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# PLASTIC AND HAY MULCHES FOR TROPICAL FRUIT CROPS: OBSERVATIONS AND ECONOMICS

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***Abstract.***

Plastic and stable hay mulches were used in newly planted avocado, mango, and papaya groves. Drip irrigation, and sprinkler irrigation were installed with the plastic mulch and the stable hay, respectively. Good tree growth and excellent weed control were obtained with the plastic mulch. There was unsatisfactory weed control with hoeing or hay mulching. Weed control adjacent to the plastic strip and around the tree hole was obtained with herbicide and fiberglass mats, respectively. Major causes of mulch deterioration were unnecessary walking on the mulch during drip irrigation installation and planting, and the careless handling of equipment while moving, digging tree holes, and cultivating. When emitters discharged water on the plastic mulch rather than on the tree hole due to shifting by pipe contraction water failed to reach tree roots. Costs of laying the plastic and stable hay mulches and hoeing are discussed.

Because of the very high cost of hoeing and the shortage of laborers, fruit growers are using herbicide and mechanical means to control weeds in orchards. In newly planted orchards, middles are cross disked and straw mulch is used around trees for the first year or two. Some growers prefer to use Paraquat applied with a hand gun. However, cross disking is not possible where crops are interplanted or where micro irrigation is used unless pipes are buried. Considerable leaf and stem burning of the main and interplanted crops usually results when Paraquat is used, even with hand applications. This is especially true with papayas. Papayas are usually interplanted in the new groves at Kendall Foods to help pay the expenses of new groves.

Table 1. Grove information (1975-76).

| Grove | Main crop | Spacing (feet) | Crop interplanted in row | Spacing (feet) | Weed control method |
|---|---|---|---|---|---|
| A | Avocados | 18x24 | Papayas | 6x24 | Hoeing and hay mulch |
| B | Mangos | 12.5x30 | Papayas | 4x30 | Hoeing and hay mulch |
| C | Mangos | 12.5x30 | Papayas plus papayas in separate rows | 4x30<br>6x30 | Black plastic (1.5 mil) and fumigant |
| D | Avocados | 18x24 | None | — | White plastic (3 mil) and fumigant |

Table 2. Costs of weed control (1975-76).

| Grove | Crop | Method | Weed Control | Cost (dollars) per acre | per 100 feet | per tree |
|---|---|---|---|---|---|---|
| A & B | Avocados & papayas | Hoeing | Poor | 280.88[x, y] | 18.59[x, y] | 0.90[x, y] |
| A & B | Avocados & papayas | Hay | Poor | 211.00[x] | 14.51[x] | 0.80[x] |
| C | Mangos & papayas | Plastic mulch | Good | 50.10 | 3.81 | 0.16 |
| C | Mangos & papayas | Plastic mulch & fumigant | Good | 81.61 | 6.21 | 0.26 |
| C | Separate papaya rows | Plastic mulch | Good | 100.20 | 7.62 | 0.47 |
| C | Separate papaya rows | Plastic mulch & fumigant | Good | 163.22 | 12.42 | 0.94 |
| D | Avocados | Plastic mulch | Good | 98.79 | 5.44 | 0.98 |
| D | Avocados | Plastic mulch & fumigant | Good | 156.32 | 8.61 | 1.55 |

[x]Mean for both groves.
[y]For 6 months only.

Plastic mulches increase yields of several crops and are very effective in preventing weeds, fertilizer leaching, and are also used to fumigate the soil (2, 5, 6). Breclell (1) found that vigor, volume, and yield of mulched trees were better than those of unmulched trees and also obtained excellent moisture conservation and weed control. Several authors found higher soil temps inside than outside the plastic strip (3, 4).

The effectiveness and cost of different weed control methods and some observations on plastic mulches used with drip irrigation are reported in this paper.

## Materials and Methods

After soil preparation, main and submain pipes were installed. The drip system was used in plastic mulched groves. Eight to ten inch high beds were formed with a bedding machine before the 5 feet plastic mulch was laid. Soil fumigation by chisels and plastic mulching were clone simultaneously using a machine. MC-33 (67% chloropicrin and 33% methyl bromide) at 200 pounds per acre was the fumigant. Then drip laterals were laid on top of the plastic. Trees were planted after burning 8 and 12 inch circles for papayas, and for avocados or mangos respectively. One Vortex emitter was placed by each tree. Other pertinent grove information is given in Table 1. Note that in grove C there were separate papaya rows at 15 feet from the mango rows in addition to papayas interplanted in the mango rows. Soil and water temps were also taken.

