INCREASING YIELDS OF BELL PEPPER, CUCUMBER, AND TOMATO WITH PLASTIC ROW COVERS AND PLASTIC MULCH[1]

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The highest yields for bell pepper (1974-75), cucumber (1974-75) and tomato (1974) were obtained with a plastic row cover plus clear plastic mulch. Row covers alone significantly increased yields of bell pepper and cucumber but not tomatoes. Generally, the largest increases occurred during the first half of the harvest period. Yield increases were probably due to wind protection and increased air temperatures provided by the row covers and higher soil temperatures generated by the clear plastic mulch.

INTRODUCTION

Yields of six vegetables were increased 19-100% by increasing soil temperatures with heating cables (9). Clear plastic mulches have successfully increased crop yields in cool areas by raising soil temperatures (6,8). Yields have also been increased in windy areas by windbreaks (4,7). Plastic row covers increased bell pepper, cucumber and tomato yields in California because of their wind break properties and also the warmer environment which they provided (1,2,3).

Winter yields of warm season crops are often depressed in the cool and usually windy winter season in the Waimea vegetable growing area which is at an elevation of 800 m. The objective of this study was to increase the yields of bell pepper, cucumbers and tomato from cool season plantings with plastic mulch and/or row covers.

MATERIALS AND METHODS

Transplants of bell pepper (cv. Keystone, 1974, and Yolo Wonder, 1975) and tomato (cv. University of Hawaii N-65, 1974-75) and plantings of cucumber (cv. Force Beauty, 1974, and Burpee Hybrid, 1975) were made in the cool season of February-March at an 800 m elevation on a Waimea silt loam soil. The mean low and high daily temperatures were 12 and 22° respectively. Treatments consisted of a plastic row cover with and without a clear plastic mulch on the floor of the row cover. The experiment was arranged as a randomized complete block with four replications. Data were analyzed by the Duncan's multiple range test at the 5% probability level. Yield data consist of total salable weight/m of row partitioned into harvest I, harvest II and total harvest. Harvest I consisted of the first harvest month for tomato and cucumbers and the first three weeks (1974) or 6 weeks (1975) for pepper. Harvest II consisted of the second month of harvest for cucumber, weeks 5-9 for tomato and weeks 3-6 (1974) or weeks 6-11 (1975) for pepper. Air temperatures were taken at a 15 cm height and soil temperatures were taken at a 7.5 cm depth on a clear sunny day with a slight breeze.

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Plastic row covers are constructed by placing rigid wire hoops (7 gauge) every 1.5 m supported by a post every 3 m; two horizontal wires (14 gauge) are attached to the hoops - one is fixed while the other may be moved up or down one side of the hoop to allow spraying of chemicals within the row covers. Transparent plastic of 90 cm width and 0.038 mm thickness is attached to a horizontal wire with spring type clothes pins; the other edge is buried in the soil. The resultant structure is 65 cm high and 80 cm wide. The plastic mulch treatments utilized the same plastic described above; the edges were buried in the soil and holes were made for the plants. Fertilizer was applied preplant and also through the drip irrigation system.

RESULTS AND DISCUSSION

The use of plastic row covers resulted in significant bell pepper yield gains in 1974 and 1975 (Fig. 1). Yields of 1.09 vs. 0 kg/m of row in 1974 and 3.3 vs. 1.3 kg/m of row in 1975 were obtained with the row cover vs. no row cover treatment. The highest yields (1.53 and 5.2 kg/m of row) were obtained with the row cover plus plastic mulch treatment. The plastic mulch treatment provided a significant yield increase in 1975 but not in 1974. The greatest yield increases for both row cover and plastic mulch occurred in Harvest I.

Row covers significantly increased total cucumber yields in both trials (17.8 vs. 4.4 kg/m of row in 1974 and 25.6 vs. 22.5 kg/m of row in 1975, Fig. 2). Again, the highest yields (19.3 and 27.1 kg/m of row) occurred in the plots with row covers and plastic mulch. The plastic mulch increased yields significantly in 1974 but only marginally in 1975.

Row covers did not provide significant tomato yield increases (Fig. 3). However, in 1974, the row cover plus plastic mulch provided a significant yield increase over no row cover treatment (16.5 vs. 10.5 kg/m of row). In 1975, the row cover treatments yielded higher in the first harvest month; however, production of the no row cover treatments caught up with the row cover treatments in Harvest II.

