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Effect of shade and intercropping in the management of sweetpotato virus disease in Uganda

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Abstract. Experiments were conducted in Uganda for two seasons during 2002 to investigate the effect of intercropping and shade on activities of whiteflies (*Bemisia tabaci*), the main vector of sweetpotato virus disease (SPVD). SPVD is the major disease constraining sweetpotato production in Uganda. The intercrop experiment consisted of the following treatments: sweetpotato sole, sweetpotato + maize, maize sole, sweetpotato + trap, sweetpotato + maize + trap and unplanted plot with trap. Traps were used to monitor whiteflies abundance in different treatments. Traps consisted of bright yellow sticky strip wrapped on 10-cm diameter plastic tubes 30 cm from the ground. For the shade experiment, sweetpotato plots of 5 x 5 m were established with temporary shade made of papyrus mats 1.5 m above the ground. Treatments under the shade trial were sole sweetpotato, sweetpotato + trap, sweetpotato + shade, sweetpotato + shade + trap, shade + trap and empty plot with trap. There were significantly more nymphs and adult whiteflies on sweetpotato in sole than in the sweetpotato maize intercrop plots. Traps located in sole sweetpotato plots also captured higher numbers of whiteflies. However, mean number of plants with SPVD symptoms was similar in intercropped and sole sweetpotato plots. There was no significant difference in storage root yield for intercropped sweetpotato and sole sweetpotato. Maize yield was not affected by intercropping. Shade did not have a significant effect on number of whiteflies, nymphs or infected plants but shaded plots yielded least in both seasons. This work shows that maize may act as a guard crop without being affected or affecting sweetpotato crop yet checking on SPVD vectors, the whiteflies.

Introduction

Sweetpotato virus disease (SPVD) remains the most single important disease of sweetpotato, occurring whenever the crop is grown (Geddes, 1990; Carey *et al.*, 1999). Ngeve and Bouwkamp (1991) reported loss associated with yield to have ranged from 0-90% in a three-year field study of SPVD. SPVD results when two viruses: the non-persistently aphid-transmitted virus *Sweetpotato feathery mottle virus* (SPFMV) (Potyviridae*: Potyvirus*) and the semi-persistently whitefly-transmitted *sweetpotato chlorotic stunt virus* (SPCSV) (*Closteroviridae: Crinivirus*) co-infect sweetpotato at the same time (Gibson *et al.*, 1998). SPCSV synergises the infection of SPFMV (Karyeija *et al.*, 1998) and appears to be the key in the spread of SPVD, being closely associated with the prevalence of whiteflies on crops (Aritua *et al.*, 1999). According to Moyer and Salazar (1989) virtually all sweetpotato grown from nonvirus-tested materials revealed the presence of one or more viruses. Often, farmers have practiced cultural methods knowing or unknowingly which has resulted in farmers keeping the incidence of this disease quite low, though some local cultivars have been lost due to the same disease. Notably among the practices are selections of 'clean' planting material (personal observation), intercroping (Ndunguru *et al.*, 2000) and use of shade (Gibson, pers. Communication). Although scanty information exists on selection and shade in management of diseases, a lot has been reported on intercropping (Gold, 1990; Ekesi *et al.*, 1999; Khan, *et al.* 2000).

Intercrops have been reported to reduce pest incidence and damage to the principle crop (Trenbath, 1993; Baliddawa, 1995) and in Uganda, have been reported as a component of IPM strategies for beans (Kyamanywa and Tukahirwa, 1988; Ogenga-Latigo *et al.*, 1992). Also studies by Ekesi *et al*. (1999) provided some evidence that intercropping improved control of thrips on cowpea by the entomo-pathogenic fungus *Meterhizium animsopliae*. Interccropping maize with napier grass and *Desmodium* sp. in Kenya has been proposed against *lipidopteran* stem borers and striga (Khan, *et al.* 2000). Intercropping the tropical rootcrop cassava with maize or cowpeas resulted in lower whitefly populations of the two species, *Aleurotrachelus socialis* and *Trialeurodes variabilis* compared to monocropped cassava. Higher whitefly populations preferred the more vigorous monocropped cassava (Gold *et al.*, 1990).

