Comparison of Polyethylene and Polyethylene-coated Bio-degradeable Paper Mulches on Strawberry[1]

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Abstract. **Bio-degradeable paper mulches with a polyethylene (PE) coating on both sides or with a single PE coating applied against the soil surface satisfactorily endured Florida's 7 month growing season and gave similar fruit yields and fertilizer leaching results as compared to black PE mulch. Paper mulch was harder to transplant through since it is less flexible than PE mulch, but it does not have to be removed from the field at season's end.**

Growers using the annual hill system of strawberry culture apply a PE mulch over their beds to maintain a more favorable soil environment (6, 7, 8). Approx 1335 ha (3300 acres) of strawberries were grown in Louisiana and Florida in 1971 (4), mostly over black PE mulch. A disadvantage of PE is that it must be removed from the field and disposed of at the end of each fruiting season since it does not decompose in the soil. Paper mulches treated with fungicides and with or without a thin PE layer on one or both sides have recently become available. Tests on some of these papers indicate that they have mulching properties similar to that of black PE but will disintegrate when incorporated into the soil (2, 5).

The purpose of this investigation was to evaluate the endurance of various paper mulches, coated and uncoated with PE, and to compare their effect on strawberry plant growth and fruiting response with that of the standard black PE mulch.

The research was conducted on Scranton fine sand soils, which had a pH of 6.1 and 4.5% organic matter, at Dover, Florida during the winters of 1970-71 and 1971-72. Embossed black PE with a thickness of 0.025 mm was used as the standard mulch and compared to 1 gray and 2 black paper mulches. One black paper incorporated relatively high levels of a fungicide while the other 2 papers incorporated medium levels. Each of the paper mulches was applied in one or more of the following ways: A) paper mulch coated on 1 side with PE and this side placed against the soil (PE down), B) the same paper with the PE side up (PE up), C) paper mulch with a coating of PE on both sides (double PE) and D) an uncoated paper mulch (no PE). The paper mulches with no PE coating or "PE up" failed to endure the 7 month season satisfactory and plants were chlorotic and smaller than those in the other treatments during the latter part of the season, presumably because of nutrient leaching. These papers were not evaluated further.

The experimental design was a randomized complete block with 4 replicates. Fumigated plots were 3 m long and standard fertilizer and pesticide programs were used with overhead sprinkler irrigation applied as needed. The mulches were applied in Sept. immediately after fumigation with methyl isothiocyanate and chlorinated hydrocarbons (Vorlex) and locally grown 'Tioga' strawberry plants were set in Oct. Fruit was harvested from Jan. to early April. Soil samples were taken from all plots in April 1972. The soil solutions were extracted from a saturated paste and analyzed for total soluble salts (3). Soil temp at 10 cm depth in center of beds were recorded during Oct., Nov., and Dec. of both years.

The PE coating on the paper surface of the "double PE" paper mulches began disintegrating soon after application and little remained at season's end. However, the "double PE" paper mulches remained in satisfactory condition during the fruiting season of both years as did the "PE down" paper mulches. This was possible because the PE coating applied against the soil remained in good condition throughout the test period. The "double PE" and "PE down" paper mulches developed minor separations at the soil line beginning in Jan., but these never became serious. Soil tests (Table 1) revealed no differences in nutrient leaching among the "double PE" and "PE down" paper mulches and the black PE mulch at the end of 7 month test period. There were no plant growth differences among the black PE, "double PE" paper, and "PE down" paper mulches.

The marketable yields for the 2 years, also given in Table 1, indicated that there were no yield differences in the 1970-71 and the 1971-72 seasons, between the black PE and the paper mulches.

Treatments had no significant effect on soil temp at the 10 cm depth for either year. In 1970, the 9 AM readings averaged 13°C and the 3 PM averaged 22° and in 1971 readings were 18° and 27°, respectively.

Paper mulch gave greater control of weeds than did black PE. Weeds can easily grow through the slits made for plants with either type of mulch. However, some weeds, such as nutsedge (*Cyperus esculentus* L.), can readily penetrate and grow through black PE but are unable to penetrate the paper mulches.

In our experience with the various mulches, either paper or black PE mulch can be applied to beds with equal ease with the proper equipment. However, the paper mulches, which are more rigid, were somewhat more difficult to set plants through. Development of a transplanter capable of setting strawberry plants through mulch would alleviate the problems.

The paper mulches from the 1970-71 investigation which were incorporated into the soil in April 1971 were almost totally disintegrated at the time of bed preparation for the 1971-72 season.

Table 1. Effects of paper and polyethylene (PE) mulches on marketable strawberry yields and soluble salts in solution extracts.

Mulch types and placement	Fungicide level	Marketable Yield (g/plant)[z] 1971	1972	Soluble salts (ppm)[y] 1972
Black paper (PE down)	M[x]	319ab[w]	379a	460a
(Double PE)	M	265b	437a	374a
(PE down)	H		396a	605a
(Double PE)	H	302ab	408a	535a
Gray paper (PE down)	M	330 ab	386a	530a
(Double PE)	M	383a		
Black PE		319ab	413a	579a

[z]About 54,000 plants per ha.

[y]Expressed on basis of soil solution at field capacity.

[x]M = medium, H = high.

[w]Means in any column followed by different letters are significantly different at the 5% level.

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Thus, the use of paper mulch would eliminate the 20-74 man-hr per ha (8 to 30 man-hr per acre) required annually to remove the polyethylene from the strawberry field (1). In addition, the effects on the environment caused by the burning or burial of the polyethylene are circumvented. Presently the paper mulches are somewhat more expensive (1.7 x) than black PE. The breakeven labor costs for polyethylene removal vs. the increased cost of the paper varies from $2.35 – $8.75/hr depending on time estimates.

