Orchard Management Effects on the Arthropod Community on Peach with Comparison to Apple [1]

M. W. Brown and Gary J. Puterka

U. S. Department of Agriculture, Agricultural Research Service,
Appalachian Fruit Research Station, 45 Wiltshire Road,
Kearneysville, WV 25430 U.S.A.

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ABSTRACT One hundred sixty-two species were recorded as part of the arthropod community associated with peach in eastern West Virginia. The community was composed of 33% phytophages, 35% insectivores, 14% scavengers, and 18% tourists. Diversity of the anthropod community was correlated inversely with intensity of orchard management. Comparing the phytophagous community on apple (from an earlier study) with that on peach, Lepidoptera comprised 49% on apple and only 31% on peach; Hemiptera comprised 9% on apple and 19% on peach. Diversity of the phytophagous arthropod community was significantly less in peach than in apple orchards, but was more similar in commercially-managed orchards than in unmanaged orchards. It is concluded that in commercially-managed peach and apple orchards insecticide use is the dominant factor controlling community structure, whereas, in unmanaged orchards the communities in peach and apple evolve into distinctly different communities. The presence of cyanogenic glycosides in peach, extrafloral nectaries on peach, and the relatively smaller species pool available to colonize peach are considered major factors for the difference in arthropod community structure in peach and apple.

KEY WORDS Species diversity, community structure, faunistic study *Prunus persica, Malus domestica*

Successful pest management in any crop system requires knowledge of the complex interactions among pest and beneficial species and higher ecosystem dynamics (Levins 1986). Fewer and more selective pesticides are being used as a result of public concerns, stricter registration regulations, and development of pesticide resistance. Consequently, there is a greater reliance on non-chemical controls, including biological control. With the reduction in broad-spectrum insecticides, pest management is becoming more knowledge-intensive, requiring a deeper understanding of ecological interactions within the agroecosystem. Tree fruit systems present a more complicated environment to manage because greater persistence than other agroecosystems allows development of a more evolved community of arthropods (Hull et al. 1983). The more complicated environment and more evolved community also provide greater opportunities to develop ecologically-balanced pest management.

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Little research has been done on the structure of arthropod communities on peach beyond faunistic studies (Gorsuch et al. 1989). The arthropod community of apple has been studied extensively, especially regarding faunistic studies (Oatman et al. 1964, Horsburg and Asquith 1968). Recently, there has been more analysis of the ecological interactions in the arthropod community on apple and how the community itself reacts to internal and external influences (Brown and Adler 1989, Szentkirályi and Kozár 1991, Brown 1993). The guild structure of arthropods in pear also has been analyzed (Liss et al. 1986).

This study was conducted to analyze the arthropod community in peach and evaluate the effect thereon of different intensities of orchard management. Level of pesticide use was the main difference in orchard management, but the level of horticultural management also varied. Comparisons are made with the arthropod community structure on apple in the same geographical region as reported by Brown and Adler (1989).

Materials and Methods

Three peach orchards at the Appalachian Fruit Research Station, Kearneysville, WV, were sampled in 1991. The first orchard, planted in 1985, was managed using commercial practices including annual pruning, fertilization with 450 kg/ha 10-10-10 (N-P-K), irrigation, and intensive orchard floor management to eliminate broadleaf weeds. There were eight insecticide applications in 1991: dormant oil, 19 liters/ha, on 26 March; parathion, 0.2 kg (Al)/ha on 4 May and 13 May; chlorpyrifos, 1.7 kg (Al)/ha, on 15 May; azinphosmethyl, 1.1 kg (Al)/ha, on 22 May and 31 May; and carbaryl 2.8 kg (Al)/ha, on 13 June and 25 June. There were also eight applications of fungicides: ferbam, 1.7 kg (Al)/ha, on 26 March; captan, 2.2 kg (Al)/ha, on 4, 13 and 31 May; thiophanate-methyl, 0.78 kg (Al)/ha, on 4, 13, and 22 May; and sulfur, 16 kg (Al)/ha, on 22 May, 13 and 25 June, and 11 July.

The second orchard, also planted in 1985, was a planting of F1 crosses in the peach breeding program and was under reduced management. This orchard was not pruned or irrigated, was less intensively managed for weeds, and was fertilized with 280 kg/ha urea. Insecticides were applied 4 times in 1991: dormant oil, 19 liters/ha, on 21 March; and methomyl and phosmet, 0.3 kg (Al)/ha and 1.1 kg (Al)/ha, respectively on 1 May, 28 May, and 24 June. There were also four applications of fungicides: ferbam, 1.7 kg (Al)/ha, on 21 March; captan, 2.2 kg (Al)/ha, on 11 and 28 May; thiophanate-methyl, 1.6 kg (Al)/ha, on 24 June; and sulfur, 12.8 kg (Al)/ha, on 24 June.