The row cover treatments were higher, though not always significantly, in Harvest I than the no row cover treatments for all six trials. There were no significant yield increases in Harvest II due to row covers although yields were slightly higher in five of the six trials. The plastic mulch treatments yielded higher in five Harvest I trials but only two of these increases were significant. Plastic mulch had no effect on yields in Harvest II.

The row covers provided wind protection for the young plants. In 1974, the wind was so severe that nearly all unprotected pepper plants were damaged. In 1975 the plots were located nearer to the windbreak; as a result the wind was less of a factor in yield differences. This was the probable reason for a tomato yield increase in 1974 but not in 1975 with the use of a row cover. It should be pointed out that although the row covers are flimsy in construction, their low profile allows the tolerance of high winds.

The obvious benefit of a row cover or a plastic mulch is to increase temperature. The air temperature at a 15 cm height increased from 4^{o} to 7^{o} with the use of a row cover on a clear sunny day with a slight breeze at 1:00 P.M. The row covers did not significantly affect the soil temperature; however, the mulch treatments increased soil temperatures 5^{o} to 8^{o} at 1:00 P.M. on a clear sunny day. It is consistent with Rykbost et al (1975) and

Knott (1962) that these higher temperatures should result in yield increases, especially during cool weather when temperatures are suboptimal for maximal yields.

Peppers displayed two added positive effects from the row covers. A decreased incidence of an insect transmitted mosaic disease was found on peppers in row covers. Shortly after row covers were either blown down or removed, portions of the pepper fruit turned a purple color. The purpling symptom appeared to be only a short term shock effect since the plants began producing normal fruits again after several weeks. The purpling did not affect the post-harvest quality of the fruits.

Plastic row covers should be especially well suited for growing warm season crops in cool tropical areas since the grower will gain added crop flexibility without applying an external heat source or constructing permanent and expensive greenhouses. It is probable that row cover construction may be modified somewhat to act as a rain shelter in wet tropical areas.

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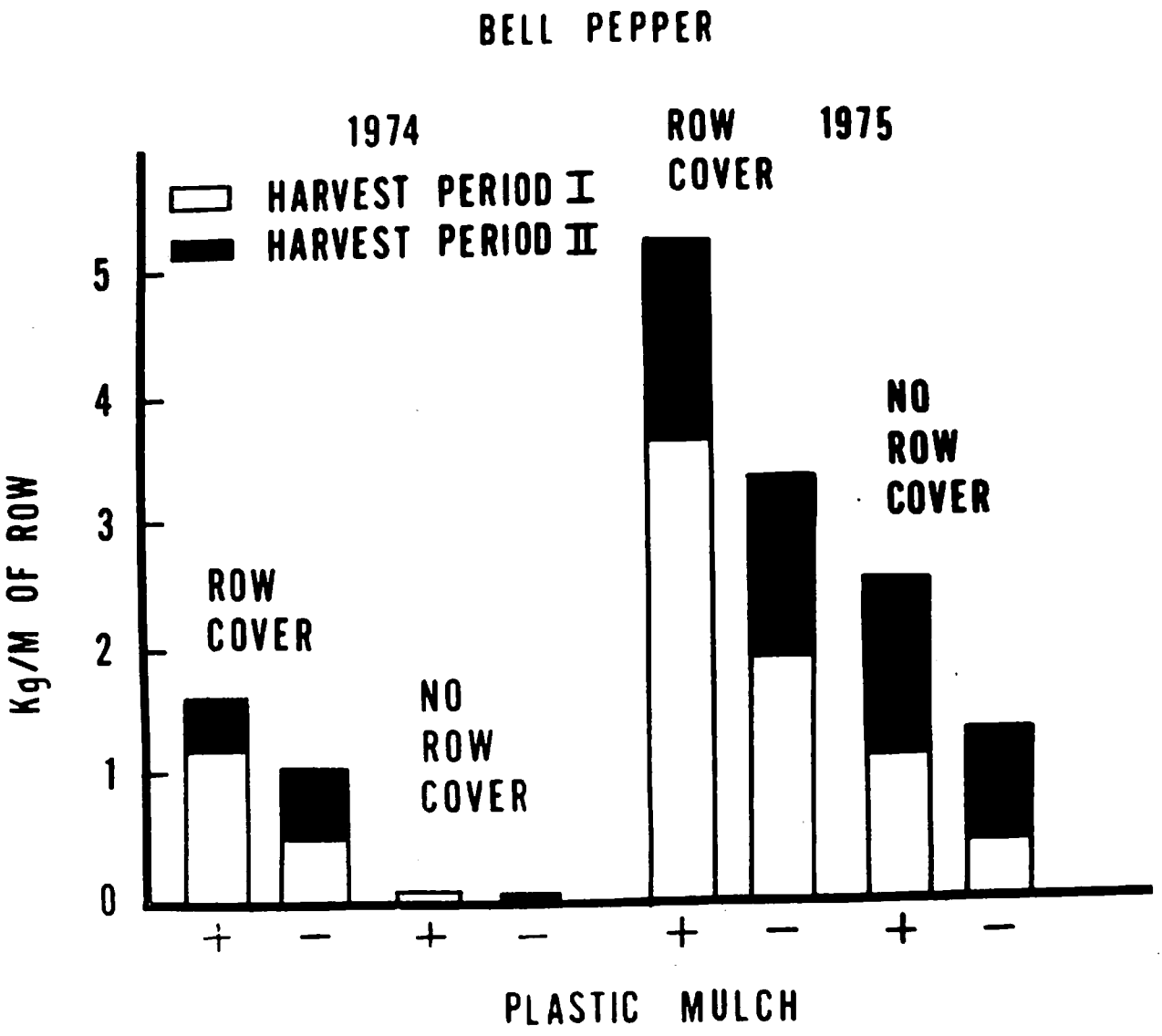

