EVALUATION OF LEAF BLIGHT RESISTANT TARO (*COLOCASIA ESCULENTA*) VARIETIES FOR BUBIA, MOROBE PROVINCE, PAPUA NEW GUINEA.

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ABSTRACT

*Thirty five taro (*Colocasia esculenta *(L.) Schott) varieties resistant to taro leaf blight (TLB) (*Phytophthora colocasiae *Racib.) were evaluated at Bubia Agricultural Research Centre, Lae, Papua New Guinea, for yield components and eating quality in comparison with the locally preferred cultivar, Numkowec. The main factors affecting eating quality were presence of conspicuous corm fibre and acridity. Leaf blight resistant varieties AN 65, 17, 50, 32, 46, 21, 12 and AN 20 had acceptable eating quality. Their corm yield ranged from 300 g/plot (AN 50) to 570 g/plot (AN 21). However, their corm yield was not significantly different from that of Numkowec (430 g/plot). These resistant varieties are recommended to farmers in the Lae area based on their resistance to TLB and their similarities in corm yield and eating quality to Numkowec.*

***Keywords**: Taro, variety evaluation, eating quality, taro leaf blight resistance.*

INTRODUCTION

Taro, *Colocasia esculenta* (L.) Schott (Araceae), is an important traditional crop in the Asia-Pacific region. In Papua New Guinea (PNG) it is a dietary staple for communities up to 2200 m a.s.l. (Oksapmin - Telefomin area), in which the farming system is predominantly taro-based. Conversely, it is cultivated as an additional seasonal crop to altitudes as high as 2740 m (Bourke 1982). Taro is now being cultivated as a semi-commercial crop.

Taro production in PNG has been declining over the last decades. This decline is due to the crop's susceptibility to insect pests and diseases and other agro-economic problems (Bourke 1982).

Taro leaf blight (TLB), caused by *Phytophthora colocasiae* Racib., is an important disease of the crop. It has been reported to cause up to 50% reduction in corm yield in PNG (Cox and Kasimani 1988).

Many fungicides have been reported to be effective in controlling the disease (Bergquist 1972, 1974, Gollifer and Brown 1974, Aggarawal and Methrota 1987, Cox and Kasimani 1988, Ghosh and Pan 1991). However, use of chemicals is usually hazardous and costly to the user and the environment. Development of new races of pathogens with resistance to the fungicides can also result from their use.

Varietal improvement of agronomic traits and resistance and/or tolerance to pests and diseases can provide a practical solution to controlling the disease, and also to alleviating the declining trend in taro production. Genetic improvement of the crop has been described recently by Ivancic, Simin and Tale (1994).

The aim of this study was to evaluate for yield and eating quality 35 TLB resistant taro varieties developed at Bubia Agricultural Research Centre (BARC), near Lae, PNG.

MATERIALS AND METHODS

The trial was carried out between June and December 1995 at BARC. The centre is situated at an altitude of 20 m and receives a mean annual rainfall of 2870 mm.

In the experiment, the most preferred local cultivar, Numkowec (syn. Numkoi) (Akus *et al.* 1991), was compared to 35 of TLB resistant varieties. Numkowec

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is susceptible to TLB. The resistant varieties were selected on a single plant basis for TLB resistance, yield and eating quality from the first cycle of breeding (cycle-1 population) of the recurrent selection programme carried out a BARC (Ivancic, Simin *et al.* 1994).

The genotypes used were replicated three time in a Randomized Complete Block Design. Plots were 5 m x 3.6 m with net plot size of 4.2 m^2. Plants were spaced 1.2 m between rows and 1.0 m between plants. Weeds were controlled using a rotovator between rows and manually between plants. A dose of 50 Kg N/ha in the form of Urea was applied after three months to boost growth. *P. colocasiae* spore suspension was prepared following the method of Ivancic, Kokoa *et al.* (1994) and was inoculated on to the leaf laminae fortnightly to reconfirm the plant's resistance.

Harvesting was done six months after planting. Yield and yield components were measured. Analysis of Variance was carried out for total (biological) yield, corm yield, cormel yield and number of suckers.

