EFFECT OF MIXED PLANTING OF TARO LEAF BLIGHT RESISTANT VARIETIES ON THE DISEASE AND YIELD OF A PREFERRED SUSCEPTIBLE TARO VARIETY

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ABSTRACT

Five combinations of susceptible and resistant varieties were used to determine the best combination that had 30% susceptible and 70% resistant plants and gave significantly higher yield and lower disease incidence. The coefficient of disease index and level of susceptibility or resistance showed a linear relationship with yield. The inclusion in the cropping system of a Taro leaf blight (TLB) resistant variety does have an effect on the incidence of the disease and the yield of the susceptible variety.

Keywords: Colocasia esculenta, Phytophthora colocasiae, *Leaf blight resistance.*

INTRODUCTION

Taro leaf blight (TLB) caused by *Phytophthora colocasiae* Racib. has been considered a major constraint on taro (*Colocasia esculenta* L. Schott) production in Asia and the Pacific region. The pathogen was first described by Raciborsici in 1900 in Java (Ooka 1983). It was recorded in Papua New Guinea (PNG) by Anon in 1953 and Shaw in 1963 (Shaw 1984). The A2 mating type is found in PNG (Arentz 1986).

All the above ground parts may be affected by this disease. Its spread can be fast and incidence very high on susceptible varieties during favourable weather conditions (Trujillo 1965). At Bubia, plants were seen to be severely blighted in a few days and destroyed in less than two weeks. The disease reduced leaf number which has a direct effect on the biomass production of the crop, reducing the corm yield (Cox and Kasimani 1990). Yield reductions of more than 20% have been reported by Trujillo and Aragaki (1964) and Kay (1973), Jackson and Gollifer (1974), Cox and Kasimani (1988), Sahu *et al.* (1989) and Vasquez (1990).

The disease is controlled by spraying of fungicides, by cultural practices, and by using resistance varieties. Until resistant varieties are developed, chemical control of the disease is seen as the most effective practice. Many reports are available on effective *in vivo* and *in vitro* control of the pathogen by fungicides, although effective fungicides are expensive and pose health risks to farmers when not handled properly. In view of these problems a safer, inexpensive and appropriate control strategy is needed.

From our observation in farmer fields, the incidence and spread of TLB on susceptible varieties under conditions of mixed cropping is lower than under monocropping. The other crop species grown together with taro act as a buffer or barrier by restricting the movement of *P. colocasiae* inoculum in the field. When a resistant taro variety is grown in a mixture with a susceptible variety the TLB resistant variety may act as the barrier crop. Higher yields of susceptible varieties were reported by Paiki (1996) under mixed cropping situations in Biak Island of Irian Jaya, Indonesia. No accurate estimates on yields of susceptible varieties under mixed cropping are available in PNG.

This study was conducted to determine the best combination(s) of a susceptible taro variety and TLB resistant varieties that will significantly reduce the disease incidence and lead to higher yields. This combination could be adopted by farmers who wish to grow their preferred susceptible variety without major TLB control activities. The TLB resistant taro varieties (Ph 15, Ph 19 and Ph 21) used in this

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study were identified by Kokoa and Darie (pers.comm).

MATERIALS AND METHOD

The trial was conducted within the months of May and November in 1995 and repeated at the same time in 1996 at the Bubia Agriculture Research Centre, outside Lae, in the Morobe Province of PNG. Both trials were conducted on different sites closer to each other on a block of land that had high percentage of gravel.

The land was ploughed with a disc plough and then disc harrowed just before planting on flat land. The susceptible variety Numkovi, normally produces one large corm and 6 - 8 suckers, depending on the growing conditions. The three resistant varieties (Ph 15. Ph 19 and Ph 21) are semi-wild and normally produce more than 10 suckers. Their corms are not edible as they weigh less than 100 g and usually associated with high concentration of oxalate. Setts of about the same size (25 - 30 cm high and 3 - 4 cm base diameter) were selected and used for planting. The setts consisted of the top part of the corm and the bases of petioles.

In both experiments plant spacing was 0.8 x 1.0 m and each plot consisted eight rows of ten plants. Five combinations of the susceptible and resistant varieties were used as treatments with the resistant plants being interspaced among the susceptible plants as much as possible (Table 1). Blocks were separated by paths, 2 m wide. The treatments were arranged in a randomized complete block design (RCBD) and replicated four times.

