EFFECT OF PROGRESSIVE BI-MONTHLY WEEDING ON THE YIELD OF YAM (*Dioscorea Esculenta*) AT SARAMANDI, EAST SEPIK PROVINCE

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ABSTRACT

*Lesser yam (*Dioscorea esculenta *var Mangilmu) was planted in a weeding trial in which weeding duration was 0, 2, 4, 6, 8 and 10 months after planting (MAP), allowing weed competition in five out of six treatments. Total yield increased from 4.2 t/ha with no weeding to 7.7 t/ha with weeding for four MAP. It then slightly decreased between weeding for four and eight MAP to 6.4 t/ha and yielded the highest at 9.3 t/ha under weeding for 10 MAP. Total yields with weeding for zero and two MAP were significantly (P<0.05) lower than with 10 MAP, and yield with weeding for four MAP was also significantly higher than with no weeding. Total tuber number only for 0 weeding (11470/ha) was significantly lower than 15760/ha from weeding for 10 MAP. Tuber number and yield proportion of large tubers increased with increased duration of weeding. Weeding for four and two MAP gave the highest estimated net incomes per hectare of K13, 457 and K12,518 after subtracting the weeding cost.*

Keywords: *weeding, competition, yield, yam*

INTRODUCTION

In many parts of Papua New Guinea (PNG) where *Dioscorea esculenta* is grown as the main food specie, gardens are hand-weeded regularly and even kept weed-free for the entire crop duration. Similar practices are followed for the successful cultivation of all other species of yam. Weed management has been a major factor apart from the decline in soil fertility for the traditional shifting cultivation.

Common weed control practices include two to three times of major hand weeding starting from one or two months and ending about four to six months after planting while allowing the yam vine canopies to provide some ground cover. For D alata, with non-pre-sprouted setts and without mulch 3-5 rounds of weeding would be needed (Pido and Pepino 1987). Weeding has been reported to take up between 20 to 30 % of the total man-days devoted to yam production (Degras 1993, Lyonga and Ayuk-Takem 1979). Although chemical weed control is an option this study will focus on hand weeding and other cultural techniques that contribute to weed control as PNG farmers are not yet producing yam commercially.

Unchecked weed competition can lead to different levels of yield reduction. Hahn (1984) reported 43% yield reduction with Unamma and Akobundu (1989) reporting 76-79 % while Moody and Ezumah (1974) reported yield losses of 69-91% from yam crops in West Indies, Ivory Coast and Nigeria respectively.

From this range of yield reductions it appears that a number of factors including a critical period determine the extent of yield reduction.

Beale *et al.* (1985) reported for *D. rotundata* the critical period to be from week 8 to week 10 in Puerto Rico and from week four to week ten for *D. alata* in Costa Rica.

This trial was carried out with the aim to assess the yield loss due to weed competition and to explore ways for farmers to increase labor efficiency in weed control for yam crops.

MATERIALS AND METHODS

This study was conducted at Saramandi Research Station near Angoram in the East Sepik Province of PNG. The trial was the third crop of yam to be grown after the land was cleared from primary forest. The soil is clay based on fine limestone sediments with a local topography of low undulating hills. The area receives between 1500 and 2000 mm of rain and experiences a pronounced dry season from June to September. This trial was planted in December 1986 and harvested in October 1987. A local Maprik variety (Mangilmu) was planted at 444plants/ha (1.5 x 1.5 m) using a standard 2 m staking height. To

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plant each sett, a hole of 30-cm diameter and 30 cm deep was dug using a garden spade. The soil was broken up by hand, removing roots, sticks and stones and was returned to fill up the hole. The sett tuber was placed in the middle of the covered hole and soil from the rim of the hole was dug up, pulverized by hand and used to build a mound about 20-30 cm high over the sett. One treatment consisted of no weeding, four treatments were hand weeded for two, four, six and eight months after planting (MAP) and then allowed to experience weed competition up to harvest. The final treatment was weeded for 10 MAP up to harvest. The randomized complete block design was used with five replications.

The plot size was 67.5 m^2, including a guard row around each plot. The net plot area was 27 m^2. Stakes were cut from the adjacent forest and erected one month after planting allowing one plant per stake. Weeding by hand was carried out monthly. At harvest the tubers were separated into five 250 g interval size or weight categories; Yield 1: < 250g, Yield 2: 250-500g, Yield 3: 501-750g, Yield 4: 751-1000g and Yield 5: >1000g. Tubers in each category were counted and weighed for each plot. Tuber numbers in each yield category were calculated to thousands of tubers per heactare and are referred to as Tuber number 1-5 of the corresponding yield categories. The data were processed using the Analysis of variance (ANOVA).

Using 2005 weed management information at NARI Laloki receipts, from sales of tubers 250g or heavier and weeding costs were estimated and net income estimates for each treatment were derived. Information used were 196.2 person days to weed 1 ha, K9.00 per person day casual hire and K3.00 per kg for yam sales in Port Moresby.