Literature Cited

1. Brooks, D. L., and R. L. Qualls. 1966. Production and marketing of Florida strawberries. *Univ. Fla. Agr. Econ. Mimeo Rpt.* EC67-3.
2. Everett, P. H. 1971. Evaluation of paper and polyethylene-coated paper mulches and fertilizer rates on tomatoes. *Proc. Fla. Sta. Hort. Soc.* 84:124-128.
3. Geraldson, C. M. 1963. Quality and balance of nutrients required for best yields and quality of tomatoes. *Proc. Fla. Sta. Hort. Soc.* 76:153-158.
4. Johnson, R. B. 1971. *Sta. Market New Service, Louisiana Dept. of Agr. Marketing Service.* p. 11.
5. Liptay, L. M., and H. Tiessen. 1970. Influence of polyethylene-coated paper mulch on soil environment. *J. Amer. Soc. Hort. Sci.* 95:395-398.
6. Locascio, S. J., and G. C. Smart, Jr. 1968. Influence of polyethylene mulch color and soil fumigants on strawberry production. *Proc. Fla. Sta. Hort. Soc.* 81:147-153.
7. Thompson, B. D. 1959. Response of strawberries to mulching with plastic. *Proc. Fla. Sta. Hort. Soc.* 72:179-185.
8. Voth, V., R. S. Bringhurst, and H. J. Bowen, Jr. 1967. Effect of bed system, bed height, and clear polyethylene mulch on yield, salt accumulation, and soil temp on California strawberries. *Proc. Amer. Soc. Hort. Sci.* 91:242-248.

Influence of Defoliation at Transplanting on Strawberry Growth and Fruiting Response[1]

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Abstract. **Defoliation of Florida-grown plants of 2 strawberry cultivars at transplanting to simulate leaf desiccation damage which may occur during and after transplanting retarded growth and reduced yields. Fruit no. was linearly correlated with fruit yield while the marketable wt per fruit was unaffected by treatments.**

Strawberry transplants used in the annual hill culture system in Florida are generally locally grown. Variation in fruit yields of these plants occurs frequently even though they are transplanted under apparently similar conditions. One cultural variation in establishing strawbarry transplants is the timing and duration of sprinkler irrigation. Irrigation is provided to reduce the water stress in the leaf caused by the undeveloped root system of the transplant and the high ambient air temp. If irrigation is not provided continuously to the transplants during the daytime stress period, the leaves become desiccated and necrotic, and the transplants are essentially defoliated. New leaves emerge from the crown, but growth and fruiting often appear to be delayed. In Central Florida, earliness is economically important. The purpose of this investigation was to determine the effect of plant defoliation of strawberry plants at transplanting on plant growth and on early and seasonal fruit yields.

The investigations were conducted in 1970-71 and 1971-72 at the Agricultural Research Center, Dover, Florida on a Scranton fine sand which had a pH of 6.1 with 4.5% organic matter. The beds were fumigated, fertilized and black polyethylene mulch applied 3 weeks prior to transplanting local plants in mid-Oct. of each year. Plants were set with 30 x 30 cm spacing on double row beds which were 60 cm wide with 122 cm centers resulting in 5.4 plants/sq m (22,000 plants/acre). Freshly dug local plants of 2 cultivars ('Sequoia', a very vigorous plant in Florida and 'Tioga' a plant of medium vigor) were placed in 2 uniform groups. To simulate loss of leaves caused by inadequate irrigation during and after transplanting, 1 group of each cultivar was defoliated by pruning the leaves 5 to 6 cm above the crown. The defoliated plants and those with normal foliage (control) were set immediately after pruning and uniform overhead sprinkler irrigation was provided during the warmer portion of the daylight hours for 7 to 10 days to prevent defoliation of the unpruned plants. Overhead irrigation was provided as needed throughout the remainder of the season. Plant size was periodically evaluated by considering plant height and leaf area. Fruit was harvested from early Jan. through mid-April once weekly the 1st season and twice weekly the 2nd season. A randomized block, split plot statistical design of 4 replicates with cultivars as main plots was utilized. Statistical analyses of yields were conducted monthly and seasonally.

During both years a few transplants in the control plots lost 1 or 2 of the original 4 to 5 leaves in the first few days after transplanting. However, the control plants were always larger than the defoliated plants (Table 1). Defoliated plants of both cultivars were only 1/2 the size of control plants in the month following transplanting and remained smaller throughout the season. During the 2nd year, plant size difference between the defoliated and control plants was less than that of the previous year. The 2nd growing season was warmer than the first and the higher temperatures may have accelerated the recovery of defoliated plants. Plant growth by control plants was excellent both years. As expected, 'Sequoia' plants within a treatment were generally larger than 'Tioga' plants at any time during the season. Even though large amounts of water were applied after transplanting, leaching of nutrients from under the polyethylene mulch was probably not important since leaf color was excellent at all times.

Significantly more early and seasonal marketable fruit were produced by the control plants of each cultivar for each year (Table 2). The reduced yields during the first season was partially the

Table 1. Size of defoliated strawberry plants relative to foliated plants at transplanting from Nov. to March of each year.

	Plant score[z]			
	Tioga		Sequoia	
Month	1970-71	1971-72	1970-71	1971-72
Nov	5	4	5	6
Dec	5	4	6	6
Jan	5	7	7	7
Feb	5	9	7	9
March	7	9.5	8	9.5

[z]Relative size (plant height and leaf area) of defoliated plants as compared to controls (unpruned plants) rated as 10; the larger plant has a higher no.

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