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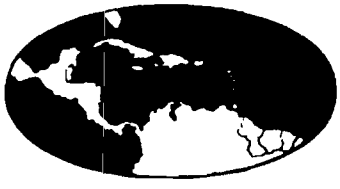

THIRD ANNUAL MEETING

RIO PIEDRAS, PUERTO RICO

AUGUST 9-13, 1965

VOLUME III

of these barriers, and of self- and cross-incompatibility is sufficient to explain the variable seed-set observed. Incompatibilities and sterilities reduce the efficiency of plant breeding efforts. They can be partially avoided by open pollination among lines selected for desirable characteristics. The potentialities of various breeding and improvement systems were discussed.

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CONTROL OF PAPAYA BUNCHY TOP VIRUS DISEASE IN JAMAICA

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The first official record of a virus disease affecting papaya, Carica papayae was informed by F. E. V. Smith in Jamaica in 1928. (4). He reported that a large number of plants around Kingston were affected and from then until the present, virus diseases have been the predominant limiting factor to the successful growing of papaya in Jamaica and some of the other Caribbean islands.

In Jamaica what is loosely called papaya mosaic is really the disease known as bunchy top which is almost always lethal. The pronounced symptoms of true mosaic i.e. the severely deformed or filiform leaves with dark and light green mottling are not observed in Jamaica. There are, however, a number of symptom expressions that indicate that virus diseases other than bunchy top are present but none of these have been officially identified.

SYMPTOMS

Some of the following symptoms occur on what is regarded as bunchy top affected plants in Jamaica:

1. A few dark green irregular shaped water-soaked flecks on young portions of stems and petioles are the first indication of infection.

2. Exudation of latex ceases in the flecked areas but can be seen about 1 foot below if the stem is scratched.

3. The flecks become very numerous until the upper portion of the young stem and petioles of leaves become dark green or mottled.

4. Petioles get shorter.

5. Leaves become bright yellow.

6. Leaves become rugose and crinkled.

7. The top of the plant becomes rosetted.

8. Most of the leaves fall, plant is pencil pointed and the top dies within two or three months.

9. If the top of an affected plant is cut off, side shoots will grow out but these soon become infected.

10. Immature fruits may have dark green mottling.

11. The texture of ripe fruits on affected plants is hard as the fruits fail to ripen uniformly.

12. Mature fruits have a poor flavor.

THE CAUSAL AGENT AND ITS TRANSMISSION

Adsuar (1) showed in 1946 that bunchy top disease was caused by a virus which was transmitted by the leaf hopper, Empoasca papayae. Later work by Sein and Adsuar (3) in 1947 and Bird and Adsuar (2) in 1952 have shown that E. papayae is the only insect, of a wide range tested, that would transmit the virus.

These leaf hoppers suck the juice from affected plants and when they feed on healthy ones they can transmit the virus which produces disease symptoms within six to twelve weeks.

Attempts have been made by the author to transmit the disease using leaf hoppers from affected papaya plants to feed on healthy seedlings. So far two out of six seedlings developed symptoms of the disease (i.e. failure of latex flow and stem mottling) after four months and four out of a separate niene after two months. The leaf hoppers were caged on the healthy seedlings for a week and the plants were subsequently kept in cages.

Bunchy top virus of papaya can also be transmitted by buds from diseased trees but it is not spread mechanically.

CONTROL

Varietal Resistance

Efforts have been made in several countries to obtain varieties of papaya with resistance to bunchy top disease but so far without much success. A number of the so-called resistant varieties have been tried in Jamaica but all have been found to be susceptible. The most recent of these is the true Solo variety from St. Croix and Hawaii.

Cultural or Other Methods of Control

In Trinidad it has been reported that by cutting off the top or diseased portion of virus affected papaya plants, healthy side growth will be produced. This has been tried in Jamaica but these shoots soon become diseased, probably from subsequent infection.

In Florida, some measure of control of a virus disease (apparently true mosaic) has been reported by Stanbaugh (5) using cultural methods but in Jamaica regular watering, mulching and fertilizing have not controlled the virus disease present.

Insecticidal Treatments

In Puerto Rico, Bird and Adsuar (2) reported in 1952 that if papaya plants were sprayed regularly with DDT, Empoasca papayae, the leaf hopper vector of the disease could be controlled and the incidence of the disease greatly reduced.

Attempts at controlling bunchy top disease with DDT in Jamaica by the author have not been very successful and the use of this insecticide resulted in severe build up of spider mites Tetranychus sp. due to the insecticide killing off beneficial insects that help to control the mites. The use of Trithion at 1/800 concentration to control the mites proved harmful to the papaya plants and had to be discontinued.

Recent work at the Ministry of Agriculture's nurseries at Hope has shown that hood control of bunchy top disease can be obtained

with Rogor and Sevin insecticides. Sevin was applied as a foliar spray treatment weekly and two-weekly at the rate of 2 lbs of the 85 per cent WP per 25 gallons water, using a low volume mistsprayer. Rogor (Dimethoate) which is systemic was applied as a soil treatment every two and four weeks using 2 1/2 ml in 1/2 gallon of water around each plant, equivalent to 3 pints of Rogor per acre. Malathion 57 per cent EC was used at 2 pints per acre, applying a 1/100 mixture as a foliar spray with a mist-sprayer at weekly and two weekly intervals.

Rows of 16 seedlings of a local variety and 16 of a so-called 'Solo variety (which was not true Solo) were established in the field in April, 1964 and spraying commenced two weeks later. As there was no apparent difference between the amount of disease occuring in the control plots on the two varieties, the figures presented in Table 1 deal with the disease in both varieties.