The third orchard, planted in 1981, with some additional plantings in 1984 and 1985, was a planting of exotic germplasm for use in the peach breeding program. The only management this orchard received was mowing and occasional herbicide applications along the tree row to reduce competition for water and nutrients.

Orchards were sampled five times during 1991: 16 to 18 April, 14 to 17 May, 13 to 14 June, 9 to 12 July, and 21 to 28 August. Sampling was conducted at least 1 wk after the most recent insecticide application. At each sample, 6 trees were randomly selected in each orchard. Six subsamples were taken within each tree: 4 terminal branches, defined as all branches originating from a 3-year-old stem, in the mid-crown of the tree; and 2 scaffold limbs, from the tree trunk to 3-year-old wood, including minor limbs and sprouts originating from that scaffold limb. Sampling consisted of examining each branch section and recording the presence of all visible arthropods on that section. The branch was approached slowly to record the more mobile species, followed by macroscopic and then closer examination with a 10X hand lens. Unknown specimens were collected for rearing and identification in the laboratory when possible. Species identifications and confirmations were provided by personnel at the Taxonomic Services Unit, Systematic Entomology Laboratory, USDA, ARS, Beltsville, MD.

Arthropods were divided into four trophic categories: phytophages, insectivores (predators and parasites), scavengers, and tourists (Moran and Southwood 1982). The Shannon index, species richness, and dominance index (Berger and Parker 1970) were used to describe the structure of the community. Diversity was calculated using the number of branch sections on which a species was found, rather than absolute density. Using this frequency of occurrence avoided difficulties in comparing densities among arthropods with diverse body sizes and feeding methods as Acarina, Homoptera, and Lepidoptera. Comparisons among the three peach orchard communities were made with the Friedman test (Conover 1971) for species richness, and confidence intervals for Shannon's index using the variance estimate of Hutcheson (1970).

Comparisons were made between arthropod communities on peach, using results from this study, and apple, as reported by Brown and Adler (1989). Only the phytophagous portion of the community was used for comparisons because that is all Brown and Adler (1989) studied. Data from one abandoned, one organic, and two commercial orchards in the eastern panhandle in West Virginia in 1983 and 1984 were used to compare with the peach community data presented herein. The apple data set was collected similarly to the peach data except that 7 branch samples were taken from 5 apple trees. Taxonomic groups found in peach and apple orchards and diversity using species richness, Gleason's diversity (Gleason 1922), dominance index, and Shannon's index were used to make the comparisons. Diversity indices from Brown and Adler (1989) were averaged over 2 years for comparison with the diversity indices from the peach orchards. Statistical comparisons between communities were made with Wilcoxon's signed rank test (Conover 1971).

Results

Community structure. A total of 16 orders (including Chilopoda), 84 families, and 162 species were recorded as being part of the community of arthropods associated with peach (Table 1). Of these, 33% were pytoqhages, 35% were

Table 1 Percentage of branch samples (180 branch samples per orchard management type) on which each taxa was found by orchard type in the arthropod community associated with peach in Kearneysville, WV, 1991. Data are provided for the lowest taxon to which an individual was identified.

	Trophic	Management Intensity		
Order: Family: Species	Group*	None	Minimal	Commercial
Chilopoda unidentified**	T	0.6		
Acari				
Eriophyidae				
Aculus cornutus (Banks)	P	20.6	1.7	
Tetranychidae				
Panonychus ulmi (Koch)	P	8.3	19.4	46.1
Tetranychus urticae Koch	P	16.7	2.2	8.3
Phytoseiidae, unidentified	I	15.6	1.7	0.6
Stigmaeidae, unidentified	I			0.6
Araneida, unidentified	I	37.2	15.0	15.0
Collembola, unidentified	S	0.6		
Ephemeroptera, unidentified	T			0.6
Odonata				
Zygoptera, unidentified	T		0.6	
Orthoptera				
Gryllidae				
Oecanthus nigricornis Walker	P		0.6	
Blattidae, unidentified	T	0.6		
Psocoptera, unidentified	S	2.8	0.6	
Pseudocaeciliidae, unidentified	S			0.6
Thysanoptera, unidentified	P	0.6		
Heterothripidae				
Heterothrips quercicola Crawford	P		0.6	
Thripidae				
Frankliniella tritici (Fitch)	P	6.1	7.2	2.8
Neohydatothrips variabilis (Beach)	P	6.7	11.1	18.3
Scolothrips pallidus (Beach)	P	2.2		1.1
Phlaeothripidae				
Leptothrips mali (Fitch)	I	10.6	8.9	2.8
Hemiptera, unidentified	P	1.7		
Anthocoridae				
Cardiastethus sp.	I	0.6		
Orius insidiosus (Say)	I	0.6	1.7	10.0

Table 1. Continued.

