According to field investigation and statistics, the traditional irrigation methods mainly have the following drawbacks.

### 1.1 Waste of water resources and low water use efficiency

The climate type of Yuepuhu County belongs to warm temperate continental arid climate, with dry air, little precipitation, and large evaporation. The main source of irrigation water is melted ice and snow, and water resources are relatively short. Water resources in irrigation areas are relatively scarce. The contradiction between supply and demand of irrigation in agricultural production is relatively prominent. Although the traditional irrigations are easy to implement, the volume of irrigation water is large, the water utilization rate is low, the waste of water resources is serious, and the phenomenon of high consumption and low efficiency of water resource utilization is very prominent.

**1.2 Easy to breed diseases and pests** In winter, Yuepuhu County is very cold. During the cotton growth period, there are many sunny days, sufficient sunshine, large temperature difference between day and night, and less pests and diseases. However, the conventional irrigation methods make the irrigation water flow become the main medium for the spread of diseases and insect pests, especially fungal and bacterial diseases. It is easy to breed the occurrence of diseases and insect pests with traditional watering methods in the plots where diseases and insect pests occur.

**1.3 Not conducive to the rise of ground temperature** In the land of traditional furrow irrigation, the volume of water is large at one time, and the surface remains moist for a long time, and the

ground temperature drops too fast, which is not conducive to the rise of the ground temperature. As a result, it is difficult to guarantee the temperature required at the cotton seedling stage, which greatly affects the local cotton production.

## 2 Main technical contents of drip irrigation under ground membrane for cotton

As new technology for cotton planting in Yuepuhu County, the drip irrigation under ground membrane for cotton can artificially control water consumption and field microclimate, alleviate the tense situation of water use in Xinjiang's head water, increase water use efficiency as much as possible, increase biological production and economic output, and improve ecological, social and economic benefits. Besides, the reproductive growth and vegetative growth of cotton can also be controlled through the drip irrigation under ground membrane technology, which is conducive to shaping the ideal plant shape and reducing the ineffective consumption of nutrients. The main technical contents of cultivation management are as follows.

### 2.1 Making well preparation before sowing and improving the quality of sowing

**2.1.1** Drying the seeds before sowing. It is necessary to choose a sunny day to dry continuously for 2–3 d on a wooden board or mat erected to promote the post-ripening of cotton seeds, enhance the activity of enzymes in the seeds and vitality of the embryos, kill the germs on the surface of the seeds, and reduce the occurrence of pests and diseases.

**2.1.2** Doing a good job of chemical treatment to reduce seedling pests and diseases. It is necessary to sprinkle 6% phoxim or 3% ethion-methyl granules evenly on the ground surface, and turn into the plow layer for soil treatment to prevent and control underground pests. For the plots where the disease is serious, use 1 kg of thiram or 50% thiram wettable powder for 50 kg of dry cotton

seed, and 40% seed dressing with double wetttable powder.

**2.1.3** Doing a good job in machine tool debugging and optimizing the sowing method. It is necessary to carry out a comprehensive inspection and debugging of the equipment before sowing, install and lay the drip irrigation capillary device, and reach the safe operation state. When the 5 cm ground temperature stabilizes above 10 °C, it is used as the initial stage of sowing. April 15 – 20 is the best sowing period for sowing. The sowing method adopts the water-saving technology of one film and two tubes, and 11 000 to 13 000 seedlings are preserved in 666.7 m<sup>2</sup>. The laying of the drip irrigation tube is carried out at the same time as the film laying and seeding. The drip irrigation tube is arranged in a narrow row, and the rough side of the drip irrigation tube is facing upward, that is, the flow channel is upward.

