whereas the pulp when separated from the peel is highly susceptible to molds. This high resistance may be due to the high polyphenol content in the peel.

Considering the overall chemical changes, it was evident that moisture played a very important role in inducing drastic changes in the acidity and sugar content during ripening while the phenol content was the least influenced. These were similar to the changes occurring in the date fruit (20, 21). At the time of harvest the moisture content in different parts of the fruit was around 20%, while the whole fruit had less than 20%. This is a very important parameter for fixing the harvest index. Sometimes the fruit is left on the tree for more than 6 months after reaching the stage of commercial harvest without spoilage. In such cases the moisture may come down below 20%. In any case, the fruit should be harvested when the moisture is lower than 20% to facilitate easy separation of the shell from the pulp. If handpicking (pulling the fruit off the peduncle) is done, 2 or 3 large, lateral fibers with the peduncle may be left on the tree. These fibers may subsequently dry and fall away. Neither leaving the peduncle with the fibers on the tree nor delayed harvesting adversely affected subsequent flowering. Fruiting in tamarind trees takes place in the newly formed branches, unlike mango and many other tropical perennial fruit crops.

Literature Cited

1. Association of Official Analytical Chemists. 1979. Official methods of analysis. 13th ed. Washington, D.C.
2. Bueso, C. E. 1980. Soursop, tamarind and chironja. p. 375–406. In: S. Nagy and P. E. Shaw (eds.). Tropical and subtropical fruits. AVI, Westport, Conn.
3. Coombe, B. G. 1976. The development of fleshy fruits. Annu. Rev. Plant Physiol. 27:207.
4. Cravioto, R. O., G. H. Massieu, T. G. Guzman, and J. Calvo de la Torre. 1951. Composición de alimentos mexicanos. Ciencia 11 (6):129.
5. Fisch, B. E. 1974. The tamarind. Calif. Rare Fruit Grow. Yearbk. 6:221–250.
6. Gopalan, C., B. V. Rama Sastri, and S. C. Balasubramanian. 1977. Nutritive value of Indian foods. Natl. Inst. Nutr., Indian Counc. Med. Res., Hyderabad, India.
7. Hasan, S. K. and S. Ijaz. 1972. Tamarind review. Sci. Ind. (Karachi). 9:131–137.
8. Hernández, M., A. Chávez, and H. Bourges. 1977. Valor nutritivo de los alimentos mexicanos. Inst. Nal. Nutr., México.
9. Hernández-Unzon, H. Y. and S. Lakshminarayana. 1982. Developmental physiology of tamarind fruit (*Tamarindus indica* L.). HortScience 17:938–940.
10. Lee, P. L., G. Swords, and G. L. K. Hunter. 1975. Volatile constituents of tamarind (*Tamarindus indica* L.). J. Agr. Food Chem. 23:1195–1199.
11. Lefevre, J. C. 1971. Revue de la litterature sur le tamarinier. Fruits 26:687–695.
12. Lewis, Y. S., S. Neelakantan, and D. S. Bhatia. 1961. Organic acid metabolism in tamarind leaves. Curr. Sci. 30:381–382.
13. Lewis, Y. S. and S. Neelakantan. 1959. Synthesis of tartaric acid in tamarind leaves. Curr. Sci. 28:152–153.
14. Lewis, Y. S. and S. Neelakantan. 1964. The chemistry, biochemistry and technology of tamarind. J. Sci. Ind. Res. 23:204–206.
15. Lewis, Y. S. and S. Neelakantan. 1964. The real nature of tamarind anthoxanthins. Curr. Sci. 15:460.
16. McCready, R. M. and E. A. McComb. 1952. Extraction and determination of total pectic materials in fruits. Anal. Chem. 24:1986.
17. Morton, J. F. 1958. The tamarind, its food, medicinal and industrial uses. Proc. Fla. State Hort. Soc. 79:355–366.
18. Rao, M. V. L., N. Subramanian, and N. Srinivasan. 1954. Free amino acids in tamarind pulp. J. Sci. Ind. Res. 13:377–378.
19. Robinson, W. B. and E. Stotz. 1945. The indophenol-xylene extraction method for ascorbic acid. J. Biol. Chem. 160:217.
20. Rouhani, I. and A. Bassiri. 1976. Changes in the physical and chemical characteristics of Shahani dates during development and maturity. J. Hort. Sci. 51:489–494.
21. Rygg, G. L. 1946. Compositional changes in the date fruit during growth and ripening. U.S. Dept. Agr. Tech. Bul. 910.
22. Ting, S. V. 1956. Rapid colorimetric method for simultaneous determination of reducing sugars and fructose in citrus juices. J. Agr. Food. Chem. 4:263–266.
23. Whiting, G. C. 1970. Sugars, p. 1–31. In: A. C. Hulme (ed.). The biochemistry of fruits and their products, Vol. I. Academic Press, New York.