Infection of *P. colocasiae* was by naturally occurring inoculum. From previous observations TLB disease pressure was very high on taro during July and August which is the wettest months of the year in the area. Thus taro planted in May reached peak leaf production at this stage, providing optimal time for TLB assessment. Assessment of the disease incidence and severity on fully expanded leaves of 10 plants of the susceptible variety per plot was done eight weeks after planting and continued weekly for three months and was discontinued two months before harvest. Disease incidence was measured as the percent of plants infected by TLB. The disease severity rating ranged from 0 to 6, with 0 being no infection and 6 being most severe disease (91 - 100% blighted leaf area) using the field assessment key of Gollifer and Brown (1974). The Coefficient of Disease Index (CODEX) was calculated using the following formula of Datar and Mayee (1981).

$$\text{CODEX} = \frac{\text{PDI X PDS}}{100}$$

PDI = Percent Disease Incidence = the number of affected compared to the total number of leaves.

PDI = Percent Disease Severity = the relative extent of disease on affected leaves based on the above assessment scale (0-6).

Table 1. **Treatment code and combination of TLB susceptible and resistant varieties planted in each plot.**

Treatment code	Number of susceptible plants per plot (var. Numkovi)	Number of resistant plants per plot (vars Ph 15, Ph 19, Ph 21)	Total plants in plot
A	80(100)	0(0)	80
B	48(60)	32(40)	80
C	40(50)	40(50)	80
D	32(40)	48(60)	80
E	24(30)	56(70)	80

Note: Figures in brackets are percentages

Figure 1. **Corm yield (g/plant) of the susceptible variety against ratio of resistant/susceptible plants (1995, 1996).**

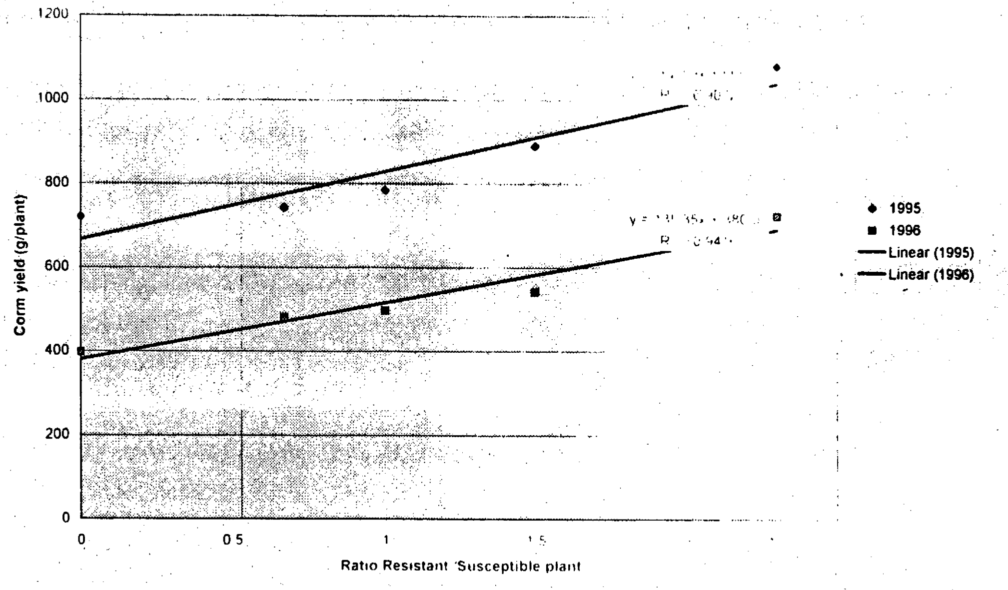
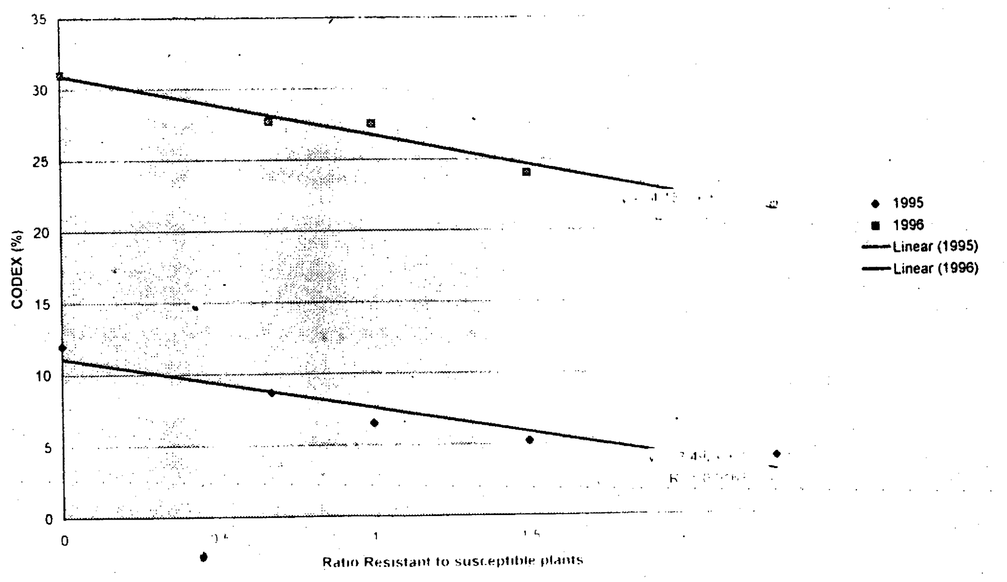