Order: Family: Species	Trophic Group*	Management Intensity None	Minimal	Commercial
Miridae				
Deraeocoris nebulosus (Uhler)	I		0.6	
Halticus bractatus (Say)	P	1.7	1.1	0.6
Leptopterna dolabrata (L.)	P		0.6	
Lygus lineolaris (Palisot de Beauvois)	P	0.6	2.2	1.1
Tingidae				
Corythucha arcuata (Say)	P	2.2	1.7	0.6
C. *pruni* Osborn & Drake	P	0.6		
Lygaeidae				
Geocoris punctipes (Say)	I			0.6
Berytidae, unidentified	P	0.6		
Thyreocoridae				
Cormelaena lateralis (F.)	P	0.6		
Pentatomidae				
Brochymena quadripustulata (F.)	P	1.1		
Cosmopepla bimaculata (Thomas)	P		0.6	
Euschistus tristigmus (Say)	P	1.1		
E. servus euschistoides (Vollenhoven)	P	0.6		
Homoptera				
Membracidae, unidentified	P	1.1		
Entylia bactriana Germar	P	0.6		
Cicadellidae, unidentified	P		0.6	
Empoasca fabae (Harris)	P	3.3	4.4	3.3
Erythroneura sp.	P	3.9		0.6
Graphocephala sp.	P	0.6		
Jikradia olitoria (Say)	P	1.1		
Scaphytopius sp.	P	0.6		
Typhlocyba pomaria McAtee	P	5.0	3.3	1.1
Cercopidae				
Clastoptera achatina Germar	P	0.6	1.1	
Philaenus spumarius (L.)	P	4.4	0.6	0.6
Derbidae				
Cedusa sp.	P	0.6		
Fulgoridae, unidentified	P	1.1		
Flatidae				

Table 1. Continued.

Order: Family: Species	Trophic Group*	Management Intensity None	Minimal	Commercial
Anormensis chloris (Melichar)	P	1.7	0.6	
Metcalfa pruinosa (Say)	P	1.7		0.6
Aleyrodidae, unidentified	P	3.3	1.1	
Aphididae				
Aphis craccivora Koch	P		0.6	0.6
A. spiraecola Patch	P	0.6		
Macrosiphum rosae (L.)	P		0.6	
M. euphorbiae (Thomas)	P			0.6
Myzus persicae (Sulzer)	P	6.7	5.0	2.8
Phylloxeridae, unidentified	P	2.8	0.6	0.6
Diaspididae				
Quadraspidiosus perniciosus (Comstock)	P	41.7	0.6	1.1
Coleoptera, unidentified	S&T	1.7	1.7	2.8
Leiodidae, unidentified	T			0.6
Staphylinidae, unidentified	T			0.6
Corylophidae				
Orthoperus sp.	S	11.1	2.8	6.7
Cantharidae				
Belotus sp.	I	0.6		
Cantharis bilineatus Say	I	5.6	1.7	0.6
Silus sp.	I		0.6	
Elateridae, unidentified	T	1.1		
Buprestidae				
Agrilus egenus Gory	P	0.6		
Nitidulidae				
Carpophilus lugubris Murray	S		0.6	
Lathridiidae				
Melanophthalma sp.	S	0.6	5.0	10.6
Mycetophagidae				
Litargus tetraspilotus LeConte	S	1.1	0.6	0.6
Coccinellidae, unidentified	I	0.6		
Adalia bipunctata (L.)	I	0.6		
Anatis mali (Say)	I		0.6	
Coccinella septempunctata L.	I	0.6		
Diomus terminatus (Say)	I	1.1		1.7
Microweisea misella (LaConte)	I	5.0		

Table 1. Continued.

