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4.6. INTERCROPPING EFFECTS ON INSECT PESTS OF CASSAVA IN COLOMBIA AND OF GROUNDNUT IN INDIA

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INTRODUCTION

Diversified agroecosystems often support a lower herbivore load than corresponding monocultures. For example, Andow (1983) and Risch *et al.* (1983) report that, for the 198 species studied, 53% were less abundant in diversified systems than in monoculture, 18% were less abundant, 9% were not affected by cropping system, and 20% showed a varied response. Reduced pest incidence in polyculture has most often occurred for monophagous insects in systems containing a nonhost (Risch, 1980; Risch *et al.*, 1983).

Lower herbivore load in diversified systems has been attributed to increased efficacy of natural enemies (Root, 1973; Sheehan, 1986) and differences in "resource concentration" by which host plants concentrated in pure stands are more easily colonized by insect pests (Tahvanainen and Root, 1972; Root, 1973).

To date, research on crop diversity and insects has focussed almost entirely on herbivores attacking plant parts above the ground (Andow, 1983). Where the distribution of soil arthropods, such as white grubs, some chrysomelids, and the potato tuberworm (*Phthorimaea operculella* (Zeller)) is dependent on an aerial adult stage the same mechanisms may affect rates of host location and oviposition. However, arthropods which pass most of their life cycle in the soil, such as termites, may perceive the agroecosystem differently than aerial insects and are more likely to be generalists, relatively sedentary, and present in fields prior to planting.

In this paper we compare and contrast the effects of intercropping on one aerial and one soil insect which attack cassava in Colombia. First, we summarize work done on the effects of intercropping cassava with cowpea and with maize on the whitefly *Aleurotrachelus socialis* Bondar (Gold, 1987). Then we report the effects of intercropping with *Crotolaria juncea* L., a promising plant for the control of soil insects, on the cassava burrowing bug, *Cyrtomenus bergi* Froeschner (Vargas *et al.*, 1987. Finally, we present preliminary data

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from an ongoing study on the effects of *C. juncea* on groundnut herbivores in the state of Andhra Pradesh, India.

CASE STUDIES

1. Intercropping and cassava pests

In the study of intercropping and the whitefly, *A. socialis*, the cowpea and maize intercrops were harvested at 17 weeks after planting (WAP) whereas cassava was not harvested until 45 WAP, therefore, we divided the cassava cycle into four time periods: *Establishment* (4 – 6 WAP), *Preharvest* (8–16 WAP), *Postharvest* (18–35 WAP), and *Mature* (39–45 WAP).

Over the entire trial, *A. socialis* egg populations per half leaf lobe were significantly lower in cassava/cowpea systems than in other treatments. Populations in this intercrop averaged 46.2% lower than those in monoculture. Egg populations were equal between the other systems. Effects of intercropping with cowea on *A. socialis* populations appeared at 6 WAP and remained throughout the trial with the greatest reductions in egg numbers occurring after cowpea harvest. Egg populations in the cassava/cowpea plots were 36.3% lower than in monoculture during preharvest phase and 59.2% lower in the postharvest period. At the end of the trial, 27 weeks after intercrop harvest, there were 52.4% fewer *A. socialis* eggs in cassava/cowpea systems than in monoculture.

Natural enemies were not a factor in treatment effects on cassava whiteflies. The coccinellid *Delphastus pusillus* Leconte displayed a functional response and was more abundant in monoculture (Gold *et al.*, 1989) and nymphal mortality was similar between treatments (Gold, 1987). Parasites emerging from *A. socialis* pupae exerted substantial mortality but rates (49% in the two intercrops and 54% in monoculture) were also equal between treatments (Gold *et al.*, 1989). Treatment effects, therefore, must have been most influential on the behaviour and host plant selection of adult whiteflies.

The burrowing bug, *C. bergi*, is a direct pest on cassava. It attacks the edible roots athough damage cannot be detected until they are peeled. Damaged roots are commercially unacceptable and if 20 to 30% of the roots are attacked, the entire crop can be rejected (CIAT, 1987). *C. bergi* is a polyphagous pest and, with a life cycle of up to two years (Bellotti *et al.*, 1985), may be abundant prior to planting of crops.

Preliminary trials in fields heavily infested by the cassava burrowing bug demonstrated that cassava intercropped with sunnhemp suffered less than 5% root damage with only moderate reductions in root production (Bellotti *et al.*, 1985). Laboratory studies suggest that sunnhemp produces an exudate that acts as a repellent to the burrowing bug (CIAT, 1987). However, it appears that the exudate quickly breaks down and there is no residual effect after the sunnhemp harvest. Whereas the cycle of sunnhemp is half that of cassava, the intercrop had to be double cropped to relaize full effects on burrowing bug damage levels.