## **2.2 Strengthening seedling management and improving sowing quality**

**2.2.1** Doing a good job in all seedlings and promoting early germination. It is necessary to overcome the influence of unfavorable natural factors by replanting, dripping seedling emergence, breaking compact soil, and promptly cultivating, *etc.*, improve the growth environment, and ensure the normal growth of seedlings. Replant in time after sowing, and fill up the fields and edges after sowing, and strive to be full of seedlings; after sowing, pipes are deployed to drip water quickly, and the work of dripping and seedling emergence will be completed before April 25; after the rain, break the compaction in time to facilitate the emergence of cotton seedlings; the intertillage should not pull the furrow, not pull the film, and not bury the seedlings. The soil should be flat, loose and broken, and tightly suppressed; clear up the remaining seedlings as soon as possible, and cultivate strong seedlings.

**2.2.2** Doing a good job of chemical control and shaping the ideal plant type. According to the characteristics of cotton "weak in the front and prosperous in the future" and the soil and climate characteristics of Yuepuhu County, it is suitable for the principle of "early stage promotion, middle stage control, and late stage prevention of decline". It is necessary to apply a growth-promoting regulator at the seedling stage, and use mepiquat chloride to regulate at the bud stage and flower boll stage; spray foliage with 1.5% urea water and 0.5% potassium dihydrogen phosphate for signs of premature aging. In the application of Mepiquat chloride, according to the difference in soil fertility and varieties, the combination of chemical regulation and fertilizer and water regulation is flexibly mastered. The goal is to adjust the internode length of the plant to be basically uniform, with an average length of 5 – 6 cm. The principle is basically "gentle, diligent, and early". The plant height is controlled at 60 – 65 cm, and the fruiting branches of a single plant are kept at 7 – 8 pieces

## **2.3 Taking multiple measures to strengthen middle and late stage management**

**2.3.1** Doing a good job in fertilizer and water management and pest control. The main goal of field management in the middle and late stages is to increase the boll formation rate and increase the boll weight. In terms of strengthening fertilizer and water management, it is necessary to ensure the growth of cotton bolls and prevent late maturity. In the control of diseases and insect pests, it is

necessary to adhere to the principle of "prevention first, comprehensive prevention and control". In addition, it is necessary to strengthen the implementation of conventional control measures such as autumn plowing and winter irrigation, strict chemical control indicators, rational use of natural enemies, and reduce the use of chemical pesticides to increase efficiency.

**2.3.2** Spraying chemical defoliant in a scientific manner. The spraying time should be reasonable, and adhere to the principle of "if cotton wadding appears, not waiting for the time, and if the time arrives, not waiting for the cotton wadding". Spraying is the best when the top boll period of cotton is more than 45 d or when the opening rate of cotton field reaches 30% – 40%. Specifically, it is around September 15 – 20. It is necessary to make sure that the spraying is uniform, the atomization is good, the upper, middle and lower leaves of the cotton plant are evenly sprayed, the effective spraying of the leaves should reach more than 95%, and the cotton damage rate should be kept below 1%.

**2.3.3** Doing a good job in mechanical harvesting. The defoliation rate of the cotton field reaches 90%, and the boll opening rate reaches more than 95%, and the mechanical harvesting should be carried out in time. Before machine harvesting, remove weeds and pick up the residual film hanging on the cotton plants, and work only after passing the acceptance check. It is necessary to strictly control the moisture and impurities of the picked seed cotton, the impurity content rate is less than 10%, the moisture regain rate is less than 10%, and the clean rate is less than 93%. After the cotton is harvested, the residual film in the field should be removed manually or mechanically to reduce the pollution to the soil. The stacking site must be cleaned up, and it is strictly forbidden for residual film, residual stalks and other debris to be mixed into the cotton stack.

## **3 Problems in drip irrigation under ground membrane in promotion and application and recommendations**

The drip irrigation under ground membrane technology is a combination of plastic film mulching technology and drip irrigation technology, showing advantages in water saving, fertilizer saving and production increase. However, some problems were also found in the actual application process, and the existing problems and solutions are sorted out as follows.