HortScience 17(6):942–943. 1982.

Effects of Aluminum-painted and Black Polyethylene Mulches on Bell Pepper, *Capsicum annuum* L.[1]

Wayne C. Porter and William W. Etzel
Louisiana State University, Sweet Potato Research Center, Chase, LA 71324

Additional index words. plant spacing, plant population

Abstract. **The marketable yield of bell peppers grown on aluminum-painted polyethylene was significantly greater as compared to that obtained from diphenamid herbicide or hand-cultivated treatments for 2 years, and black polyethylene for 1 year. Two plants in a hill planted in 2 rows on a bed significantly increased yields over double rows of single plants or single rows of single plants on a bed. Average fruit weight was greater from plants planted in a single row.**

Mulches may increase yield and earliness of yield, control soil moisture and fertilizer leaching, modify soil temperature, and produce higher quality fruit (4, 5). Opaque mulches control annual weeds, while reflective mulches repel aphids and reduce the incidence of aphid-borne viruses such as tobacco etch, potato Y, and cucumber mosaic. These are so epidemic in some areas that bell peppers cannot be successfully grown unless they are on a reflective mulch (2). Black (2) found that under these conditions, aluminum-painted polyethylene (PE) mulch would produce greater yields than black polyethylene, even though the black polyethylene promotes higher soil temperatures. Oebker et al. (7) reported that aluminum-coated paper promoted higher bell pepper yields than black polyethylene-coated paper and the plants showed fewer virus symptoms.

The purpose of this study was to measure the effect of aluminum-painted PE, black PE and diphenamid on yield on peppers where aphid-borne viruses were not apparent. Three plant populations were superimposed on the main treatments and a control.

Main plots were single rows, 122 cm wide and 15.3 m long, replicated 4 times in a randomized block design. Main effects were aluminum-painted PE, black PE, diphenamid at 4.48 kg/ha, and a hoed check. The diphenamid treatment was added as a commercial check. Subplots were 21,518 plants/ha (single row, 38 cm between plants), 43,036 plants/ha (2 rows 30 cm apart, 38 cm between plants in the row) and 86,072 plants/ha (2 rows 30 cm apart, twin plants 38 cm apart in the row).

Fertilizer, at the rate of 56 N, 112 P, and 56 K kg/ha, was broadcast and incorporated before transplanting and the PE mulches are applied. Six-week-old transplants of 'Emerald Giant' bell pepper were set in the field in May 1978 and 1979 and the diphenamid was applied. A side dressing of 37 N kg/ha in the form of ammonium nitrate was applied 4 wks after transplanting. The soil type was a silt loam. Monthly average and extreme temperatures that occurred during both growing seasons are shown in Table 1.

No treatment had a significant effect on average fruit weight (Table 2), however, the average fruit weight was greater in 1979 than in 1978. This was probably due to the greater

[1]Received for publication April 29, 1982.

The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

Table 1. Monthly temperature averages and extremes that occurred during the growing season.

		Temp (°C)			
		Averages		Extremes	
Year	Month	High	Low	High	Low
1978	April	24.9	11.6	27.8	6.7
	May	28.3	17.8	35.5	8.9
	June	31.7	20.6	36.7	18.9
	July	35.0	22.8	37.2	21.1
1979	April	22.8	13.3	26.1	11.1
	May	26.7	16.7	30.6	10.0
	June	31.1	20.6	34.4	14.4
	July	31.7	22.2	36.1	20.0

amount of rainfall in 1979. The plots mulched with aluminum-painted PE produced marketable yields significantly greater than the hoed check in 1978 and with the increased precipitation in 1979, out-yielded all other treatments. Since aphid-borne virus diseases were not a problem, the increased yields in plots of the aluminum-painted plastic was probably due to increased light reflection. The yield increase obtained with the reflective mulch agrees with that reported by Dufault and Wiggans (3) and Oebker et al. (6, 7). There was no difference between the hoed check and the diphenamid-treated plots. The diphenamid plots were hoed once to remove late season weeds.