RESULTS

The tuber yields from this trial were quite low and could be due to it being the third crop of yam after land was cleared from forest. The total yield increased with increased duration of weeding and results from the weed-free plot were significantly higher than yields from plots that were unweeded and weeded only for two MAP. The next highest total yield was obtained from weeding for four MAP but this was not significantly different from weeding for two, six and eight MAP (Table 2).

Weeding for 6 and 8 MAP (Table 2), yielded less total tubers progressively. Yield loss from unchecked weed competition amounted to 55 percent while yield reduction at weeding up to four MAP was only 17 percent. Weeding up to four MAP gave the highest estimated net income of K13, 457.00 followed by weeding up to two MAP and no weeding respectively (Table 2). As total yield increased, the yield proportion of large tubers also increased as shown in Figure 1.

Similarly the total number of tubers ('000/ha) increased with duration of weeding (Table 2). However, only the unweeded treatment yielded significantly lower total tuber numbers than the weed-free treatment of weeding for ten MAP.

Figure 2 and figure 3 show that tuber numbers and yield distribution increased in favor of large tubers with increased weeding duration.

DISCUSSION

The general relationship between weeding duration and increased yield reaffirms the importance of

Table 1. Six weeding treatments that were applied to the trial.

Treatment No.	Duration of weeding from planting (MAP) (Planted December 1986)	Duration of weed competition in months to harvest (MTH) (Harvested October 1987)
1	0	10
2	2	8
3	4	6
4	6	4
5	8	2
6 (Control)	10	0

Table 2. **Effect of weed competition on total yield, total number of tubers and estimated net income (K) in *D. esculenta***

Treatment	Total tuber yield (t/ha)	Total tuber numbers ('000/ha)	Estimated net income (K) after taking out weeding cost
6	9.3a	15.8a	7, 999
3	7.7ac	13.6ab	13, 457
4	7.1abc	11.7ab	8, 695
5	6.4abc	12.4ab	2,794
2	5.9bc	12.4ab	12, 518
1	4.2b	11.5b	10, 020
LSD (0.05)	3.0	3.7	NA
	* **Treatment means followed by the same letter, are not significantly different at the 5% LSD level.**		

Figure 1. **Effect of weed competition on *D. esculenta* tuber yield components**

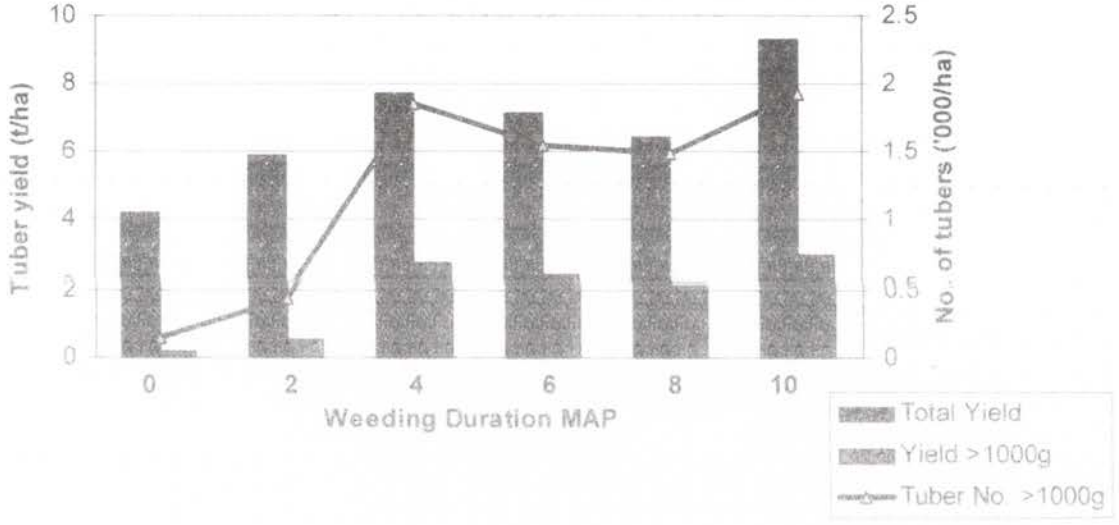


Figure 2. **Effect of weed competition on yield partitioning into different tuber size in D. esculenta**

