A COMPARISON OF SOME ARTHROPOD GROUPS ON MONOCROPPED AND INTERCROPPED TOMATO IN BAJA VERAPAZ, GUATEMALA

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There is evidence that intercropping with certain plant species can be used to increase numbers of beneficial insects by providing them with food sources such as pollen, nectar, and alternate prey (Pimentel 1961, Root 1973, Altieri and Letourneau 1982, Corbett 1998). In 1998, a survey was carried out in the Salamá valley, a tomato-growing region in central Guatemala, to determine if levels of arthropods were different on tomato (*Lycopersicon esculentum* Mill.) intercropped with cilantro (*Coriandrum sativum* L.), roselle (*Hibiscus sabdariffa* L.), and velvetbean (*Mucuna deeringiana* (Bort.) Small) compared to levels on monocropped tomato. Three pesticide subplot treatments were included to assess pesticide effects on non-target arthropods.

The research was carried out at the Instituto de Ciencia y Tecnología Agrícolas (ICTA) field station in San Jerónimo (15°03'N, 90°15'W, elevation 1000 m), Baja Verapaz, Guatemala. A split-plot design was used with two whole-plot treatments (monocrop and intercrop tomato) and three subplot pesticide treatments (imidacloprid, a detergent/oil rotation, and control). Each treatment was replicated four times.

Whole plots contained nine rows, 17 m in length. Between-row spacing was 1.0 m. Monocrop plots consisted of eight rows of tomato, cv Elios. Intercrop plots consisted of nine rows of the tomato/intercrop mix. Spacing between plants was 20 cm for cilantro and velvetbean and 40 cm for tomato and roselle. Intercrop species were planted 25-26 March. Tomato was transplanted 28 April-6 May.

Each whole plot was divided into 3 sections, each 5.67 m in length. These sections were randomly assigned to the imidacloprid treatment, the detergent and oil treatment, or the control. Imidacloprid (Confidor 70 WG, Bayer, Germany) was prepared at a rate of 0.73 g/liter of water. Approximately 10 cc of this mixture (73 mg imidacloprid) was applied to the base of each tomato plant on three occasions (Smith 1999). Olmeca® vegetable oil (Olmeca S.A., Guatemala) and Unox® laundry detergent (Quimicas Lasser S.A., El Salvador) were applied at a rate of 1%, or 16 cc/16 liter spray tank (Calderón et al. 1993). Detergent or oil was applied in rotation every five days.

On 3 July, one beat cloth sample per subplot was collected at random from each row of cilantro, roselle, and velvetbean. One beat cloth sample was taken from intercrop tomato in rows two and four of each subplot. These rows were situated between velvetbean and roselle and roselle and cilantro, respectively. One beat cloth sample was taken from monocrop tomato in rows two and four of each subplot. Tomato was producing flowers and green fruit, and cilantro was flowering when the samples were collected. Roselle and velvetbean had foliage only.

To collect beat cloth samples, a 1.0-m × 0.75 m plastic sheet (Olefinas, S. A., Guatemala) was spread out on a wooden board at the base of the crop row. The plants were struck manually four times to dislodge arthropods toward the sheet. Arthropods were grouped as spiders, insect predators, hemipteran herbivores, and Coleoptera. Most insects and spiders were classified to family. Pentatomids were grouped as phytophagous or predaceous based on buccal morphology (Slater and Baranowski 1978).

Analysis of variance (SAS 1996) was used to compare numbers of arthropods among main effect treatments and among intercrop species. Tukey's studentized range procedure was used to separate means when appropriate.

Insect predators consisted primarily of both adult and immature *Geocoris* (Lygaeidae), assassin bugs (Reduviidae), and ladybird beetles (Coccinellidae) (Table 1). *Engytatus modesta* (Distant) (Miridae), the tomato bug, comprised 92% of herbivorous Hemiptera recovered, and was found predominantly on tomato (Table 1). About 68% of the herbivorous Coleoptera recovered belonged to the Chrysomelidae and Elateridae. Proportions of various groups were influenced by the fact that four times as many samples were taken from tomato (48) as from each of the other crops (12).

There were too few insect predators on intercropped and monocropped tomato for meaningful comparisons. There were no differences ($p > 0.1$) between monocropped and intercropped tomato in total numbers of spiders, hemipteran herbivores, or Coleoptera (Table 2). Spiders were the primary predatory group found on tomato (Table 2). Spider levels were higher ($p < 0.05$) on unsprayed tomato than on tomato that had been treated with imidacloprid or the detergent and oil rotation (Table 2). Numbers of hemipteran herbivores were higher ($p < 0.1$) on tomato treated with detergent and oil than the other two treatments.

When arthropod levels on different intercrop species were compared, it was evident that levels of insect predators were highest ($p < 0.05$) on cilantro. Hemipteran herbivores (primarily *Engytatus modesta*) were most numerous ($p < 0.05$) on intercropped, unsprayed tomato. Beetle densities were highest ($p < 0.05$) on roselle and velvetbean. Spiders were unaffected by plant species.