## Results and Discussion

*Economics and Other Observations.* Hoeing and hay mulching were very expensive because of the hand labor involved (Table 2). Interplanting papayas decreased costs of weed control. Hay mulching also required equipment to load, unload, and transport the hay. Hoeing data are for only 6 months. With both hoeing and hay mulching, weeds grew back fast because of rains and irrigation. Wild oats and other grasses were growing a short time after the stable hay was laid. Fifty avocado and 100 papaya trees in grove A were burned when arsonists set several nay mulched rows afire in an effort to drive away the large number of flies associated with stable hay.

Plastic mulches without or with fumigation were very effective in weed control. MC-33 was applied because all plastic mulched groves were set in old lemon orchard land. The

use of MC-33 to control weeds and pathogens is a standard and very effective practice among strawberry and vegetable growers. Fumigation is expensive but preliminary information with avocados in Dade County indicates that it may be a very sound practice.

Deterioration of the plastic mulch was much more related to grove care practices than to mulch color or thickness. The elimination of large rocks, roots, and stems was very helpful in minimizing rips on the plastic mulch. Some damage to the plastic strips was done by the unnecessary traffic of workers during the installation of sprinkler pipes and drip laterals, by the tree hole digger, and by the crew planting trees. Considerable damage was observed when the disk operator disked too close to the plastic and during turns. All equipment operators should be warned to stay away from the plastic.

Weeds adjacent to either side of the plastic strip (out to 1.5 feet from it) were controlled by spraying Paraquat with an enclosed boom to prevent drift. Only the two outside nozzles were used. Eight and f6 inch fiberglass mats for papayas, and mangos or avocados respectively were placed around tree holes to prevent weed growth. Two by two feet inexpensive, perforated plastic mulch mats could have been used as effectively. It must be emphasized that herbicide weed control adjacent to the plastic strips *is essential* as no mechanical means can be used without damaging the plastic. Two by six perforated plastic mats could control weeds around the tree area while Paraquat could be used to control weeds between plants if growers do not want to use a continuous plastic strip.

*Irrigation and Plastic Mulches.* Using one emitter per tree, though enough for newly set trees was not advisable. Two emitters per tree are safer as if one emitter clogs, the second can still provide water. Pipe contraction caused emitter shiftment which in turn resulted in water discharge on the plastic. Using two emitters per tree and sigzagging the drip lines should diminish this problem. Laying lines under the plastic is difficult and makes maintenance check up for emitter clogging a very expensive and difficult task. The best method to avoid water discharge on the plastic, regardless of shifting, is to perforate the plastic strip entirely or partially with a spiked roller before planting. In our case, a pitchfork was used to perforate the plastic 2 to 3 feet around the tree hole area.

Daytime irrigation when using plastic: strips, regardless of plastic mulch color, and especially in the hoi summer days, can result in death of trees due to excessively high water temperatures. About 40 avocado trees were lost in scattered rows during daytime drip irrigation in the plastic mulched groves. The affected trees were always the farthest 4 or 5 from the beginning of the drip line. Also, in most of the affected trees, emitters were discharging directly against tree trunk or very close to it.

Soil and water temps were taken at different distances from the well, and from the beginning, midway, and end of the exposed drip lines (Table 3). Note that the longer the exposed drip line the higher the temperature. During daytime irrigation, even with short distances of exposed pipes (50-100 feet), tree death resulted. It is thought that backflow of water created at the end of drip lines 'has a radiator effect thus increasing water temperature, if air temperature is hot enough, and this in turn "burned" the stem at the crown. Affected trees looked yellowish and wilted. When this point was reached, trees eventually died. At the beginning of the drip line this does not happen because

discharging emitters down the line keep the water cool. The overheated water problem was solved by watering at night.

Table 3. Water and soil temperatures during daytime drip irrigation.

| Grove | Color of plastic | Lenth of unexposed pipe (feet) | Length of exposed pipe (feet) | Water temp.* (F°) | Soil temp. close to emitter* (F°) |
|---|---|---|---|---|---|
| A | White | 220 | 10 | 80 | — |
| | | 220 | 140 | 100 | — |
| B | Black | 175 | 6 | 78 | 82 |
| | | 175 | 138 | 88 | 86 |
| | | 175 | 242 | 106 | 100 |
| B | Black | 2020 | 6 | 78 | 80 |
| | | 2020 | 138 | 90 | 88 |
| | | 2020 | 242 | 104 | 98 |
| B | Black (white washed) | 2050 | 6 | 78 | 79 |
| | | 2050 | 138 | 88 | 88 |
| | | 2050 | 242 | 106 | 100 |

*Date: October 19, 1976; 2 P.M.; air temperature 90°F.

Soil temperature inside the plastic was 88°F and 82°F in bare soil when air temperature was 90°F.

Plastic mulch in fruit crops should be used more extensively because of the inexpensive and excellent weed control obtained.

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