Also reports indicate whiteflies are weak fliers, relying on air currents for both short and long distance migration (Byrne & Bellows 1991, Byrne *et al.* 1996). Several tall-growing non-host plants, primarily in the family Gramineae, have been tested as barrier crops or intercrops to reduce whitefly colonization and virus transmission among main crops mainly on vegetables. Maize as an intercrop in sweetpotato is hoped to limit activities of whiteflies hence limiting spread of SPVD. This work was set to evaluate the effect of maize crop as a barrier and temporary shade in the management of whiteflies

Materials and Methods

The trials were planted at Namulonge Agricultural and Animal production Institute (NAARI) for two seasons. First planting was done on 30/4/2002 and the second 16/9/2002. Treatments were sole sweetpotato (cultivar 'Tanzania'), sweetpotato + maize, maize sole, sweetpotato with sticky traps, sweetpotato + maize with sticky traps, empty plot with sticky trap. Vine cuttings of cultivar 'Tanzania' infected with SPVD were planted around experimental plots to provide infector inoculum. Plot size was 5 x 5 m and planting was done on ridges with intra-row spacing of 15 cm. Maize was planted between ridges and 15cm within the rows. The design used was complete randomized block with 4 replications. Sticky traps made of bright yellow plastic (Oecos Ltd, UK: Yellow roller traps) double adhesive stripes 75 mm wide wrapped at 50 cm above the ground on 60 cm plastic poles were used to improve the whiteflies estimates in intercropped and non intercropped plots. One trap was placed at the centre of each treatment. The sticky tape would be changed every after data taking. For the shade experiment, treatments were trap in empty plot, trap with shade, trap + sweetpotato + shade, sweetpotato alone, sweetpotato + trap and sweetpotato + shade, making six plots in all. Covers made from papyrus mats placed approximately 1.5 m above the ground were raised on plots to provide temporally shade. Trap setting was as above. The following data were collected: number of sweetpotato plants infected per week, number of whitefly nymphs on sweetpotato on 4 randomly selected plants once a week, number of adult whiteflies on sweetpotato on two ridges once a week, number of whiteflies on traps twice a week. At harvest (three and half months for maize, five months for sweetpotato) grain yield and storage root yield were recorded.

Results and Discussion

Nymphs, adult whiteflies and infected plants in intercropped and non-intercropped plots. Number of nymphs and adult whiteflies on middle two ridges and mean number infected plants are shown in Table 1. There were significantly more nymphs and adult whiteflies in sole sweetpotato compared to the intercropped sweetpotato plots. However, mean number of plants with SPVD symptoms was similar. Similarly, there was significantly high number of whiteflies trapped in plots with sole sweetpotato compared to the intercropped ones (Table 2). This may be a result of the shielding effect of maize that possibly interfered with the movement of whiteflies. This result concurs with findings of Gold (1990) that intercropping cassava with maize or cowpea resulted in lower whitefly populations of the two species, *Aleurotrachelus socialis* and *Trialeurodes variabilis* compared to monocropped cassava. Although Hugh and McSorley (1997) reported limited effect of corn as a barrier crop in beans in the management of whiteflies, use of maize in sweetpotato appears to be effective in reducing numbers of whiteflies infesting the crop.

Storage root yield of sweetpotato and grain yield of maize. There was no significant difference in storage root yield for intercropped sweetpotato and sole sweetpotato (Table 3). The first season had poor yield because of drought that set in early in the season. The yield of maize was not affected by intercropping. Both intercropped and sole maize plots had statistically similar grain yield. This is similar to results obtained when maize was intercropped with cauliflower

Table 1: Nymphs, adult whiteflies and infected plants in intercropped and non-intercropped plots during the two seasons 2002a and b.

Treatment	No. nymphs	Adult whiteflies (two middle row)	Infected plants
2002a			
Sweet potato	5.88a	49.64a	0.39
Sweet potato/maize	3.99b	26.0b	0.33
LSD (0.05)	1.5	8.5	NS
CV (%)	64.6	47.7	
2002b			
Sweet potato	5.3a	88.4a	0.71
Sweet potato/maize	3.4b	38.6b	0.68
LSD (0.05)	1.4	15.1	NS
CV (%)	69.9	50.3	

Table 2: Mean number of whiteflies trapped in sweet potato/maize plots during the two seasons 2002a and b.

Treatment	No. of whiteflies	
	2002a	2002b
Sweet potato/trap	47.3a	50.63a
Sweet potato/trap/maize	42.9a	35.14b
Trap	32.4b	26.84c
LSD (0.05)	4.95	5.68
CV (%)	28.7	34.19

Table 3: Storage root and grain yield of sole and intercropped sweet potato and maize during 2002a and b.