Figure 1. The influence of plastic row covers and plastic mulch on bell pepper yields.

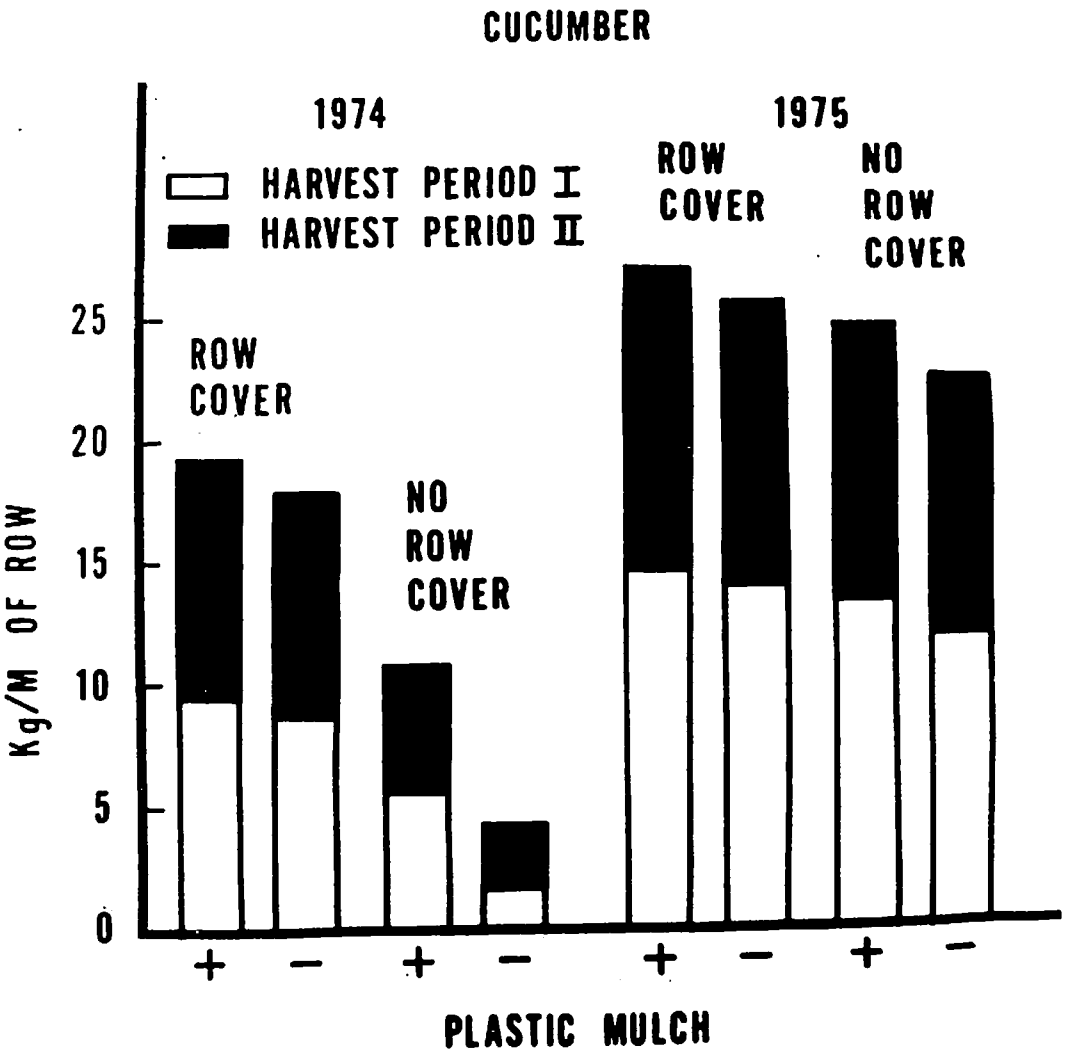

Figure 2. The influence of plastic row covers and plastic mulch on cucumber yields.