These preliminary observations suggest that the arthropod groups on tomato were apparently unaffected by the proximity of different crops supporting distinct arthropod communities. The data also demonstrate the predominance of spiders as preda-

TABLE 1. ARTHROPOD GROUPS COLLECTED FROM SAMPLES ON FOUR CROPS IN BAJA VERAPAZ, GUATEMALA.

Family	Individuals	Crops[1]
ARANEAE		
Thomisidae	34	Cilantro, tomato, velvetbean
Lycosidae	18	Cilantro, tomato, velvetbean
Oxyopidae	22	Cilantro, roselle, tomato
Tetragnathidae	8	Tomato
Theridiidae	7	Roselle, tomato, velvetbean
Salticidae	6	Cilantro, tomato
Oxyopidae	4	Tomato
Araneidae	3	Cilantro, tomato
Philodromidae	2	Cilantro, tomato
Theridiidae	2	Tomato
Corinnidae	1	Velvetbean
Dictynidae	1	Tomato
HEMIPTERA		
Lygaeidae (*Geocoris*†)	46	Cilantro, roselle, tomato, velvetbean
Reduviidae†	27	Cilantro, roselle, tomato, velvetbean
Pentatomidae (herbivore)	19	Cilantro, tomato, velvetbean
Lygaeidae (herbivore)	14	Tomato, velvetbean
Pyrrhocoridae	13	Roselle, velvetbean
Largidae	7	Cilantro, tomato
Coreidae	5	Tomato
Pentatomidae†	2	Tomato, velvetbean
COLEOPTERA		
Chrysomelidae	49	Cilantro, roselle, tomato, velvetbean
Elateridae	28	Roselle, velvetbean
Coccinellidae†	18	Cilantro, roselle, tomato, velvetbean
Cicindellidae†	16	Velvetbean
Anthicidae	8	Cilantro, roselle
Meloidae	7	Cilantro, velvetbean
Erotylidae	4	Roselle, tomato, velvetbean
Nitidulidae	3	Cilantro, roselle
Cleridae	3	Cilantro
Lampyridae	2	Tomato
?	5	Cilantro
Staphylinidae	1	Tomato
Tenebrionidae	1	Velvetbean
Histeridae	1	Cilantro
Mordellidae	1	Cilantro
DIPTERA		
Syrphidae†	9	Cilantro, tomato
NEUROPTERA		
Chrysopidae†	2	Roselle, tomato

[1]Four times as many beat cloth samples were taken from tomato (48) as from each of the other crops (12).
†Indicates insect predator.

TABLE 2. EFFECT OF CROPPING TREATMENT, CROP SPECIES AND PESTICIDE TREATMENT (APPLIED TO TOMATO ONLY) ON ARTHROPOD NUMBERS PER 0.75-M^2 BEAT CLOTH SAMPLE COLLECTED IN BAJA VERAPAZ, GUATEMALA.

Treatment	Spiders	Insect predators	Hemipteran herbivores	Beetles
Cropping treatment				
Intercrop tomato	1.00 ± 1.15a	0.04 ± 0.21a	8.04 ± 7.47a	0.35 ± 0.67a
Monocrop tomato	1.67 ± 1.61a	0a	11.88 ± 11.88a	0.33 ± 0.64a
Pesticide treatment				
Imidacloprid	0.81 ± 0.98a[1]	—	9.67 ± 8.76a	0.40 ± 0.74a
Detergent/oil	1.07 ± 1.27a	—	13.36 ± 14.32b	0.29 ± 0.61a
Control	2.12 ± 1.67b	—	7.50 ± 5.87a	0.33 ± 0.62a
Intercrop species				
Tomato	1.75 ± 1.39a[1]	0.75 ± 0.71b	6.25 ± 4.89a	0.33 ± 0.82b
Cilantro	3.75 ± 3.40a	6.50 ± 5.26a	2.25 ± 0.96b	2.00 ± 2.16ab
Roselle	0.74 ± 0.50a	1.25 ± 0.50b	2.25 ± 3.20b	5.50 ± 3.11a
Velvetbean	1.25 ± 0.50a	1.50 ± 1.00b	1.25 ± 0.96b	4.00 ± 1.83a

[1]Data are means ± SD of eight replications (two main plot treatments and four replications). Means for each effect within a column followed by the same letter do not differ ($p < 0.1$) according to Tukey's studentized range test.

tors on tomato, and indicate the negative effect of some pesticides on spider numbers. The results suggest that cilantro may be a useful crop for augmenting levels of generalist predators in some cropping systems, although movement to target crops could be problematic.

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Summary

Levels of insect predators and spiders did not differ on monocropped tomato from levels on tomato intercropped with cilantro, roselle and velvetbean. Among the intercrop plants tested, cilantro supported the highest number of predators.

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