Order: Family: Species	Trophic Group*	Management Intensity: None	Minimal	Commercial
Scymnus sp.	I			0.6
Stethorus punctum (LeConte)	I	3.3	6.7	14.4
Scarabaeidae				
Cotinus nitida (L.)	P		3.3	
Popillia japonica Newman	P	6.1	1.7	
Chrysomelidae				
Anomoea laticlavia (Forster)	P	0.6		
Chaetocnema pulicaria Melsheimer	P	1.1	1.1	0.6
Crepidodera violacea (Melsheimer)	P	0.6		
Diabrotica undecimpunctata howardi Barber	P		0.6	
Epitrix fuscula (Crotch)	P	1.1		
Hornaltica atriventris Melsheimer	P	0.6		0.6
Odontata dorsalis (Thunberg)	P		1.7	2.8
Curculionidae				
Apion sp.	T	0.6		
Ceutorhynchus assimilis Paykull	T		0.6	
C. rapae Gyllenhal	T		0.6	
Myllocerus hilleri Faust	S	3.9	1.1	2.2
Rhynchaenus pallicornis (Say)	T	1.1		
Smicronyx sculpticollis Casey	T	0.6	0.6	
Neuroptera				
Coniopterygidae				
Coniopteryx sp.	I	11.1		1.1
Hemerobiidae				
Hemerobius humulinus L.	I		0.6	1.1
Chrysopidae, unidentified	I	12.8	14.4	6.7
Lepidoptera				
Papilionoidea, unidentified	T			1.1
Arctiidae				
Hyphantria cunea (Drury)	P	1.1		
Noctuidae, unidentified	P	1.1		
Geometridae, unidentified	P		0.6	1.7
Lomographa vestaliata (Guenee)	P	1.7		

Table 1. Continued.

Order: Family: Species	Trophic Group*	Management Intensity None	Minimal	Commercial
Tortricidae, unidentified	P	2.8	0.6	0.6
Acleris sp.	P	4.4		
Choristoneura rosaceana (Harris)	P		0.6	
Grapholita molesta (Busck)	P		0.6	
Platynota idaeusalis (Walker)	P	1.1		
Gelichiidae, unidentified	P	1.1		
Sesiidae				
Synanthedon pictipes (Grote & Robinson)	P	0.6	4.4	0.6
Diptera, unidentified	S&T	6.7	10.0	2.2
Tipulidae, unidentified	T			0.6
Chironomidae, unidentified	T	1.7	8.3	3.9
Simuliidae				
Simulium venustum complex (Say)	T	2.8	3.9	0.6
Bibionidae				
Bibio femoratus Wiedemann	S	1.7	11.1	19.4
Sciaridae				
Bradysia sp.	S	0.6	5.6	
Cecidomyiidae, unidentified	T		0.6	
Stratiomyidae				
Microchrysa polita. (L.)	T	0.6	1.1	
Dolichopodidae, unidentified	S&T	8.3	1.1	1.1
Phoridae, unidentified	T			0.6
Syrphidae, unidentified	I	12.2		1.1
Tephritidae, unidentified	T	1.1	0.6	
Euresta bella Loew	T	1.1		
Chaemaemyiidae, unidentified	I	1.7		
Drosophilidae, unidentified	S&T	6.1		
Philygria debilis (Loew)	T			3.3
Chloropidae				
Conioscinella sp.	T	5.6		
Malloewia setulosa (Malloch)	T		1.1	
Rhopalopterum umbrosum (Loew)	T	0.6		
R. carbonarius (Loew)	T		3.3	
Thaumatomyia glabra (Meigen)	S			3.3
Agromyzidae				

Table 1. Continued.

Order: Family: Species	Trophic Group*	Management Intensity None	Minimal	Commercial
Ophiomya sp.	T		0.6	
Phytomyza persicae Frick	P	3.9		2.2
Muscidae, unidentified	T	2.2	3.3	3.3
Eudasyphora cyanicolor (Zetterstedt)	T		0.6	0.6
Calliphoridae, unidentified	T		1.7	
Sarcophagidae, unidentified	T	2.8		0.6
Oxysarcodexia sp.	T		0.6	
Tachinidae, unidentified	I	2.8	2.2	3.9
Myiopharus infernalis (Townsend)	I	1.1		
Panzeria sp.	I	0.6		
Hymenoptera, unidentified	I&T	7.2	4.4	0.6
Braconidae, unidentified	I	2.8	0.6	
Mymaridae, unidentified	I	1.1	0.6	
Trichogrammatidae, unidentified	I	3.3		
Aphelinidae, unidentified	I	1.1		
Encyrtidae, unidentified	I	1.7	1.7	
Pteromalidae, unidentified	I		0.6	
Eurytomidae, unidentified	I	2.8	0.6	
Proctotrupidae, unidentified	I	0.6		0.6
Scelionidae, unidentified	I	1.7		
Bethylidae				
Goniozus sp.	I	0.6		
Formicidae, unidentified	T		0.6	
Camponotus sp.	S	2.8		
Formica pallidefulva nitidiventris Emery	S	12.2	0.6	1.1
F. subsericea Say	S	23.9		
Lasius sp.	S	26.7	13.3	
Prenolepis imparis (Say)	S	4.4	2.2	
Vespidae, unidentified	I			0.6
Sphecidae, unidentified	I	0.6		
Halictidae, unidentified	T	1.7	1.1	
Apidae				
Apis mellifera L.	T		0.6	0.6
Megabombus pennsylvanicus (DeGeer)	T	0.6		

* P, phytophage, I, Insectivore; S, scavenger; T, tourist.

