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EFFECT OF BLACK PLASTIC MULCH ON CUCUMBER YIELDS, WATER USE AND ECONOMIC RETURNS

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ABSTRACT

The effects of black plastic mulch on the cucumber (cv. Victory) yield, water use and economic returns were evaluated in a field experiment with three replications. Mulched plots produced higher marketable yields (34.1 tons/ha vs. 27.8 tons/ha), and used less water (674 m3/ha vs. 894 m3/ha) than plots without mulch. An economic analysis indicated that the cost of mulching was more than compensated for by increased yields and reduced costs for weed control and water use. The economic analysis also revealed that net returns of approximately $20,020 and $13,110 per hectare can be obtained from mulched and unmulched plots, respectively.

RESUME

INCIDENCE D'UN PAILLAGE PLASTIQUE NOIR SUR LA PRODUCTION D'UNE CULTURE DE CONCOMBRE, SUR LES BESOINS EN EAU ET LE BILAN ECONOMIQUE

A partir d'un essai au champ conduit sur trois répétitions, l'impact sur la production du concombre (cv. Victory) d'un paillage plastique noir est étudié à la fois du point de vue des besoins en eau mais aussi des retombées économiques. La production commercialisable des parcelles paillées est plus élevée (34,1 T/Ha contre 27,8 T/Ha) avec une consommation d'eau moindre (674 m3/Ha contre 894 m3/Ha). L'étude économique montre que le coût du paillage est compensé largement par l'augmentation de production, et la réduction des frais pour le désherbage et la consommation en eau. L'étude économique a montré également que le revenu net obtenu était d'environ 20 020 $ et 13 110 $ par hectare respectivement pour les parcelles avec paillage et sans paillage.

INTRODUCTION

Next to tomatoes, the other most important and most popular vegetable crop in the U. S. Virgin Islands is the cucumber *(Cucumis sativus L.)*. Cucumbers have very strong appeal to farmers because of their excellent qualities as a cash crop : they are hardy, very prolific and it takes only a very short period of time for most commercial varieties to produce a crop. The market demand for cucumbers is almost always very good. Another advantage of the cucumber over other vegetable

crops, is its storing characteristics. Cucumbers can retain its superior food quality longer than most vegetable crops. As a vegetable, cucumber is very versatile. It is often used raw in salads, in sandwiches and for garnishing other foods, but it can also be eaten cooked like squashes.

The tropical climate of the U.S. Virgin Islands allows the production of cucumbers through out the year. Many local farmers do in fact produce cucumbers year around. But the market as well as growing conditions existing during parts of the year do not seem to show that growing cucumbers year around is economically sound. There are indications that farmers might find it more advantageous to raise other

alternative crops particularly during the late Spring and the Summer periods. Imported vegetables principally from the Mainland United States during this time, caused the prices of most fruit vegetables to fluctuate downward. Also the lack of rain during the same period usually forced farmers to use more water (an expensive commodity in the U.S. Virgin Islands) for irrigation which increased cost of production.

This study is being conducted to determine water use with and without mulch during the year, and to estimate the economic returns from year around cucumber production. The data reported here were taken only from the first planting.

MATERIALS AND METHODS

The study was conducted at the University of the Virgin Islands Agricultue Experiment Station on St. Croix. The soil at the experiment station has been classified as Fredensborg clay loam. This series consists of well-

drained soils formed over limestone or marl (Rivera et al. 1970). The annual average rainfall is 113 cm and the average temperature is approximately 26° C. (Jordan 1975 and Rivera et al. 1970).

The treatments were mulched (1 mil black plastic) and non mulched plots. Each treatment consisted of four 8 m rows spaced 152 cm apart. Planting distance in the row was 46 cm. The treatments were arranged in a randomized complete block design with three replications.

The irrigation system was installed three days before planting. Main lines and submains of the system were 15 mm polyethylene hose. The laterals were 15 mm Bi-wall tubing with laser-drilled orifice 46 cm apart (Hardie Irrigation). Irrigation for each plot was automatically controlled by an electric tensiometer with a moisture level selector (Irrometer Company). The moisture level was set at 30 centibars which allowed the system to be turned on when the soil moisture level rose above 30 centibars and shut off when the moisture level dropped below 30 centibars.

