Growth and yield response of 'Sunrise Solo' papaya to weed management strategies

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Abstract

The effects of five different weed control methods (hoe weeding, chemical weeding, intercrop with pumpkin [Yellow var.], pumpkin [White var.] and groundnut intercrop) on the growth and yield of papaya (*Carica papaya* cv. 'Sunrise solo') were compared on an alfisols in Ibadan Southwestern Nigeria. No weed control method significantly (P>0.05) influenced plant height and stem diameter of papaya. Days to 50% flowering were lowest under chemical weeding. Weed dry matter (WDM) was lowest under chemical weeding. Chemical weed control reduced weed density by 79, 49 and 70% at 5, 9 and 12 months after planting (MAP), respectively, when compared with hoe weeding. Papaya fruit number per plant was highest in the last quarter of both the first and second year. While the white pumpkin gave the highest fruit yield among the intercrops, chemical weed control gave the highest fruit yield (first and second year harvests) and revenue among all the strategies.

Media summary

Herbicide usage is the most sustainable weed management strategy system for papaya production. It improves fruit yield, reduces labour input and gave the highest revenue.

Keywords:

Papaya, weed control, intercrop, pumpkin, groundnut.

Introduction

Papaya (*Carica papaya L*.) is a short-lived perennial tropical fruit tree. Its commercial cultivation occurs within latitude 23?N and S (Nakasone and Paul, 1998). In Nigeria, papaya features in many low input traditional cropping systems where hand weeding is the main method of weed control. This, in most cases, is directed towards the main crop in an inter-cropping system where papaya is regarded as the secondary crop. For this reason its cultivation as a commercial crop until recently has not been organised and very few investigations have been undertaken on weed control. This study examined weed control strategies for papaya farmers by comparing live mulch, inter-cropping system, hoe weeding, and chemical weeding options. This represent a range of available weed control technology adopted in traditional and more advanced cropping systems.

Methods

The study was carried out from May 2000 until May 2003 at the National Horticultural Research Institute, (NIHORT) Ibadan, Nigeria (7^0 $23^/$N, 3^0 $35^/$ E, 168m a.s.l.) in the humid forest/moist savanna transition zone. The soil was sandy loam and the dominating weed was *Imperata cylindrical*. In May 2000, papaya seedlings (cv. sunrise solo) raised in a seed tray and transferred into poly-bags were planted out in the field at 2 x 2 m spacing when they were about 15 cm in height. Each plot was 8 x 8 m with one and two metre inter-plot and inter-replicate spacing, respectively. There were 16-papaya stands/plot. Four weeks after transplanting the weed control treatments that were hoe weeding, chemical, yellow pumpkin, white pumpkin and groundnut commenced.

Hoe weeding was done monthly. For chemical weed control, Delsate (glyphosate) was used at the rate of 4.5 L/ha. Pumpkin (*Cucurbita pepo*) acc.Nhcpe 97-1 and acc.Nhcpe 97-2 were used as live mulch treatments. A third live mulch groundnut *(Arachis hypogaea)* cv. RRB was inter-cropped at 50 x 25 cm. The treatments were assigned using a randomised complete block design with four replications. Apart from hoe weeding which was consistent, all other treatments were repeated after 12 months. Papaya stands in plots received N-P-K 15-15-15 fertiliser at 250 kg/ha/year.

Weed dry weight was determined from fixed quadrats and expressed as g/m^2. The average of the two years at 5, 9 and 12 MAP is presented. The fruits of the pumpkin species and groundnut were harvested and weighed after three months corresponding to 5 MAP papaya.

Papaya plant height, stem diameter at 300 mm above ground level, and days to 50% flowering were recorded. Fruits were harvested weekly at the matured green stage and each fruit weight was recorded. The number of fruits harvested was pooled quarterly for each year. Number of fruits was presented on a per plant basis. Partial budgeting was carried out to assess the profitability of using each weed control strategy. Data collected were subjected to analysis of variance (ANOVA) using PROC GLM (SAS Inst., 1996).

Results and Discussion

Weed control methods did not significantly affect plant height and stem diameter of papaya but the use of chemical as a means of weeding gave the least number of days to 50% flowering (Table 1) being 35 days (20%) quicker than hand weeding. This is useful for commercial farmers who can get their produce to market earlier.

Table 1: Effects of weed control strategies on the growth, yield and revenue from papaya.

Treatment	Plant height (cm)		Stem diameter (cm)		Days to 50% flowering	Weed dry matter (g/m2)			Fruit yield (t/ha)	Revenue x N10000
	5	7	5	7		5	9	12		
Months after planting							MAP			
Hoe weeding	105	126	3.3	3.8	176	44	24	419	66.60	320.00
Delsate	98	119	3.1	4.1	141	9	12	125	94.50	471.20
Yellow Pumpkin	133	103	2.8	2.8	155	47	223	463	80.40	393.76
White Pumpkin	94	110	2.7	3.3	162	36	13	457	83.10	409.35
Groundnut	88	107	2.5	3.1	156	20	25	365	76.14	374.49

LSD (5%)	76.4	26	1.4	1.6	17.3	11	7	102	10.25	-

The weed dry matter (WDM) at 5 MAP showed that chemical weed control gave the least WDM (8.8 g/m?) which was 79, 81, 75 and 56% lower than the hand weeding; yellow pumpkin intercrop, white pumpkin intercrop and groundnut intercrop, respectively. At 9 MAP, there was a general weed reduction in all the treatments. This was due to the dry season generally observed during the period from November to March. Glyphosate has been known to be systemic in species like *Imperata cylindrica* (Akobundu 1987; Aalbers 2001) and therefore provide better control.

The pattern of the total number of fruit per plant-collected quarterly showed that, irrespective of the weed control methods, fruit production in papaya was lowest in the first quarter (January-March) and highest in the last quarter (October-December) of the year (Figure 1). This may be due to reduced pollination by moths and other insects in the dry months (Elder *et al*., 2000). At 12MAP, a general increase in WDM was observed. The highest WDM (463 g/m?) was obtained in papaya + yellow pumpkin. This was 73% higher and significantly different from chemical weed control (125 g/m?) showing the benefit of spraying the weeds.
The overall fruit weight indicated that chemical weed control significantly produced the highest fruit yield (94.50 tons/ha) in the two-year harvests (Table 1). This was 42% higher than the least fruit yield (66.60 tons/ha) obtained in hand weeding. Among the intercrops, papaya + groundnut gave the least fruit yield of 76.14 tons/ha. This response to weeding methods was probably due to better use of the total soil volume which remains undisturbed in plots with chemical weeding and lower soil temperature in the first few centimetres. In hand weeding and groundnut intercrop the soil was disturbed during weeding and every harvest. It is also possible that manipulation of the soil might have led to flower drop thereby reducing the number of flowers that eventually reach the fruit formation stage as observed by Kouame (personal communication). Moreover, it has been observed that tree yield (fruit weight and number) was greater on trees without weed competition than on those in weedy controls (Al-Hinal and Roper 2001). Since the chemical weed control was weed free for most of the year it is likely this resulted in better fruit formation.

Conclusion

This study has shown the use of herbicide in papaya is a valuable management practice promoting earlier flowering and increasing yield. It may also be useful information to solving the problem of labour shortage for would-be papaya farmers.

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