**Data for taxa labeled unidentified represent one or more species in that taxon.

insectivores, 14% were scavengers, and 18% were tourists. Tourist species were those species that were passing through the ecosystem without a niche within the community. The seasonal pattern of abundance of the four trophic groups is shown in Fig. 1. The total number of taxa was lowest in April at 63, increased to 114 in May, 129 in June, peaked at 135 in July, and decreased to 122 in August. The abundance pattern of phytophages was similar to that of the community as a whole. Insectivores were initially the most abundant trophic group, but their rate of increase from April to May lagged behind the other groups. Insectivores were the only group to increase in number throughout the season and were the most abundant group in July and August. Tourists peaked in abundance in May and scavengers mirrored the trend of the community as a whole. There were no consistent differences among orchard type in the abundance pattern of the various trophic groups.

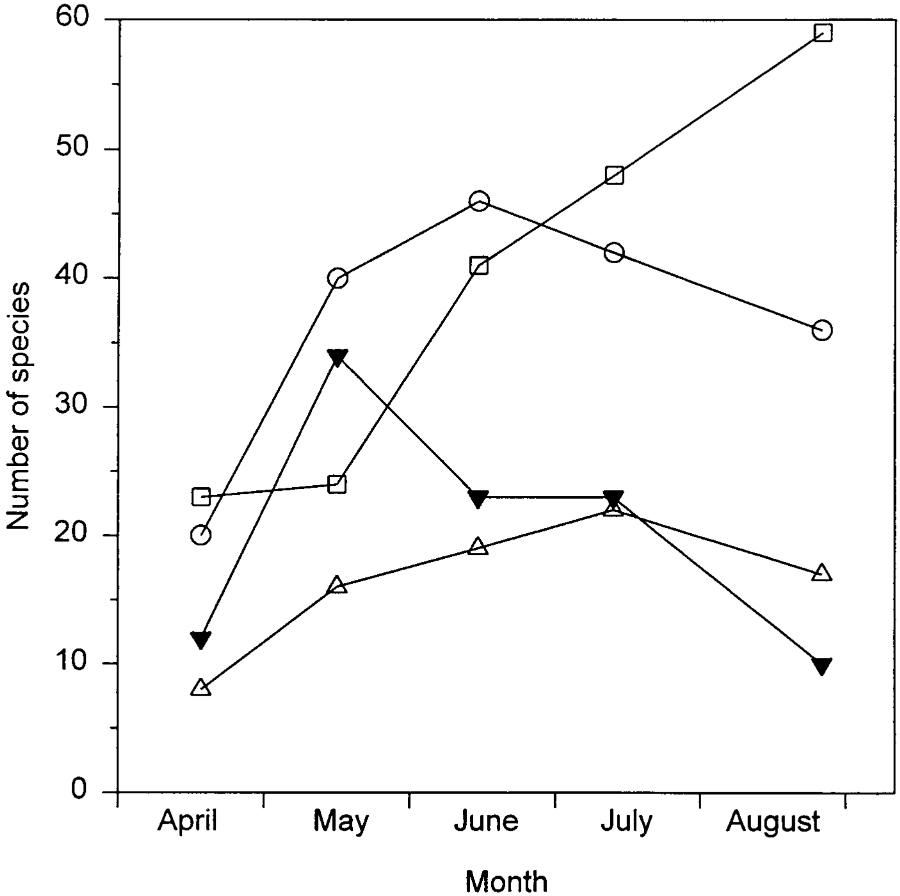

Fig. 1. Number of arthropod species recorded in peach orchards in West Virginia, 1991, by trophic group: circles, phytophages; squares, insectivores; solid triangles, tourists; open triangles, scavengers.

In the commercially-managed orchard, *Panonychus umi* (Koch) was dominant in each sample, except May, and in the minimally-sprayed orchard this mite was dominant in August (Table 2). However, in the unsprayed orchard, *P. uimi* was uncommon (Table 1), but *Acuus cornutus* (Banks) was dominant in May (Table 2). The latter mite species was uncommon in the sprayed orchards (Table 1). Ants were rare in the commercially-managed orchard (Table 1) but were dominant in the other orchards (Table 2): *Prenolepis imparis* (Say) in the minimally-managed orchard, *Lasius* sp. and *Formica subsdsericea* (Say) in the unsprayed orchard. The scavenger, *Bibio femoratus* Wiedemann, was dominant in the two sprayed orchards in May (Table 2). Thrips, *Frankliniella tritici* (Fitch) and *Neohydatothrips variabilis*

Table 2 Dominant taxa in the peach community comprising at least 10% of the individuals in the sample, or if no taxon comprised more than 10%, the most abundant taxon for that month and management type. The percent of the total individuals per sample belonging to that taxon is given..