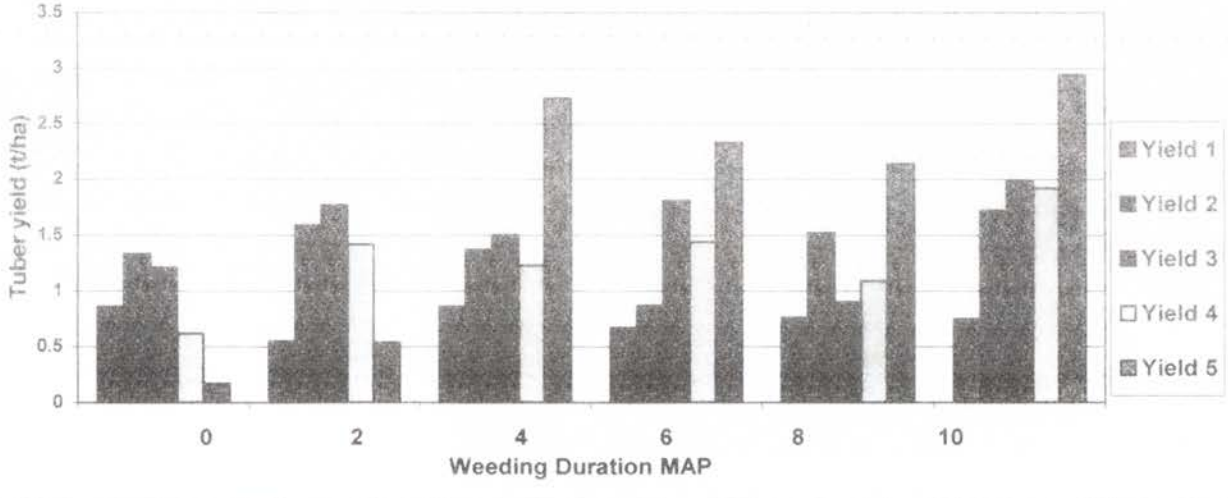
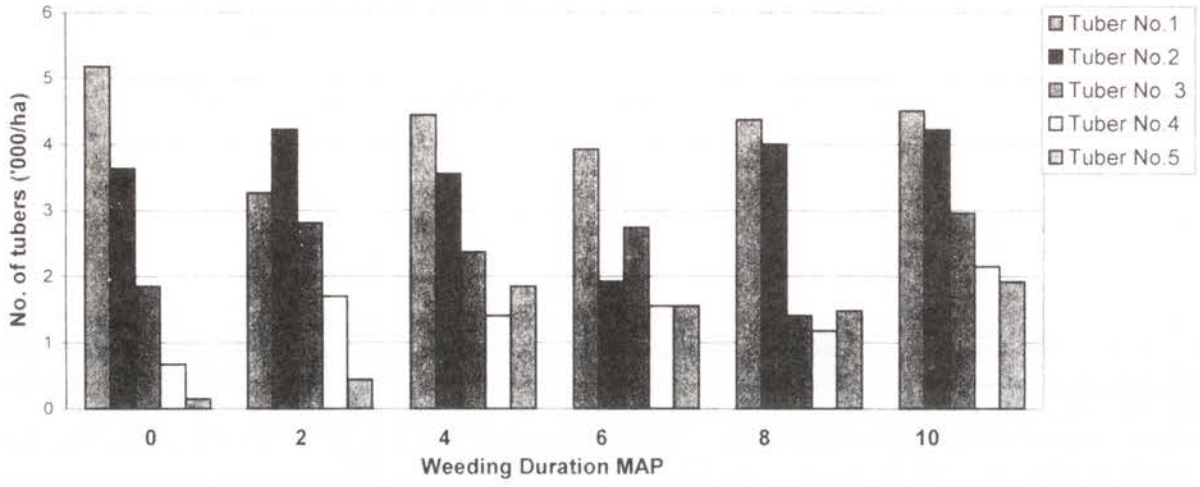


Figure 3. **Effect of weed competition on number of tubers in different size categories in *D. esculenta***



weed control in a yam crop. Yam total yields were low compared to figures reported by Quin (1985) 18t/ha and by King and Risimeri (1992) 63.3 t/ha at the same plant population. A contributing factor could be that Southern Oscillation Index in 1987 was one of the 7 strong El Nino Southern Oscillation (ENSO) events between 1877 and 1988 (Kapal *et al.* 2003).

While weed control by clean-weeding on a monthly basis produced the highest yields this trial has raised the issues of cost-benefit of weeding and the identification of the critical stage in the phenology of *Dioscorea esculenta* after which the severity of yield reduction from weed competition is less. Highest estimated net income after subtracting the weeding cost was obtained from weeding up to four MAP followed by weeding up to two MAP and even the unweeded treatment was higher that the others. The data presented here is in agreement with Onochie (1973) whose work suggested that yield is most affected by weed competition between the fourth and sixteenth weeks.

There appears to be a second factor interacting to reduce yield as continued weeding up to six and 8 MAP resulted in lower yield than 4 MAP. As 1987 experienced a strong dry season it appears that treatment 3 benefited from a mulching effect by the herbaceous weed cover going into the tuber bulking and crop maturity phase. Weed mulch can be beneficial as discussed by Moody and Ezumah (1974).

Appropriate planting hole arrangements and staking techniques that would prove more economical can better achieve mulching and shading effects.

Ndegwe *et al.* (1990) supports this suggestion with their findings that; staking six plants onto one stake achieved the highest net cash returns per hectare. Using the "Pyramid and "A Frame" staking techniques, observations at Bubia and Laloki show that; after full canopy establishment the yam crops create ample self-generated shading to reduce weed establishment and vigor. Further research is required to refine cultural practice combinations to formulate economical weed control options.

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