Presence of corm cortex fibre, texture and acridity were assessed in evaluating eating quality. Corm samples of 500 - 600 g fresh weight (chopped up into 50 - 100 g pieces) of each variety were peeled (removing all tissues surrounding the corm cortex), bagged separately in onion bags and boiled in excess water for 20 - 30 minutes. A panel of 15 people were used to assess eating quality based on the preference scale shown in Table 1.

Table 1. **Aspects of texture, taste preference, fibre content and acridity used to determine preference scores for taro varieties.**

Score	Texture	Preference	Fibre	Acridity
1	Firm, dry	Most liked		
2	Friable, dry	Liked		
3	Soft, sticky	Disliked		
4	Firm, sticky	Most disliked		
5	Spongy			
			Present/Conspicuous	Present
			Absent/Inconspicuous	Absent

RESULTS

Significant differences ($P<0.05$) were observed in corm yield (Table 2). Of all the resistant varieties, only AN 25 (800 g/plot) significantly out-yielded the locally most preferred cultivar, Numkowec (430 g/plot) in mean corm yield. AN 31 was the only variety with a significantly lower yield (mean of 240 g/plot) than Numkowec.

The number of suckers was significantly different ($P<0.05$) between varieties (Table 3). However, the co-efficient of variation was very high (40.5%). This was due to the occurrence of different plant forms in different varieties which differ in their suckering tendency and general corm morphology (Figure 1). Forms observed were simple corms with stolons, simple corms with side shoots, simple corms with both stolons and side shoots, and multiple-headed (or branched) corm with no suckers. Separation of the four forms into sub-groups resulted in a decrease in the co-efficient of variation. Nevertheless, the variation range (maximum - minimum) was still high. Varieties which had simple corms with stoloniferous suckers had a variation range of 18.56 suckers and a co-efficient of variation of 28.16% (Table 4).

The eating quality of the varieties was assessed relative to that of Numkowec (Table 5). Numkowec has inconspicuous corm cortex fibre, firm and dry texture and no acrid taste. The traits which mainly affect

Table 2. **Mean corm yields of 36 taro varieties**

Variety	Mean corm wt. (g/plot)	Variety	Mean corm wt. (g/plot)
AN 25	800	AN 36	390
AN 49	580	AN 68	390
AN 21	570	AN 34	390
AN 22	540	AN 36	380
AN 12	530	AN 20	370
AN 42	520	AN 32	360
AN 9	480	AN 46	350
AN 65	480	AN 19	350
AN 8	470	AN 23/2	350
AN 4	460	AN 33	340
AN 10	460	AN 16	330
AN 43	450	AN 11	310
NUMKOWEC	430	AN 5	300
AN 17	420	AN 50	300
AN 3	410	AN 6	280
AN 51	410	AN 37	280
AN 54	410	AN 29	270
AN 7	390	AN 31	240

Table 3. **Mean number of cormels (suckers) on 36 taro varieties.**

Variety number	Mean sucker	Variety	Mean sucker number
AN 38	31.06	AN 7	12.03
AN 68	24.47	AN 50	11.31
AN 43	23.92	AN 9	11.53
AN 19	23.56	AN 8	10.78
AN 49	20.53	AN 10	10.78
AN 16	18.94	AN 20	10.61
AN 54	17.39	AN 3	10.19
AN 22	16.89	NUMKOWEC	9.70
AN 17	16.53	AN 11	9.21
AN 4	16.31	AN 65	8.36
AN 36	15.78	AN 6	7.22
AN 29	13.92	AN 42	5.97
AN 51	13.70	AN 33	5.86
AN 21	13.19	AN 31	5.75
AN 23/2	12.55	AN 34	4.64
AN 5	12.50	AN 46	3.89
AN 12	12.44	AN 37	3.61
AN 32	12.11	AN 25	0

LSD (0.05), C.V. = 40.4%

Figure 1. **Suckering habits and corm morphology of some taro varieties; (a) simple corm with side shoots, (b) simple corm with stolons, and (c) corm with multiple heads.**