All the plants were fertilized with a 2:1 mixture of ammonium sulphate and muriate of potash using 1/4 lb. every six weeks until they were six months old. Subsequent fertilizer treatments consisted of 1/2 lb. per plant every two months. The plot was sprayed once per month with a mixture of Kelthane and Maneb to control mites, leaf and fruit spots. During the very dry period between January and April, 1965 the plot was surface irrigated on four occassions.

The insecticide treatments were as follows:

Treatment Number	Treatment	Time of Application
1.	Malathion 57 % EC 1/100 concentration	weekly
2.	Malathion 57 % EC 1/100 concentration	2-weekly
3.	Sevin 85 % WP 2 lbs/acre	weekly
4.	Sevin 85 % WP 2 lbs/acre	2-weekly
5.	Rogor 2 1/2 ml in 1/2 gal. water per plant	2-weekly
6.	Rogor 2 1/2 ml in 1/2 gal. water per plant	4-weekly
7.	Rogor as Tr. 5 from May to December, 1964 then discontinued	
8.	Rogor as Tr. 6 from May to December, then discontinued	
9.	Control using so called 'Solo' variety	
10.	Control using local variety	

Each treatment consisted originally of two rows of eight plants each (one row of local and one of the so-called 'Solo' variety). Treatment of half the plants in the Rogor plots was discontinued in December, 1964 after seven months of application to see how long the plants would go without showing symptoms of the disease. There was a marked increase of the disease in these plots three months after cessation of Rogor application.

Experimental Results

Table 1 shows the cumulative percentage of plants diseased in various treatments. Up to the end of May, 1965 after one year of treatment good control was obtained in the Sevin weekly and Rogor four weekly plots where 13 per cent of the plants were then diseased as against 88 per cent in the 'Solo' controls and 100 per cent in the local controls. Sevin two weekly was also effective and gave 19 per cent of infection at the end of the year. For some unknown reason control with Rogor two weekly was not spectacular and disease control in the Malation plots was poor.

Following heavy rains late in April and during May, 1965 plant growth improved and there was a very heavy build up of leaf hopper infestation especially on the untreated plants. By the end of June the incidence of the disease made an upward surge in all the treatments and only Sevin weekly could be regarded as giving a fairly adequate measure of control.

The trial was discontinued at this point as it was apparent that none of the treatments could be expected to prevent the spread of bunchy top disease to the healthy plants when there was such a heavy infestation of viruliferous leaf hoppers coming in from the untreated plants close by. Further work on this problem however continues.

The economics of the spray treatments were not assessed in this observation trial at Hope but it will be done for a new trail commenced in November, 1964 at Denbigh Kraal.

Analysis of fruits for Rogor residues was done by Disons in England as this is a systemic insecticide and less than one part per million residue was detected in fruits taken from plants four days after treatment. Treated fruits were therefore regarded as safe for human consumption on the advice of the manufacturers.

SUMMARY

Bunchy top virus disease transmitted by the leaf hopper, Empoasca papayae is the most serious disease of papaya (Carica papayae) in Jamaica. No varietal resistance has so far been found but fairly adequate control of the leaf hopper and spread of the disease were obtained by the use of Sevin insecticide applied as a weekly foliar spray. Up to, a point Sevin two weekly sprays and Rogor (Dimethoate) applied to the soil at two or four weekly intervals were quite effective.

TABLE I

Effects of Insecticides on Papaya Bunchy Top Disease Control

Treatment No.	Treatments	Number of Plants	Cumulative percentage of plants diseased												
			1964							1965					
			June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
1.	Malathion weekly	12	0	0	8	17	25	25	25	25	33	42	42	50	58
2.	Malathion 2 weekly	16	13	13	13	13	25	25	38	44	44	44	44	56	69
3.	Sevin weekly	16	6	6	6	6	6	6	6	6	6	13	13	13	31
4.	Sevin 2 weekly	16	0	6	6	6	19	19	19	19	19	19	19	19	44
5.	Roger 2 weekly	8	0	0	0	0	0	13	13	13	13	25	25	25	50
6.	Roger 4 weekly	8	0	0	0	0	0	0	0	0	0	0	0	13	50
7.	Roger 2 weekly Suspended after 18/12/64	8	0	0	0	0	0	0	0	0	0	38	38	75	100
8.	Roger 4 weekly Suspended after 18/12/64	8	0	0	0	0	13	13	13	13	13	25	25	38	87
9.	Control So-called "Solo" Variety	16	0	0	6	13	19	19	19	44	56	63	63	88	100
10.	Control Local Variety	16	0	0	0	13	13	32	32	63	81	94	94	100	100

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A NEW APPROACH TO GRAFTAGE

William Pennock 1/

Grafting is one of the oldest of the Arts of plant craft. Records of mango approach grafting have been found in the old Sandskrit literature showing that the art was practiced since very early times in ancient India. Mention of graftage is made in the writings of Virgil and the elder Pliny describes a cleft-graft in great detail giving numerous precautions many of which are in substantial agreement with modern knowledge.

For several centuries now grafting practices have been widely practiced and studied and great ingenuity has been excercised in devising different methods. The basic fundamentals, however, remain the same and improvements in practice have been very slight indeed. In fact several treatises on grafting which are over 50 years old seem to be just as good as most recent treatments of the subject.

There was, however, a definite break through to a better understanding of the mechanism of graft union in the early 1930's. Previously the old books insisted that the graft union was achieved by new cells origination exclusively from the cambium or according to a later school from the medullary rays. Sass (2) and Sharpless and Gunnery (3) and Mendel (1) showed that all live tissues in the bark and young xylem cells without secondary walls were capable of regeneration and that the grafting union was achieved in 3 basic steps as follows:

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