Figure 2. **CODEX (%) of the susceptible variety against the ratio of resistant/susceptible plants (1995, 1996).**



At harvest the corms and suckers of the susceptible variety were carefully lifted with a digging stick. The main corms were weighed after the tops were removed. Sample plants were used to test the relationship between CODEX, level of resistance or susceptibility and yield and was analysed using linear regression and simple correlation analysis.

RESULTS

The yield and CODEX of the five treatments is shown in table 2. There was a positive correlation (r = 0.95 for 1995 and r = 0.97 for 1996) between corm yield of the susceptible variety and the proportion of resistant plants in each plot, with maximum yield in the susceptible variety occurring when the ratio of susceptible plants in the plot was 30/70 (Figure 1). The increase in yield in the susceptible variety was associated with a decrease in disease incidence, disease severity and CODEX in the susceptible variety. Generally, yield recorded for the susceptible variety was higher in 1995 than in 1996 (Table 2).

Simple linear regression analysis showed a positive correlation between corm yield and the ratio of resistant to susceptible plants and a negative correlation on CODEX in both years (see Figure 1). The relationship between CODEX and ratio of Resistant/Susceptible plants showed a negative correlation (see Figure 2).

DISCUSSION

Treatment E which had 24 susceptible plants grown among 56 resistant plants escaped severe infestation of TLB and had the highest corm yield in the susceptible variety. It is seen that the yield of the susceptible variety has an indirect relationship with CODEX. The resistant plants, which mimick other crop plants, prevented *P. colocasiae* inoculum from spreading rapidly between susceptible plants. Apparently resistant taro plants have the same canopy height as the susceptible plants and therefore are effective barriers to *Phytophthora colocasiae* spread. Higher yield and lower disease incidence on a susceptible taro variety were observed under mixed cropping on Biak Island (Paiki 1996).

It is apparent that incorporation of a TLB resistant variety does have an effect on the disease incidence and yield of the susceptible variety. Although treatment E gave the highest yield of the susceptible variety, 70% of the plants in the plot were the lower yielding resistant variety. This tends to decrease

***Table 2.* Effect of different ratios of susceptible to resistant taro varieties on corm yield, disease incidence, disease severity and CODEX in the susceptible variety measured in two field trials (1995, 1996).**

Treatment	Ratio suscep./ resist. plants	Mean corm yield (g/plant) of suscep. var. 1995	Mean corm yield (g/plant) of suscep. var. 1996	Disease incidence (%) 1995	Disease incidence (%) 1996	Disease severity* (%) 1995	Disease severity* (%) 1996	CODE X 1995	CODE X1996
A	10/0	721	397.7	30.25	57.8	39.68	53.6	12	31
B	60/40	742.2	480.5	21.49	56.2	40.48	49.29	8.7	27.7
C	50/50	784.6	497.1	15.42	53.58	42.14	51.32	6.5	27.5
D	40/60	890.6	542.3	13.79	49.74	37.71	48.25	5.2	24
E	30/70	1081.4	723.1	11.92	45.71	33.56	46.97	4.0	21.5

* Disease severity rating on a scale of 0 (no disease) to 6 (91 - 100% leaf area affected)

the total yield. If the resistant variety had useful corms, this would increase the overall yield of the plot. Local farmers will benefit more when desired resistant taro plants are developed and made available which they could use together with preferred susceptible local varieties.

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