	Orchard Management Intensity		
Month	Unmanaged	Minimal	Commercial
April	*Quadraspidiotus perniciosus*, 28	Simuliidae, 16 Chironomidae, 13 *Prenolepis imparis*, 13 *Synanthedon pictipes*, 10	*Panonychus ulmi*, 18 *Q. perniciosus*, 12 Salticidae, 12
May	*Aculus cornutus*, 18 *Formica subsericea*, 13	*Bibio femeratus*, 30 Chironomidae, 11	*Bibio femeratus*, 44
June	*Lasius* sp., 10	*Frankliniella tritici*, 17 *Myzus persicae*, 12	*P. ulmi*, 23
July	*Q. perniciosus*, 7	Sciaridae, 11	*P. ulmi*, 29 *Melanophthalma distinguendus*, 17 *Neohydatothrips variabilis*, 11
August	*Q. perniciosus*, 13	*P. imparis*, 16 *P. ulmi*, 15 Chrysopidae, 11 *N. variabilis*, 11	*P. ulmi*, 22 *Stethorus punctum*, 15 *N. variabilis*, 13 *Orius insidiosus*, 11

(Beach), became dominant late in the season in the two orchards receiving insecticides (Table 2).

Diversity indices showed a significant increase in diversity of the arthropod community, all trophic groups combined, with a decrease in the intensity of management (Fig. 2 and 3). There was a significantly greater number of species (Friedman test, P=0.05) in the unmanaged orchard than in the commercially-managed orchard (Fig. 2). In all but one sample, the minimally-managed orchard had a number of species intermediate between the other two orchards (Fig. 2). Differences were detected in the Shannon index among the three management intensities each month (Fig. 3). The unmanaged orchard consistently

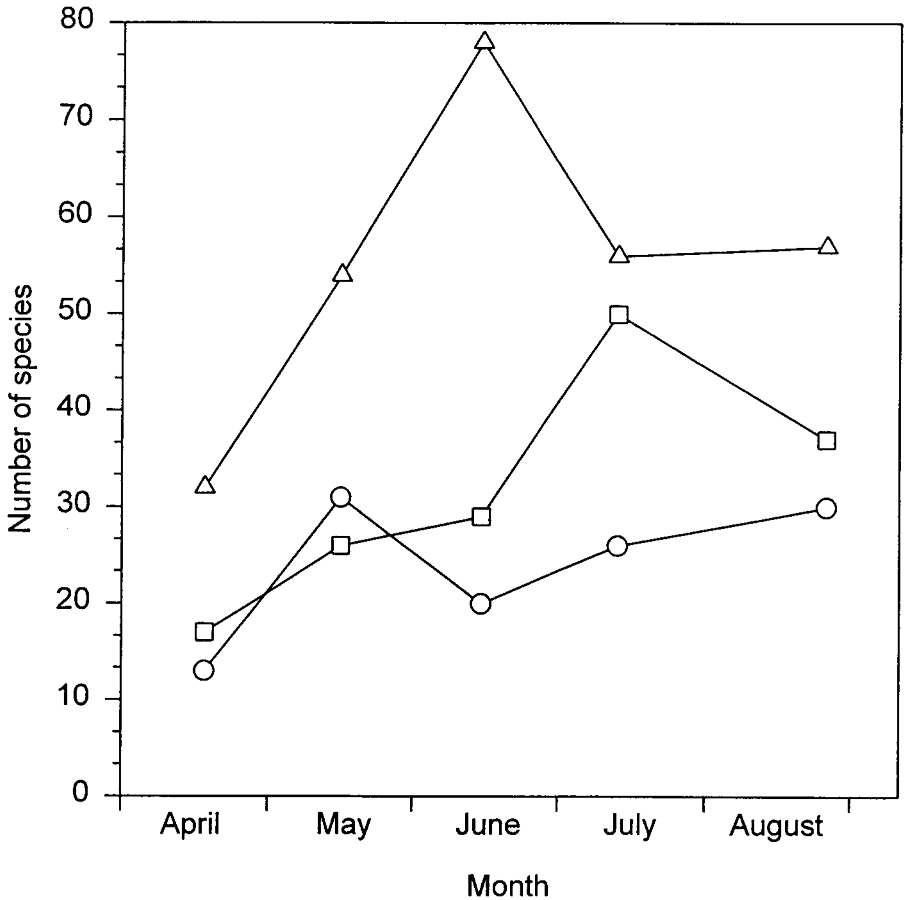

Fig. 2. Number of arthropod species of all trophic groups recorded in peach orchards by orchard management type: triangles, unmanaged; squares, minimally managed; circles, commercially managed. There was a significant difference (P<0.05) among orchard types using the Friedman test.

