caribbean food crops society

17

Seventeen Annual Meeting

November 1981

VENEZUELA

Vol. XVII

STUDIES ON SOIL MANAGEMENT FOR THE DRY AND WET SEASON PRODUCTION OF CABBAGE (Brassica oleracea cv. capitata) IN TRINIDAD

J. Tumuhairwe and F.A. Gumbs

Department of Soil Science
University of the West Indies
St. Augustine
Trinidad.

ABSTRACT

In the wet season cabbages were grown with and without bagasse mulch and with four different bed layouts to improve drainage. The bed layouts were Raised-Flat Beds, Cambered Beds, Single-Row Ridges and Double-Row Ridges. Mulching increased average cabbage head weight and total marketable yield on Raised-Flat Beds and on Cambered Beds but the differences were not significant. Ridges produced better yields than Flat or Cambered Beds but the differences were not statist ca ly significant.

In the dry season the yield of cabbage was studied with and without mulches and irrigation. Four mulch materials (bagasse, bay leaves, coffee husk and dry grass) and two irrigation levels (irrigation at 3 and 7 day intervals) were used. Both irrigation and mulching significantly (P = 0.01) increased plant growth and yield above the control. There was no significant difference between two levels of irrigation and coffee husk gave the highest yield.

INTRODUCTION

There are several problems associated with the all year production of vegetables in Trinidad. Some of these problems are caused by the nature of the distribution of rainfall during the year. Climate in Trinidad is characterised by a strong dry season from about January to Abril or May and a predominantly wet season from about May to December. The rainfall is intense from June to August and after a short (two or theree weeks) drier spell in September or early October, the rainfall intensifies during the remainder of the year. Since most of the vegetables are produced on low lying solis of the Flood Plains in Trinidad, excessive moisture in the wet season and moisture deficiency in the dry season limit crop produc-

tion on most of the soil types. Soil management techniques are required to overcome the water relations problemas in the wet and dry season.

Cabbage, and important vegetables in the Caribbean, is often grown on low lying soils which are subjected to flooding or waterlogging. In Trinidad severe losses are incurred when cabbage fields are flooded but no quantitative assesments of the effects of waterloggins or duration of flooding on cabbage yields have been made. Higashi et al 1967 found that cabbaage is better adapted to waterlogget ("paddy") conditions than many other vegetables but soils with less than 20% oxygen cause poor germination, root deterioration, yellowing and wilting. Pests and diseases are also serious limitations to cabbage production (Thompson and Kelly, 1957). In the wet season in Trinidad cabbage is particulary vulnerable to pests e.g Diamond-back moth (Plutella maculipennis) and cabbage bud-worm (Hellula phiditealis), and to diseases e.g. black leg (Phomal lingam) and black rot (Xanthomonas campestris).

Cabbage is a cool zone crop and its production in the tropics is often limited by the higher temperatures of the tropics and particularly the high night temperatures in the wet season in Trinidad.

The yield of cabbage and the production by farmers are higher in the dry season. Inadequate water supply, high temperatures and high evapotranspiration are some of the main limitations to crop production. Cabbage is particularly sensitive to drought conditions. The plan's water requiring more than 50% soil available water throughout its growth (Villum and Flocker, 1967; Nieuwhof, 1969).

These problems in the wet and dry seasons lead to low annual cabbage production, irregular or variable supply and large fluctuations in the market price. To overcome some of these problems fertilizer and pest control inputs are high and many farmers restrict their crop to the times of the year when the conditions are more suitable.

Improved soil management techniques are needed to reduce waterlogging in the wet season and to conserve or make more water available in the dry season. In this study the yields of cabbage on different bed layout in the field in the wet season and with irrigations and mulches in the dry season is measured with the

aim of evaluating soil management practices suitable for the production of cabbage throughout the year.

MATERIALS AND METHODS

SOIL: The trials were carried out on St. Augustine loam an Orthoxic Tropudult (Smith 1974). The soil is of low fertility and has free internal drainage.

Wet Season Trial: There were four bed layouts

(i) Single-Row Ridges
(ii) Double-Row Ridges
(iii) Raised Flat Beds (2.7 metres wide)
(iv) Cambered Beds (9.1 metres wide)

with and without bagasse mulch (4 cm thick). The trial was replicated 3 times and laid out as a split-plot design with bed layouts as main plots and mulching as sub-plots.