Table 2. Effect of mulch treatments on fruit size and yield, all spacings combined.

	Avg. fruit size (g fruit)		Marketable yield (MT/ha)[z]	
Treatment	1978	1979	1978	1979
Check, hoed	91a[y]	129a	8.6b	12.9b
Aluminum-painted plastic	75a	120a	11.3a	17.5a
Black plastic	82a	120a	11.0ab	13.2b
Diphenamid (4.48 kg/ha)	95a	129a	9.4ab	12.7b

[z]Includes U.S. size grades Fancy and No. 1.
[y]Mean separations within columns by Duncan's multiple range test, 5% level.

Table 4. Yields of bell pepper as affected by the interaction of plant population and mulch treatment (1978 & 1979 combined).

	Yield (MT/ha)[z]			
Density (Plants/ha)	Check	Aluminum Painted plastic	Black plastic	Diphenamid
21,518	7.5	11.9	9.5	7.9
43,036	10.3	12.9	12.2	10.6
86,072	14.3	18.3	14.7	14.6
LSD 5%	NS	NS	NS	NS

[z]Includes U.S. size grades Fancy and No. 1.

Table 3. Effects of plant spacing on fruit size and yield, all mulch treatments combined.

	Avg/fruit size (g/fruit)		Marketable-yield (MT/ha)[z]	
Density (plants/ha)	1978	1979	1978	1979
21,518	100a[y]	139a	8.0b	10.2c
43,036	82b	123b	8.7b	13.8b
86,072	82b	120b	12.9a	18.2a

[z]Includes U.S. size grades Fancy and No. 1.
[y]Means separation within columns by Duncan's multiple range test, 5% level.

Average fruit weight was significantly greater at the lowest plant population for both years (Table 3). There was no difference in fruit weight for the double row treatments. Marketable yields were significantly higher in both years at the highest plant population (Table 3). In 1979, the marketable yields increased significantly from one population to the next. Batal and Smittle (1) achieved increases in yield with population increases from 27,000 plants/ha to 40,000 plants/ha, but not at 60,000 plants/ha; however, their plantings were on bare soil and had a different spatial orientation. There was no significant mulch × spacing interaction, but the data (combined for both years) indicated that the aluminum-painted PE promoted higher yield at all plant populations (Table 4).

The results of these experiments indicate that bell peppers grown on a silver reflective plastic mulch will produce greater yields than plants grown on black plastic or bare ground plots. This increase was found even when aphid-borne viruses were not an apparent problem. The increased yields were probably due to increased light (PAR) reflection of the aluminum-painted PE. The double row of twin plants may not be a practical planting arrangement, however, it does indicate that the upper limit for plant populations under our growing conditions is greater than those currently used.

Literature Cited

1. Batal, K. M. and D. A. Smittle. 1981. Response of bell pepper to irrigation, nitrogen, and plant population. J. Amer. Soc. Hort. Sci. 106:259–262.
2. Black, L. L. 1980. 'Aluminum' mulch: less disease, higher vegetable yields. La. Agr. 23(3):16–18.
3. Dufault, R. J. and C. Wiggans. 1981. Response of sweet peppers to solar reflectors and reflective mulches. HortScience 16:65–67.
4. Gerald, C. J. and G. Chambers. 1967. Effect of reflective coatings on soil temperatures, soil moisture, and the establishment of fall bell pepper. Agron. J. 59:293–296.
5. Hopen, H. J. and N. F. Oebker. 1976. Vegetable crop responses to synthetic mulches—an annotated bibliography. Ill. Agr. Expt. Sta. Special Pub. 42.
6. Oebker, N. F., U. Barr, and H. J. Hopen. 1974. Experiences in mulching pepper and lettuce. HortScience 9:158. (Abstr.).
7. Oebker, N. F., F. Harper, and A. D. Halderman. 1973. Plastics and early pepper production in Arizona. Proc. Nat. Agr. Plast. Conf. 11:200–209.