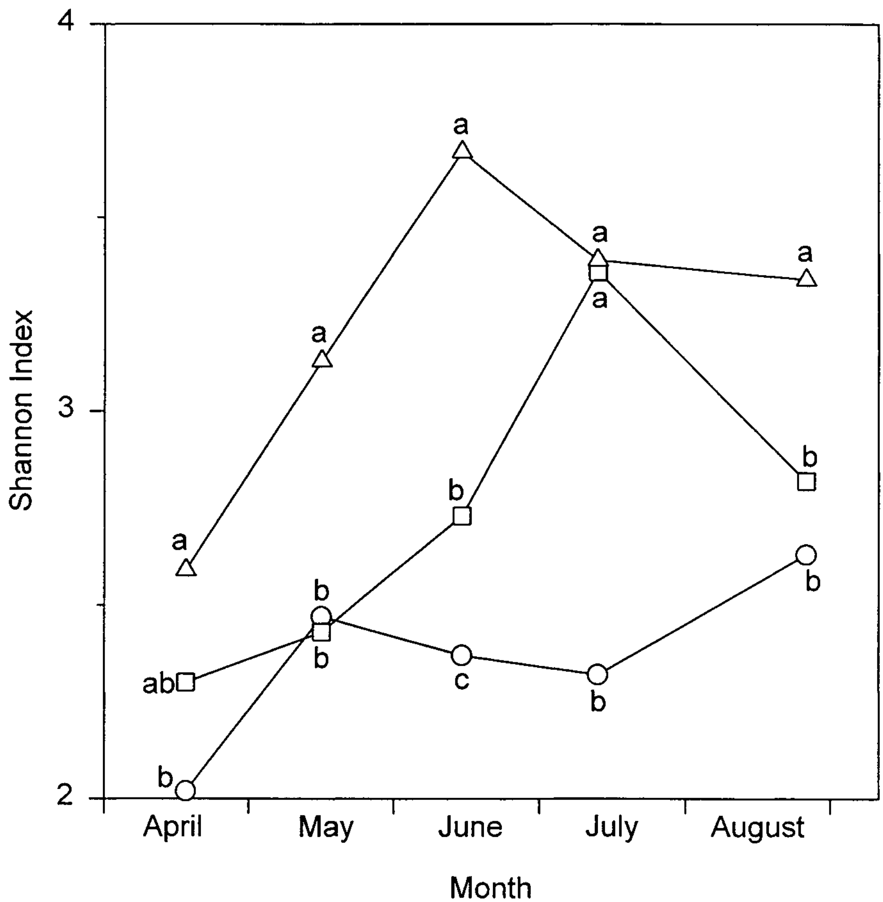

Fig. 3. Shannon index of diversity for the arthropod community on peach by orchard management type: triangles, unmanaged; squares, minimally managed; circles, commercially managed. Data points with different letters are significantly different within sample date using 95% confidence itervals.

had the highest diversity and, except in May, the commercially-managed orchard had the lowest diversity.

Comparison of arthropod communities on peach and apple. In 1983, 7 orders, 41 families and 128 species of phytophages were found on apple in West Virginia apple orchards (Brown and Adler 1989). In 1984, these same orchards had 8 orders, 38 families and 138 species of phytophages. Using similar sampling procedures and the same frequency of sampling, we found about the same number of higher taxa, but nearly half as many species of phytophagous arthropods on peach as apple: 8 orders, 30 families, and 74 species. The taxonomic distribution of phytophagous species (Fig. 4) shows a much higher proportion of Lepidoptera in the apple samples (49%) than in the peach

