Effects of Seedling Nursing With Liquid Film on Growth and Yield of Cotton

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Abstract: Seedling raising and transplanting is a momentous innovation in cotton culture in China. Research on this technique started in 1954 by former Huadong Institute of Agricultural Sciences, and had been improved then. At present, it has become an important high-yield technique in cotton-growing areas especially in the Yangtze River Valley and the Yellow River Valley. However, breeding seedling was difficult to standardize with plastic film by this technique, which resulted in weak cotton seedlings, high incidence of various diseases, and high seedling mortality. By comparison, the new ground-covered technique with liquid film could overcome such obstacles. Liquid film, also called multifunctional and degradable liquid film, is a new organic macromolecular compound. After it is sprayed on soil surface, a thin black film would form. Such liquid film could increase soil temperature and moisture, and improve other soil properties. In the current study, effects of plastic-fied technique and liquid-film technique on cotton growth, development, and yield were tested and compared. The objectives of the study were: (1) to investigate the mechanism of high-yield transplanted cotton with liquid-film raised seedlings, (2) to provide theoretical support for popularization of liquid film in cotton production practice.

The experiment was conducted from 2002 to 2003 on a sandy loam at Henan Agriculture University Experimental Station, Zhengzhou, Henan, China. Content of soil organic matter, total N, available P, and available K was 1.22%, 0.95 g • kg^{-1}, 24.4 mg • kg^{-1}, and 116.5 mg • kg^{-1}, respectively. The treatments were different at amount of liquid film used: T1(250 kg • hm^{-2}), T2(500 kg • hm^{-2}), T3(750 kg • hm^{-2}), and T4 (1000 kg • hm^{-2}). Plastic-film was used as control. Diluent of the liquid film, prepared by Henan Agricultural University, with 20-time water was uniformly sprayed on soil surface. Seeds of CCRI 41 were sown in nursery pots on March 20. Seedlings were transplanted on May 5 at an establishment of 49500 plants • hm^{-2}, with a 1-m row space and 0.2-m plant space. Randomized block design was adopted and three replications were used. Area of each plot measured 24 m^2 (4×6 m^2). 150, 112.5, and 112.5 kg • hm^{-2} of N, P_2O_5, and K_2O was mixed to apply as pre-planting fertilizers. Additional 35 and 150 kg • hm^{-2} of N were top dressed at seedling stage and boll stage, respectively. Other management practice was the same as common high-yield cotton fields.

Emergence and seedling mortality were recorded during seedbed period. At transplanting period, morphological traits of seedlings were measured and root vigor was determined by the improved Triphenyltetrazoliumchloride (TTC) method. The period for transplanted seedlings to re-grow was observed. Content of chlorophyll, a fluorescence parameter of cotton leaf, was determined by a portable fluorometer (FMS) at budding period, flowering period and boll-opening period. Activity of sucrose invertase in bolls was determined by the 3,5-Dinitrosalicylate (DNS) method at 10 d, 15 d, 25 d and 30 d after flowering, respectively. Leaf area per plant was calculated after leaf length and width were measured at each period for 10 randomly chosen plants per plot. Also for those 10 chosen plants, "the four kind of bolls", a criterion of temporal distribution of bolls, was observed. The model chart of bolls on the plant was drawn on September 10. Boll weight and lint percent were measured after harvesting opened bolls, and then yield per plot was determined.

The results showed that cotton yield of using seedlings raised with advisable liquid films (T2 and T3) significantly increased, compared with that of using seedlings raising with plastic film. The reason might be that seedlings transplanted were more vigorous, the time for transplanted seedlings to re-grow was shortened, maximum leaf area per plant maintained for a longer period (it increased quickly during the early growing period and decreased slowly in the late growing period), leaf photochemical characteristics were improved and activity of sucrose invertase enhanced in cotton bolls, and temporal and spatial boll settings were reasonable, high-quality bolls were more, and bolls weight were higher. In addition, liquid film was easy to use, the cost was low, and it was biodegradable and did not result in any environmental pollution. Therefore, the author believed application of liquid film is a feasible technique in cotton transplanting culture, which makes a way for high-yield of cotton.

Key words: cotton; liquid-film; seedling-nursing; yield