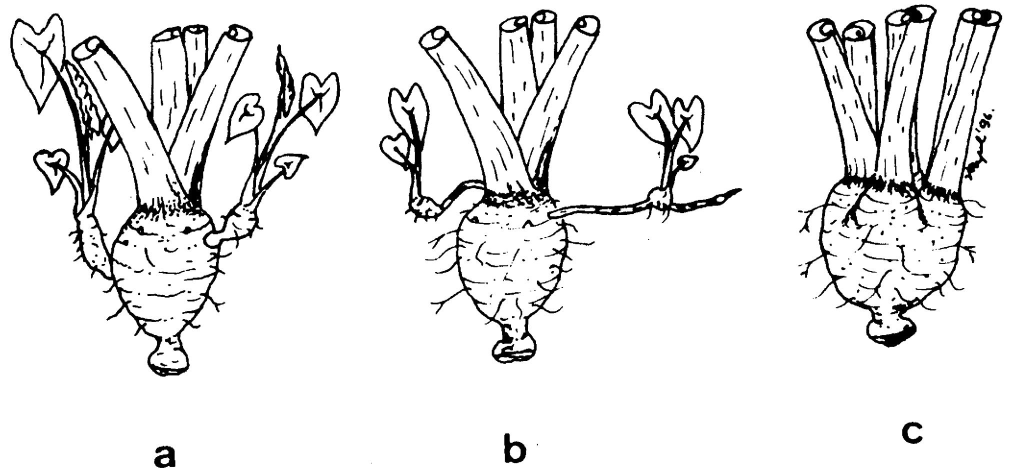

Table 4. **Variability in number of suckers after separation of varieties into their different suckering habits.**

Suckering form	N	Mean	S. Dev.	C.V. (%)	Min.	Max.
Stolons	12	19.27	5.43	28.16	12.50	31.06
Stolons & side shoots	9	11.90	3.27	27.43	5.75	16.89
Side shoots	14	8.52	3.13	36.78	3.61	13.19

eating quality are presence of conspicuous corm fibre and the acrid taste. The varieties with acceptable quality were AN 65, 17, 50, 32, 46, 21, 12, and AN 20. Their corm yields, ranging from 300 g/plot (AN 50) to 570 g/plot (AN 21), were not significantly different from that of Numkowec (430 g/plot).

DISCUSSION

In this study, the corm yields of eight TLB resistant varieties with acceptable eating quality were not significantly different from that of the susceptible, standard cultivar, Numkowec. Any influence of the disease on the corm yield of Numkowec was not detected in this study, although it is known that a linear relationship exists between TLB intensity and yield components (Paiki 1996).

Eating quality is affected by presence of noticeable corm cortex fibre and an acrid taste which is related to the presence of calcium oxalate crystals (Strauss *et al.* 1979). Most varieties with unacceptable eating quality in this study expressed one or more wild and/

Table 5. **Eating quality assesments of taro varieties based on corm fibre content, texture and acridity giving a preference score of 1 (highest) to 5 (lowest).**

Variety	Quality Characteristics			
	Fibre	Texture	Acridity	Preference
AN 3	+	3	+	3
AN 4	-	1	-	3
AN 5	+	4	+	4
AN 6	-	1	+	3
AN 7	+	4	+	4
AN 8	+	3	+	3
AN 9	+	3	+	4
AN 10	+	3	+	3
AN 11	+	4	+	4
AN 12	-	2	-	2*
AN 16	+	4	+	4
AN 17	-	1	-	1*
AN 19	+	4	+	4
AN 20	-	1	-	2*
AN 21	-	1	-	2*
AN 22	-	3	+	3
AN 23/2	+	3	+	3
AN 25	+	4	+	4
AN 29	+	4	+	4
AN 31	+	4	+	4
AN 32	-	1	-	2*
AN 33	+	1	+	4
AN 34	+	3	+	3
AN 36	+	5	+	4
AN 37	+	4	+	4
AN 38	+	3	+	3
AN 42	-	3	+	3
AN 43	+	1	+	4
AN 46	-	2	-	2*
AN 49	+	3	+	3
AN 50	-	2	-	2*
AN 51	+	4	+	4
AN 54	+	4	+	4
AN 65	-	1	-	1*
AN 68	+	1	+	3
NUMKOWEC	-	1	-	1

* **Acceptable preference scores**

or semi-wild type characteristics, these being small corms, high concentration of calcium oxalates (as reflected by their acridity), stoloniferous suckers (Ivancic *et al.* 1995), and conspicuous corm cortex fibre.