The planting, fertilizer use and plant protection recommemdations of Ganpat (1973) and Charles (1976) for both nursery and crop management were followed.

Cabbages were harvested and weighed as they became mature. Total cummulative yield and the yield at the time of harvesting the first set of mature plants were measured.

Dry Season Trial: Two irrigation frequencies, irrigation at 3 and 7 day intervals (W_2 and W_1 respectively) and a control and four mulch materials about 4 cm thick.

(i) Bagasse (B_g) approximately 1 year old;
(ii) Bay Leaves (B_l) from which bay oil had been extracted one month previously;
(iii) Coffee husks (C_h) - approximalety 2 years old;
(iv) Dry grass (G_r) - three months old;

were used. The trial was laid out as a Split-Plot design with irrigation levels as main plots and mulch treatments as sub-plots. The trial was replicated three times.

Cabbages were harvested and weighed as they matured and total cummulative yields were compared.

Variety Kono Cross was used in both wet and dry season studies.

RESULTS AND DISCUSSION

Wet Season Trial.

The average weight of cabbage heads (g/plant) and total marketable yield (tonnes/ha) on mulched and unmulched plots of the different bed layouts are presented in Table 1.

Mulching did not significantly affect the average head weight nor the total marketable yields. Mulching however, reduced the variation in yield on the different bed types. Without mulch the differences in average head weight and total marketable yields between Double-Row Ridges and Cambered Beds (the layout with the highest and lowest yields, respectively) were 148 g/plant and 3.2 tonnes/ha, respectively. With mulch these differences were reduced to 78 g/plant and 1.67 tonnes/ha, respectively.

Average head weight were highest on Double-Row and Single Row Ridges with and without mulch but these were not significantly higher than the head weights on Raised-Flat Beds nor on Cambered Beds. Double-Row Ridges produced the highest total marketable yields on both mulched and unmulched plots but these were however not significantly higher than the yields on the other bed types. Although there was very little difference between average head weight o n Single-Row and Double-Row Ridges, Double-Row Ridges yielded (2.6 tonnes/ha) or 21.5 percent more marketable yield than Single-Row Ridges. This was the results of the larger number of plant per hectare in the former than the latter.

Cambered Beds had the smallest average head weights and only Single-Row Ridges had a smaller, although non-significant, total marketable yield. The plant sizes were very variable across the cambered beds with the plants close to the drain edges being very small. Some of these plants did not head at all and this contributed to the poorer yields. Cabbages on Cambered Beds mature 2 to 3 weeks later than those on the other bed types. Plans on Duoble-Row Ridges matured earliest. This bed layout had the highest porcentage of mature plants at first harvest.

Dry Season Trial

The average head weight and total marketable yield of cabbage are presented in Table 2. Both irrigation and mulches significantly (P=0.01) increased yield. Irrigation at 3-day and 7-day intervals (W_2 and W_1) both produced significantly (P=0.01) higher yoields than the control but there was no significant difference between the two levels of irrigation.

Of the mulch treatments, yields were highest with coffee husks and lowest with bagasse mulches on plots irrigated at both W_2 and W_1 levels. The reverse was however true on non-irrigated (W_0) plots. Yields on plots mulched with dry grass and bayleaves were intermediate.

Chemical analyses showed that mulches increased soil pH and soil potassium but decreased total soil nitrogen. Only the increase in soil K was significant (P=0.001) and the soil K with coffee husks as mulch was significantly higher (P=0.001) than other mulch treatments.

The mulches did not have a significant effect on the mean soil moisture content. Soil moisture contents were higher at all depths to 36cm in the mulches plots than in the control (Table 3). The differences were largest in the 0-12cm depth and were significant at P=0.05. The moisture contents under the four mulches were very similar except perhaps grass mulch which gave the lowest soil moisture contents.

Soil temperatures were lower under mulches than the control and the day-time temperatures under coffee hushs were generally higher than under the other mulches (fig.1). Sufficient replicates of temperature in the different treatments were not taken to allow the data to be analysed statistically.