### **3.1 Problems**

**3.1.1** The drip irrigation under ground membrane mode affects the plant's own ability to find water. Most of the plants need to grow on their own, and the roots spread downward, contacting and absorbing water from the groundwater. Drip irrigation is to give water from the surface of the land, so that the roots cannot extend downwards and float on the shallow layer of the land, so that they cannot spontaneously absorb water and grow after the drip irrigation supply is stopped. It cannot spontaneously absorb water to grow after stopping the drip irrigation supply, and has poor drought resistance, poor wind resistance, easy lodging, and poor stress resistance.

**3.1.2** Abandoned film pollutes the soil. The drip irrigation under

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Through the final examination, the overall learning effect of students is assessed, which is conducive to a comprehensive understanding of students learning effect. This kind of mixed evaluation is more objective than traditional teaching evaluation and can reflect students' learning situation truly.

## 5 Conclusions

To sum up, in order to adapt to the new requirements of "new concept, new orientation, new structure and new mode" of the education teaching reform of new liberal arts, the curriculum reform of Finance takes "quality optimization" as the guiding ideology of the teaching reform, and by broadening the teaching objectives, updating the teaching content, reforming the teaching means and methods, enriching practical education resources, and improving the assessment and evaluation system, a scientific and complete content teaching system of "Finance" has been constructed to make the classroom "live" and students "learn", which is conducive to improving the teaching level of teachers, enhancing the professional quality and humanistic character of students, and

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ground membrane technology can effectively maintain soil moisture and increase ground temperature through mulching. However, due to the use of film, there are also some problems. In the cotton field after picking, only large pieces of film can be simply collected. More small pieces of plastic film left in the land will pollute the soil and produce physical reactions, making the gaps in the soil smaller and oxygen less, accordingly destroy land nutrients and soil structure, even deform the growth of plants, affect the growth of plants, re-use of land, make farming difficult, and cause serious soil salinization.

### 3.2 Recommendations

**3.2.1** Changing the drip irrigation under ground membrane to subsurface drip irrigation or other treatments. Changing the drip irrigation under ground membrane to underground drip irrigation, so that the characteristics of the plants seeking water from the inside of the soil remain unchanged, and the impact on its growth and root system development is reduced. It is recommended to extend the drip irrigation technology in an all-round way, make various attempts, and combine drip irrigation under ground membrane, underground drip irrigation with other treatment methods to obtain an optimal solution.

**3.2.2** Using degradable film to take the place of general film. It is recommended to explore the use of degradable film for covering to reduce the degree of soil pollution and improve the soil utilization. For the recycling of old polluting membranes, degradable membranes are used, which have strong light transmission, good ductility, and relatively fast degradation. The processing of degradable mulch film is relatively easy, and the growth load on plants is small, so it can be popularized and applied experimentally.

According to the field data survey and yield test and acceptance, compared with traditional planting, the high-yield cultiva-

cultivating compound financial talents with "thick foundation and broad caliber", both virtue and ability, comprehensive quality and strong innovation ability.

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tion technique of drip irrigation under ground membrane for cotton can increase cotton yield, effectively improve water and fertilizer use efficiency, and improve economic benefits. In addition, drip irrigation under ground membrane can improve the soil, discharge salt and compress alkali, and have a significant effect on reducing the salinization of the soil. In terms of popularization and application of this technology, China should increase financial support for the application of drip irrigation under ground membrane technology, so as to reduce the production cost of cotton farmers. The agricultural law enforcement system has stepped up supervision over drip irrigation under ground membrane for cotton equipment, tools, seeds, *etc.*, to ensure the quality of agricultural materials corresponding to drip irrigation under ground membrane. The agricultural technology promotion system will increase technical guidance on drip irrigation under ground membrane for cotton to help solve the difficulties encountered by farmers in actual operation. Furthermore, the government should strengthen the publicity and promotion of drip irrigation under ground membrane for cotton, and increase the awareness of cotton farmers on this technology, so as to facilitate the better application of drip irrigation under ground membrane for cotton technology.

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