In an attempt to reduce burrowing bug damage without cost in cassava root production, cassava was grown in monoculture, in rotation with sunnhemp, and intercropped with sunnhemp at varying densities. Attack by *C. bergi* was significantly lower than in monoculture only in systems where cassava and sunnhemp were grown in alternate rows (Table 1). Placement of a row of sunnhemp for every two rows of cassava had no effect on root damage (Vargas *et al.*, 1987). Although cassava yields were significantly lower in systems containing sunnhemp in alternate rows than in all other treatments, the reduction in root damage made this the only economically viable system.

Table 1. Cropping system effects on cassava yields and damage by the burrowing bug, *Cyrtomenus bergi* in Santagueda, Dept. of Caldas, Colombia. 1985/1986

Cropping system	Yield (t/ha)	Roots damaged (%)	Grade of damage
Cassava + crotalaria (alternate rows)	29.9 B[1]	5.0 B	0.4 B
Crotalaria - cassava (rotation)	40.6 A	76.2 A	3.4 A
Cassava (monoculture)	39.9 A	90.0 A	3.7 A

1. The same letter in the same column indicates treaments not significantly different by Duncan multiple range test; $P < .05$

Source: Vargas *et al.* (1987)

2. Intercropping and groundnut pests

Groundnut (*Arachis hypogaea* L.) is grown through much of the semi-arid tropics. Although often a cash crop, intercropping systems with groundnut are common in parts of Africa (Norman, 1974). In India, intercropping of groundnut is most often found on marginal lands (Walker pers. comm.). Termites are a major problem in parts of Africa and India and, to date, methods of control are limited (Wightman and Amin, 1988). Use of an intercrop, such as sunnhemp, which could lower yield losses to direct pests, such as termites, would probably be rapidly adapted by farmers. We are currently investigating the effects of sunnhemp on groundnut termites. Here we present results of a preliminary trial in which we looked at the effects of sunnhemp on the groundnut thrips, *Scirtothrips dorsalis* Hood and *Frankliniella schultzei* (Trybom).

DISCUSSION

In all three studies, the intercropped systems supported a lower herbivore load than corresponding monocultures. In the case of cassava, lower whitefly populations and burrowing bug incidence in intercrops resulted in higher cassava yield in these systems than in monoculture. Populations of groundnut thrips did not exceed economic injury levels and no yield advantages were presented by the intercropping combinations used.

Sunnhemp roots produce phenolic compounds (Kandasamy and Prasad, 1979) which may act as a repellent or be toxic to soil insects is believed to be through an exudate (CIAT, 1987). Our results suggest that the effects of this exudate are short-lived and occur in a very narrow area around the sunnhemp plant. No residual effects persisted after sunnhemp harvest and high densities of this intercrop were required for it to be effective. Additionally, the reinvasion of cassava fields by these bugs after sunnhemp removal suggest that the insects are highly mobile.

Cropping system effects on herbivore colonization rates may be far less important for polyphagous soil insects, such as termites, leafcutter ants, some whitegrubs, and the cassava burrowing bug, which are present in fields prior to planting. The mobility of soil insets may be more limited than aerial insects. For example, olfaction in termites is believed to be important over only a few centimetres (Waller and La Fage, 1987). Additionally, dispersal out of fields is greatly facilitated by aerial movement. Cassava whiteflies landing on nonhosts

often flew upward and were quickly carried out of the system by wind currents (Gold, 1987). In contrast, the repellent effects of sunnhemp appear to be limited in space and dispersing burrowing bugs and dispersal appears to be limited to leaving the zone of sunnhemp exudates. Finally, microenvironments affecting soil arthropods (soil texture, mositure) are likely to be quite different than those affecting aerial insects (wind, shade, relative humidity).

SUMMARY

In Colombia, populations of the whitefly, *Aleurotrachelus socialis* Bondar were lower on cassava intercropped with cowpea than on cassava in monoculture. The intercrop affected whitefly load through changes in host plant quality and this effect persisted for up to six months after cowpea harvest. Cassava intercropped with sunnhemp suffered less root damage from the burrowing bug, *Cyrtomenus bergi* Froeschner, than cassava in monoculture. Lower herbivore load was attributed to root exudates of short persistence and localized. In India, groundnut thrips populations were lower in sunnhemp intercrops, presumably due to barrier effects or differences in microclimate.

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