SUMMARY AND CONCLUSIONS

The yield of cabbage on four different bed layouts in the field in the wet season was studied. The average head weights of cabbage were highest on Single-Row and Double-Row Ridges than on Raised-Flat Beds and Cambered Beds. The larger number of plants on the Double-Row Ridge layout than the Single-Row however

resulted in a higher total yield per hectare on Double-Row Ridges. This latter layout is therefore recommended for use in the wet season.

In the dry season the yields with two levels of irrigation (irrigation at 3-day and 7-day intervals) and four different mulches (coffee husks, bay leaves, bagasse and dry grass) and the yields without irrigation and without mulches were compared. Irrigation and mulches both significantly (P=0.01) increased yields. Irrigation at 7-day intervals was as good as irrigation at 3-day intervals and coffee-husks was the best mulch material. The effect of mulching on yield seems to be through the improvement in soil chemical properties, particularly the potassium content of the soil, and in the temperature and water content of the soil.

REFERENCES

1) CHARLES, W.B. (1976). Cabbage Growing Extension Bulletin No. 20, April 1976, Dept. of Agric. Extension, U.W.I., Trinidad and Tobago.

2) GANPAT, ROOP. (1973). Growing Cabbage Year-round. Crop Bulletin 19. Ministry of Agriculture, Lands and Fisheries, Trinidad and Tobago.

3) HIGASHI, S., KAGOHASHI, S., KOJIMA, M., MAFSUMARA, Y. and KAWANISHI, H. (1967). (studies on the growth of vegetable crops in paddy field conditions) Tokai-Kiuki Nats. Agric. Exp. Stat. Res. Progr. Rep. 4 (1). Abstract from Biol. Abst. 50 (1969), No. 55591.

4) NIEUWHOF, M. (1969). Cole Crops. World Crop Books. London. p 31-32.

5) SMITH (1974). Report on the study of the correlation on the soils of the former Bristish territories in the West Indies. Dept. od Soil Science, U.W.I., Trinidad.

6) THOMPSON, H.C. and KELLY, W.C. (1957). Vegetable Crops, 5th ed. p. 288-293.

7) VITTUM, M.T. and FLOCKER, W.J. (1967). Vegetable Crops, In HAGAN, R.M., HAISE, H.R., and EDMINISTER, T.W., 1967. (eds). Irrigation of Agricultural Lands. p. 677. Agronomy Monograph No. 11. Amer. Soc. of Agron. U.S.A.

Table 1: Effect of bed layout and mulching on total marketable yield (tonnes/ha) and average head weight (g/plant)[5]

MULCHING	BED LAYOUT				
	Raised-Flat Beds	Cambered Beds	Single-Row Ridges	Double-Row Ridges	Means
Mulched	14.07 (656.6)	12.71 (593.0)	12.08 (676.3)	14.38 (671.1)	13.31 (649.3)
Not Mulched	13.19 (615.5)	11.91 (555.9)	12.13 (679.5)	15.08 (703.7)	13.08 (638.7)
Means	13.63 (636.1)	12.31 (574.5)	12.11 (677.9)	14.73 (687.4)	13.20 (644.0)

[5]Values for Average Head Weight are in brackets

	AV. Head Wt.	Yield
Between Bed Types	P=80%	P=86%
	CV=10%	CV=10%

Between Mulches Probability levels were very low

Table 2: Effects of irrigation and mulches on total marketable yield tonnes/ha) and average head weight (g/head)[4]

IRRIGATION	MULCHES					
	Bg	Bl	Ch	Gr	0	Means
W_2	46.93 (1055.9)	47.46 (1068.0)	54.27 (1221.1)	49.41 (1111.8)	37.11 (834.9)	47.04 (1058.3)
W_1 N_1	45.38 (1021.1)	41.82 (941.0)	48.09 (1082.0)	42.18 (949.0)	23.12 (520.3)	40.12 (902.7)
W_o	33.07 (744.2)	29.46 (662.8)	27.48 (618.4)	29.02 (552.9)	14.36 (323.2)	26.68 (600.3)
Means	41.79 (940.4)	39.58 (890.6)	43.28 (973.8)	40.20 (904.6)	24.86 (559.5)	37.95 (853.8)

[4]The values for Average Head Weight are in brackets.