The expression of these wild traits may be attributed to the influence of wild germplasm in the parent genotypes. The varieties used were selected from the population of the first cycle of recurrent selection which consisted of segregating offsprings resulting from random mating between susceptible cultivars and resistant wild and semi-wild varieties. Hence, the fact that some of the resistant varieties retained some wild-type characters could explain the observation that their resistance to TLB did not result in a superiority in corm yield over that of the susceptible, standard cultivar Numkowec. It may also have caused the variation observed between and within the different suckering types. Suckering ability cannot be compared in this study because of the variation between the varieties in the forms of the corms and their suckering habits.

Taro varieties AN 65, 17, 50, 32, 42, 21, 12 and AN 20 are recommended to farmers in the Lae area based on their resistance to TLB and the similarities in corm yield and eating quality to Numkowec. However, further testing of the performances and consumer acceptability of these varieties under different agro-ecological regimes and with different ethnic groups in PNG is needed.

REFERENCES

AGGARAWAL, A. and METHROTA, R.S. (1987) Control of *Phytophthora* blight of *Colocasia esculenta* by fungicides and roughing. *Phytoparasitica* 15(5):299-305.

AKUS, W., PISEA, T., KRIOSAKI, P. and GHODAKE, R.D. (1991) Fertilizing taro in the Lowlands of Papua New Guinea. *Pallawija News, The CGPRT Centre Newsletter* 8(1):1-7.

BERGQUIST, R.R. (1972) Efficacy of fungicides for control of *Phytophthora* leaf blight of taro. *Annals of Botany* 36:281-287.

BERGQUIST, R.R. (1974) Effect of fungicide rate, spraying interval, timing of spray application, and precipitation in relation to control of *Phytophthora* leaf blight of taro. *Annals of botany* 38:213-221.

BOURKE, R.M. (1982) Root crops in Papua New Guinea. pp: 51-63, in Proceedings of the Second PNG Food Crops Conference, Part One. R.M. Bourke and V. Kesavan (eds). Department of Primary Industry, Port Moresby.

COX, P.G. and KASIMANI, G. (1988) Control of taro leaf blight using metalaxyl. *Tropical Pest Management* 34(1):81-84.

GHOSH, K.S. and PAN, S. (1991) Control of leaf blight of taro (*Colocasia esculenta* (L.) Schott) caused by *Phytophthora colocasiae* Racib. through fungicides and selection of variety. *J. Mycopath. Res.* 29(2):133-140.

GOLLIFER, D.E. and BROWN, J. (1974) *Phytophthora* leaf blight of *Colocasia esculenta* in the British Solomon Islands. *PNG Agriculture Journal* 25(1,2):6-12.

IVANCIC, A., KOKOA, P., GUNUA, T. and DARIE, A. (1994) Breeding approach to testing for resistance to taro leaf blight. Paper presented at the Second Taro Symposium, November 23-24, Faculty of Agriculture, Cenderawasih University, Indonesia.

IVANCIC, A., SIMIN, A. and TALE, Y. (1994) Breeding for flowering ability and seed productivity of taro. Paper presented at the Second Taro Symposium, November 23-24, Faculty of Agriculture, Cenderawasih University, Indonesia.

IVANCIC, A., SIMIN, A., OSOSO, E. and OKPUL, T. (1995) Wild taro (*Colocasia esculenta* (L.) Schott) populations in Papua New Guinea. *PNG J. Agriculture, Forestry and Fisheries* 38(1):31-34.

PAIKI, P.A. (1996) Symptoms of taro leaf blight disease (*Phytophthora colocasiae*) and relationship with disease intensity and yield components in Biak, Irian Jaya. *Science in New Guinea* 21(3):153-157.

STRAUSS, M.S., STEPHENS, G.C., GONZALES, C.J. and ARDITTI, J. (1979) Genetic variability in taro, *Colocasia esculenta* (L.) Schott (Araceae). *Annals of Botany* 45:429-437.