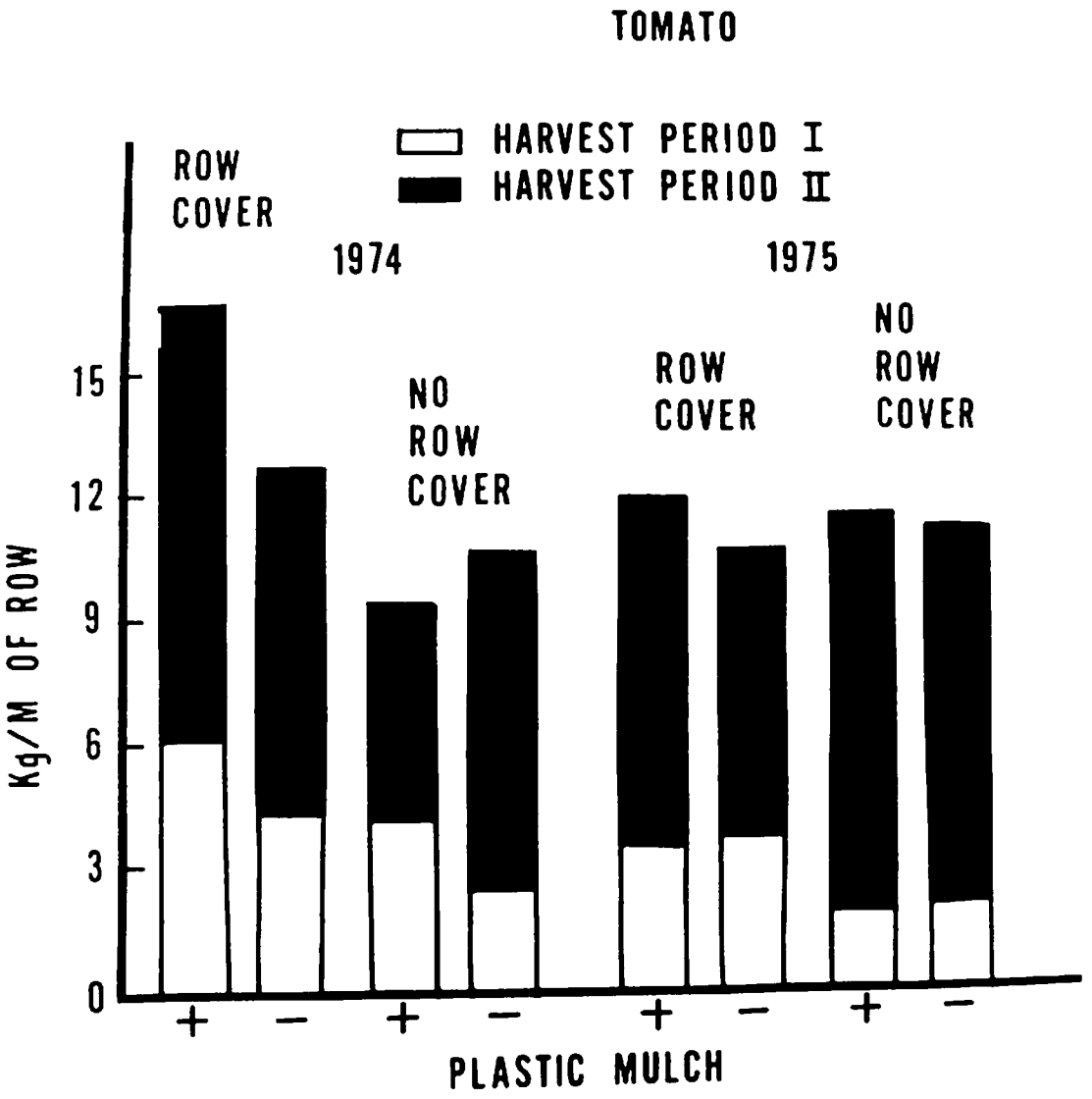

Figure 3. The influence of plastic row covers and plastic mulch on tomato yields.