Cucumber seeds (cv. Victory) were direct seeded on February 05, 1989. Three weeks after planting 12-12-12 fertilizer was applied by hand at the rate of 138 kg/ha.

Pest were controlled by bi-weekly spraying of Diazinon until a week before harvest. Kocide was applied once a month as a preventive measure against fungus diseases. During the harvesting period, pests were controlled by weekly spraying of Dipel *(Bacillus thuringiensis var kurstaki)*.

The first harvest was done on April 6th, approximately 60 days after planting. Fruit were harvested every two days. A total of nine different harvests were made. At harvest the weight and the number of marketable fruits were recorded. During each harvest, a survey of whole sale market prices for cucumbers was undertaken.

RESULTS AND DISCUSSIONS

Effect of mulching on yield and water use. Differences were observed in the yields and water use of mulched and unmulched plots (Table 1).

The results also showed that the estimated overall cost of production and predicted net return were also affected by mulching (Table 2). An average yield of 34.07 tons per hectare were obtained from mulched plots. Unmulched plots produced an average yield of 27.80 tons per hectare.

Table 1 : Effect of mulching on yield, water use and net return

	YIELD	WATER USE	NET RETURN
Mulch Plots	34.07 Tons/ha	674.19 m/ha	$20, 020.40
Non Mulch Plots	27.79 Tons/ha	893.8 m/ha	$13, 109.80

Table 2 : Economic analysis of mulched vs non-mulched plots

	MULCH PLOTS	NON MULCH PLOTS
Yield	34. 07 Tons/ha	27. 80 Tons/ha
Gross Returns ($1. 24/kg)	$37, 477	$30, 580
Production cost		
Land prep.	812. 00	812. 00
Seedlings	1302. 00	1302. 00
Mulching	1850. 00	
Fertilizing	1313. 00	1313. 00
Pest. Appli.	2121. 00	2121. 00
Water Cost	2484. 600	3305. 99
Irrigation Equip & Inst.	2222. 00	2222. 00
Subtotal	$12, 104. 60	$11, 076. 00
Labor cost $5. 00/hr		
Weeding		1522. 50
Tilling		505. 00
Harvesting	3030. 00	2472
Subtotal	$3, 030. 00	$4, 499. 50
Packing and Handling		
Boxes	1212. 00	989. 00
Packing	1110. 00	905. 72
Subtotal	$ 2, 322. 00	$ 1, 894.72
Total Cost	17 456. 60	17 470. 20
Net return	$20, 020. 40	$13, 109. 80

The beneficial effect of mulching on plant growth an yield is a common knowledge. Conserving moisture and controlling weeds are the two main advantages of mulching (Bhella 1984 and Ashworth 1983). In the temperate region, one other advantage of mulching is in minimizing loss of heat to the atmosphere and increasing soil temperature (Bonanno and Lamont 1987, Blatt 1984 and Bhella 1988). In the present study, the greater yields from the mulched treatment can not be attributed to more optimum moisture condition since the irrigation was supplied on plant demand or on depletion of soil moisture beyond a predetermined level. Also, soil temperature was not a factor. The soil temperatures between the two treatments were relatively the same. The difference in the yield performance between the two treatments was more likely been brought about by the disturbance of the root systems of the plants in the unmulched treatment during weeding. No weeding was done on the mulched plots and therefore the plants were spared the kind of root disturbance in the unmulched plots.

Compared with the unmulched plots, there was a lower rate of moisture evaporation from the ground surface among the mulched plots as indicated by the lower total crop water use (Table 1). The influence of mulching in conserving moisture by minimizing moisture loss by evaporation from the ground surface has been documented in a number of studies (Bonanno and Lamont 1987, Renquist et al. 1982 and Wien 1988). In addition, weeds growing around the plants cause considerable loss of moisture by transpiration (Blatt 1984 and Bonanno and Lamont 1987). Since mulching controlled weeds efficiently, loss of water through transpiration by weeds is negligible.

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