Treatment	Marketable storage root weight (t/ha)	Maize yield (t/ha)
2002a		
Sweet potato/Trap	5.7	
Sweet potato	5.1	
Sweet potato/Maize	3.4	0.96
Sweet potato/Maize/trap	3.1	0.87
Maize		0.72
LSD (0.05)	NS	NS
CV (%)	48.5	26.8
2002b		
Sweet potato/Trap	11.49	
Sweet potato	9.10	
Sweet potato/Maize	6.41	2.52
Sweet potato/Maize/trap	5.65	2.96
Maize		2.37
LSD (0.05)	NS	NS
CV (%)	74.39	19.65

(Kasetsart, 1997). Gold *et al*. (1990) also reported similar findings that a maize intercrop did not affect yield of cassava. The fact that maize does not affect the yield of sweetpotato means that farmers can use the intercrop to manage whiteflies without losses in yields of either crop.

Effect of shade on adult whiteflies, nymphs, SPVD and yield. Shade did not have a significant effect on number of whiteflies and nymph populations and mean SPVD infected plants. However, there were slightly more adult whiteflies in unshaded plots than the shaded ones in both seasons (Table 4). In the second season, there were significantly more nymphs in shaded plots than unshaded. Trap catches varied significantly with treatment. Shaded plots had fewer whiteflies trapped in both seasons (Table 5). Shade did not have any effect on adult whiteflies and nymphs in the first season probably due to high rainfall, compared to second season, which was relatively dry. The more nymphs recorded in shaded plots of sweetpotato in the second season could have been due to microclimate effects created under shade favouring oviposition.

Yield varied significantly, unshaded plots yielding highest and shaded least in both seasons (Table 6). Weight of vines was not significant in the first season (probably due to poor weather) but varied in second season with shaded plots having least weight. Also the mean number of marketable storage roots per plant was lowest in shaded plots. Shade encourages vegetative growth and therefore affects yield. In addition, less radiation reaches the leaves in shaded plots, reducing the net Photosynthetically Active Radiation (PAR), hence affecting yield. Abdel-Mawgoud *et al*. (1995) found out that shade reduced total dry matter production significantly although it did not affect the fruit yield in tomatoes.

This work has shown that intercropping sweetpotato with maize does not affect yield of either crops. It also shows that maize acts

Table 4: Nymphs, adult whiteflies and mean infected plants in shaded and unshaded sweet potato plots during 2002a and b.

Treatment	Season					
	2002a			2002b		
	Number of adult whiteflies on two middle ridges	Average no. of nymphs	Average no. of infected plants	Number of adult whiteflies on plants	Average no. of nymphs	Average no. of infected plants
Shade	2.69	0.26	0.48	63.03	31.87a	0.13
Unshaded	3.56	0.22	0.30	52.89	6.25b	0.19
LSD (0.05)	NS	NS	NS	NS	8.9	NS

Table 5: Whiteflies on traps placed in shaded, empty and sweet potato plots during 2002a and b.

Treatment	Number of adult whitefly on trap	
	2002a	2002b
Sweet potato/trap	7.39a	12.89a
Trap	9.22a	9.37b
Shade/trap/sweet potato	2.17b	7.45b
Shade/trap	1.69b	4.45c
CV (%)	89.7	55.2

Table 6: Weight of vines, average marketable storage roots/plant and marketable fresh weight in shade and unshaded plots of sweet potato during 2002a and 2002b.

Treatment	Weight of vines (5plants)	Average marketable	Storage roots/plant
2002A			
Marketable yield (t/ha)			
Sweet potato/shade	9.2	0.16b	1.49b
Sweet potato	8.9	0.78a	10.52a
Sweet potato trap	8.0	0.67a	9.04a
Sweet potato/shade/trap	6.4	0.22b	2.24b
LSD		0.25	3.42
2002B			
Sweet potato/shade	8.23c	0.21b	1.64b
Sweet potato	21.23a	1.80a	13.80a
Sweet potato trap	12.93b	1.40ab	13.06a
Sweet potato/shade/trap	4.47c	0.21b	1.64b
LSD	4.69	1.33	11.76

as a barrier to movement of whiteflies. This could further be explored by altering dates of planting and spacing. The shade effect on yield was significant. Farmers may plant under shade to conserve planting material but it may not be effective as a management option for controlling sweetpotato virus disease.

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