		LSD at 0.05 P	0.01 P	0.001 P
1. Yield	a) between Irrigation means	8.13	13.49	25.23
	b) between Mulch means	3.41	4.63	6.20

C.V = 9%

	L.S.D at 0.05 P	0.01 P	0.001 P
2. AV. Head weight			
a) between Irrigation means	183.1	303.7	567.9
b) between Mulch means	76.8	104.1	139.4

C.V = 9%

Table 3: Average soil moisture (% by weight) under different irrigation and mulching treatments

DEPTH	IRRIGATION	MULCHING					MEANS
		Bg	Bl	Ch	Gr	O	
0.12cm	W_2	19.6	19.9	19.5	19.1	13.6	18.3
	W_1	18.5	17.0	18.1	16.0	13.6	16.6
	W_o	15.2	15.7	14.7	15.0	12.5	14.6
MEANS		17.8	17.5	17.4	16.7	13.2	16.5
12-24cm	W_2	19.4	19.9	19.2	18.7	15.5	18.5
	W_1	18.0	17.3	17.6	17.5	16.0	17.3
	W_o	15.9	16.7	15.5	16.0	14.3	15.7
MEANS		17.8	18.0	17.4	17.4	15.3	17.2
24-36cm	W_2	18.8	19.3	18.2	18.4	16.2	18.2
	W_1	17.6	17.5	17.7	17.0	16.7	17.3
	W_o	16.2	15.7	15.9	15.4	14.4	15.5
MEANS		17.5	17.5	17.3	16.9	15.8	17.0

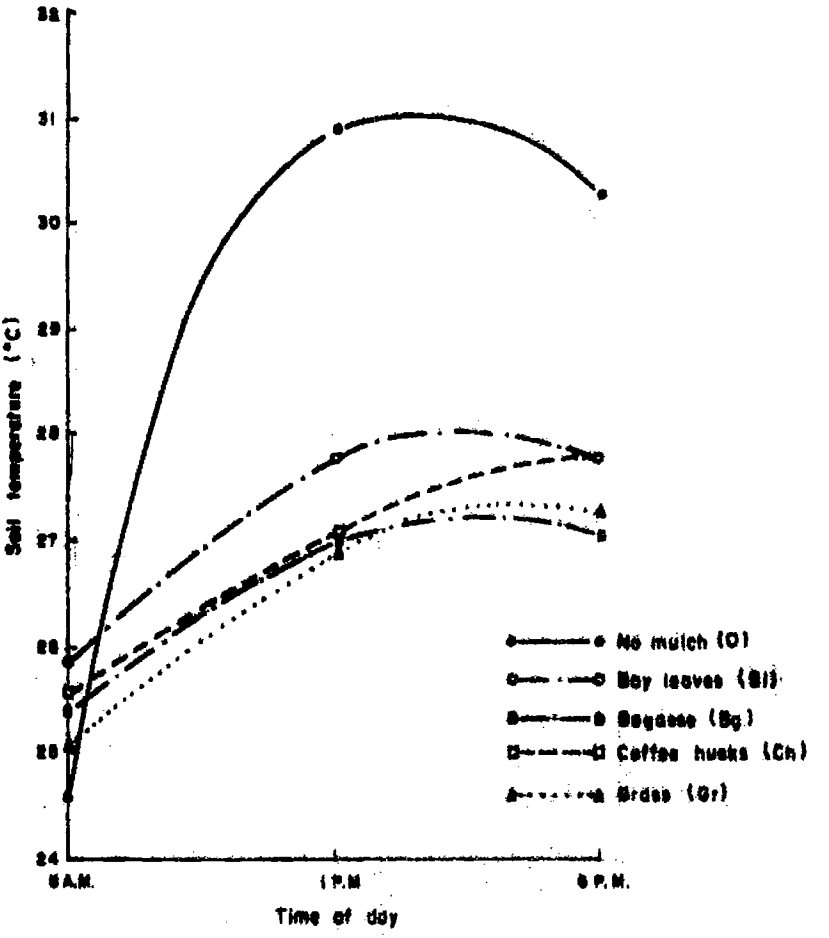

FIGURE 1 : Variation in day-time soil temperatures under different mulches (without irrigation).