Effect of Degradable Plastic Film Mulching on Cotton Yield in Yuli County

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Abstract Nine kinds of biodegradable plastic film and one kind of conventional PE film are used to conduct experiment in the field, and study the effect of degradable plastic film on cotton yield. The results show that there is no difference in cotton yield between Treatment II, III, and ordinary PE film, and other kinds of degradable plastic film significantly reduce yield, with yield reduction of 6.5%-16.7%. The yield differences among treatments are mainly affected by the number of plants harvested.

Key words Yuli, Biodegradable film, Cotton, Soil temperature, Yield

1 Introduction

Xinjiang is China's largest high-quality cotton base, and also one of the world's largest growing areas of high-quality fine staple cotton and long-staple cotton. According to statistics, 15% of Xinjiang's revenue is from cotton and related industries. Plastic film mulching can not only improve land and water use efficiency, but also increase crop yield, so it has been widely used[1]. Cotton planting area accounts for nearly half of total agricultural planting area in Xinjiang, and the film mulching rate reaches 100%[2]. However, with the increasing application of plastic film, plastic film, as a synthetic polymer with stable molecular structure, has long been accumulated in the fields, but it is difficult to degrade under natural conditions in the short term, and may remain in the soil for 200 to 400 years[3]. Long-term accumulation of white plastic film causes soil pollution, damages farmland ecological environment, and results in "white pollution" of farmland[4]. Cotton is the main crop in Yuli County, and it is imperative to solve plastic film pollution in the cotton fields, so in this experiment, we select 10 mu of typical cotton plot, nine kinds of biodegradable plastic film and one kind of conventional PE film, to explore the degradation characteristics of degradable plastic film and the impact on crop yields. Finally, we determine the type of degradable plastic film suitable for local cotton fields, which lays the foundation for fundamentally solving plastic film pollution.

2 Materials and methods

2.1 Experimental site Yuli County, located in central Xinjiang, features a warm temperate continental desert climate, with the annual average sunshine of 2975 h, annual average temperature of 10.1 ℃ and annual frost-free period of 144-212 d. The annual precipitation is 30-150 mm, the average annual precipitation is 43 mm, and the average annual evaporation is 2700 mm.

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2.2 Experimental design Nine kinds of biodegradable film are selected, and nine treatments are set. A conventional plastic film is set as Treatment X (PE film), with width of 2.2 m and thickness of 0.008 mm. The tested cotton is Xinluzao XX. There are a total of 10 treatments, and drip irrigation is adopted. Each experimental plot uses the method of random arrangement, and has three replications. The guard rows are set around experimental site, and the area of experimental site is 10 mu.

2.3 Methods Spss17.0 is used for ANOVA and LSD multiple comparison, and Origin8.5 is used to draw.

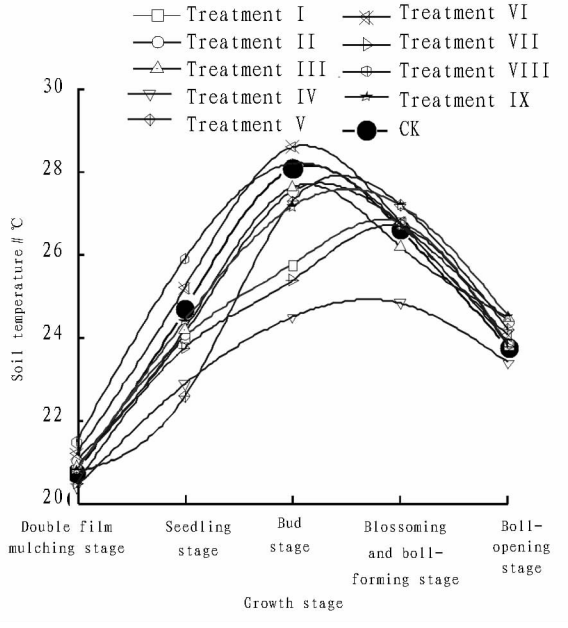

Fig. 1 Soil temperature comparison under different biodegradable plastic film at different growth stages of cotton in Yuli County

3 Experimental results

3.1 Differences in the impact of degradable plastic film on cotton field soil temperature (i) As can seen from Fig. 1, un-

der plastic film mulching, the soil temperature in 10 cm soil layer is in the order of bud stage > blossoming and boll-forming stage > seedling stage > boll-opening stage > double film mulching stage. (ii) At various growth stages of cotton under film mulching, compared with eight treatments of degradable plastic film, the 10 cm soil layer temperature under conventional plastic film (CK) is not significantly increased. Under Treatment IV, the 10 cm soil layer temperature is the lowest at various stages among eight kinds of degradable plastic film. (iii) During the double film mulching period, the highest soil temperature in 10 cm layer reaches 21.557℃ (Treatment Ⅷ), while the lowest temperature is 20.479℃ (Treatment IV), a difference of 1.078 ℃. At the seedling stage, the highest soil temperature in 10 cm layer reaches 25.279℃ (Treatment VI), while the lowest temperature is 22.664℃ (Treatment V), a difference of 2.615℃. At the bud stage, the highest soil temperature in 10 cm layer reaches 28.669℃ (Treatment VI), while the lowest temperature is 24.576℃ (Treatment IV), a difference of 4.093℃. At the blossoming and boll-forming stage, the highest soil temperature in 10 cm layer reaches 27.285℃ (Treatment V), while the lowest temperature is 24.91℃ (Treatment IV), a difference of 2.375℃. At the boll-opening stage, the highest soil temperature in 10 cm layer reaches 24.588℃ (Treatment IX), while the lowest temperature is 23.478℃ (Treatment I), a difference of 1.11℃. With the growth of cotton, the soil temperature gap between conventional plastic film and degradable plastic film is getting smaller and smaller.

3.2 Effect of degradable plastic film on cotton yield Table 1 shows the effect of degradable plastic film on cotton yield and its components. From Table 1, it is found that the cotton yield is 134.06, 139.28, 137.94, 135.38, 133.14, 132.88, 133.13, 132.62, 134.41, 137.27 kg/mu under Treatment I, Treatment II, Treatment III, Treatment IV, Treatment V, Treatment VI, Treatment VII, Treatment VIII, Treatment IX, respectively. By the analysis of variance, we can see that there is no significant difference in cotton yield between two kinds of degradable plastic film (Treatment II, III) and PE film (Treatment X), but the yield is higher than under other treatments. By analyzing the yield components, it is found that the difference in yield between the treatments is mainly affected by the number of plants harvested.

Table 1 Effect of degradable plastic film on cotton yield and its components

Treatment	The number of plants harvested per mu	Boll number per plant	Single boll weight//g	Lint percentage /%	Plot yield kg	Yield kg/mu
Treatment I	7141	8.09	5.50	42.19	93.22	134.06bc
Treatment II	7601	8.07	5.39	42.13	96.85	139.28a
Treatment III	7570	8.10	5.34	42.13	95.92	137.94a
Treatment IV	7279	8.06	5.48	42.11	94.14	135.38bc
Treatment V	7294	7.99	5.42	42.15	92.58	133.14c
Treatment VI	7179	8.05	5.46	42.11	92.40	132.88bc
Treatment VII	7315	7.97	5.41	42.21	92.58	133.13bc
Treatment VIII	7290	8.00	5.39	42.19	92.22	132.62c
Treatment IX	7287	8.10	5.40	42.17	93.46	134.41bc
Treatment X	7466	7.96	5.48	42.15	95.46	137.27a

Note: Different letters indicate the significant difference between different kinds of biodegradable plastic film ($p<0.05$).

4 Conclusions

Nine kinds of biodegradable plastic film and one kind of conventional PE film are used to conduct experiment in the field, and study the effect of degradable plastic film on cotton yield. The results show that there is no difference in cotton yield between Treatment II, III, and ordinary PE film, and other kinds of degradable plastic film significantly reduce yield, with yield reduction of 6.5% – 16.7%. The yield differences among treatments are mainly affected by the number of plants harvested.

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