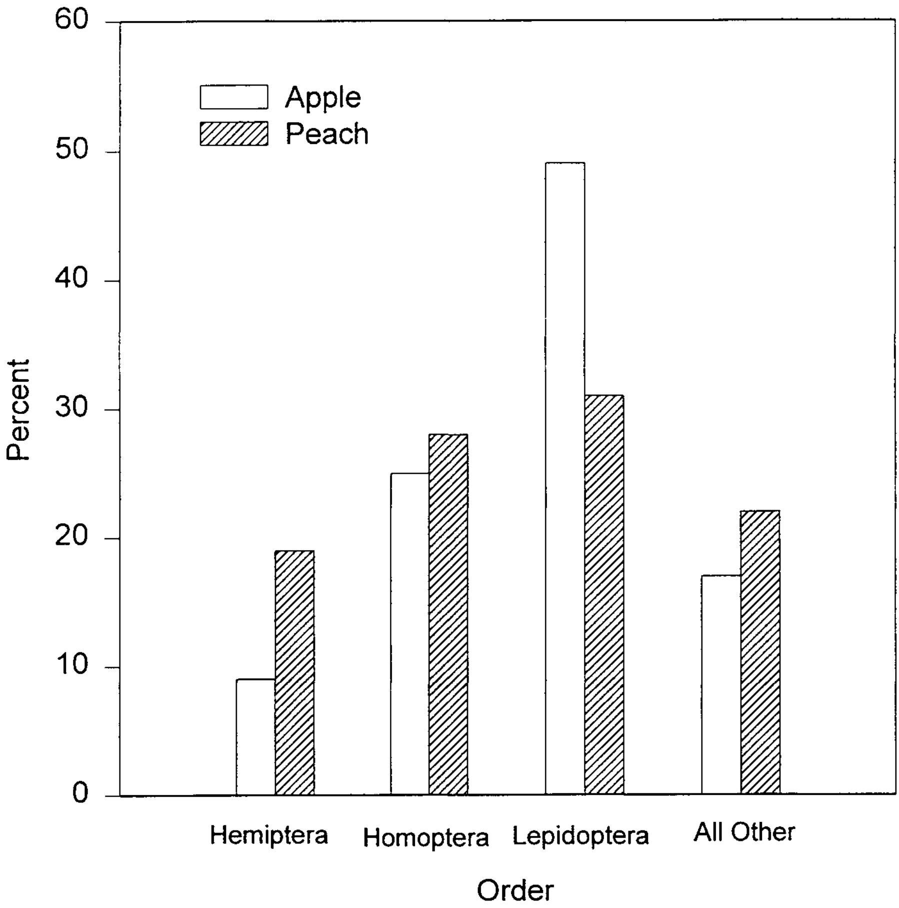

Fig. 4. Comparison of the taxonomic diversity of phytophagous arthropods between communities on apple and peach, West Virginia, 1991.

samples (31%) and a higher proportion of Hemiptera in peach (19%) than apple (9%). Thysanoptera, included within the "all other" category of Fig. 4, were common and even dominant (Table 2) in the peach orchards, but rare in apple orchards. Coleoptera and Orthoptera were proportionately more abundant in apple orchards than in peach orchards.

Comparing diversity of the phytophagous trophic group by orchard management intensity in apple and peach (Table 3), the null hypothesis that diversity is equal on the two host trees was rejected. The phytophagous community in unsprayed peach orchards was significantly less diverse than in unsprayed apple orchards for all indices. In the minimally-sprayed peach orchard, the community was less diverse than in the organic apple orchard in all except the dominance index, but two of the three probabilities were at the P=0.10 level.

Table 3 Comparison between the structure of phytophagous arthropod communities on apple (Brown and Alder 1989) and peach (present study). Probabilities are given for the Wilcoxon sign rank test of the null hypothesis: the diversity of the phytophagous community on peach is greater than or equal to that on apple (that is, a signigficant difference means that the community on peach is less diverse than on apple).

Diversity	Orchard Management Intensity		
index	Unmanaged	Minimal*	Commercial
Species richness	P=0.05	P=0.10	P=0.05
Diversity**	P=0.05	P=0.05	P>0.10
Dominance+	P=0.05	P>0.10	P>0.10
Shannon	P=0.05	P=0.10	P>0.10

* Organic apple orchard in Brown and Alder (1989).

** (Species number-1) / log (number of individuals) (Gleason 1922).

+ Proportion of the sample belonging to the most abundant species (Berger and Parker 1970).

Only species richness was significantly lower in the commercially-managed peach orchard than in the commercially-managed apple orchards.

Discussion

There is a large and diverse community of arthropods associated with peach orchards in West Virginia. Even in the commercially-managed orchard, there were as many as 30 species present in two of the five sample dates (Fig. 2). Fewer species were collected in this study (162) than the 583 species collected by Gorsuch et al. (1989), who used a chemical knockdown method of sampling which is a much more efficient sampling method for collecting arthropods. The distribution of trophic groups was essentially the same as found by Moran and Southwood (1982) in data from 6 tree species, including apple, in Great Britain and South Africa. The only unexpected result with regard to the trophic groups was that we had expected a larger proportion of scavengers because of the presence of extra-floral nectaries on peach leaves.

The arthropod community on peach showed the same responses to insecticide use and other management practices as has been shown in other agroecosystems (Liss et al. 1986. Brown and Adler 1989). With increased intensity of orchard management, diversity of the arthropod community decreased (Fig. 2,3). Insecticide use is the most important aspect of orchard management; pruning, fertilization, and irrigation also impact the arthropod community. These horticultural practices are designed to produce more vigorous trees, but also produce more favorable food sources for many phytophagous arthropods. The effects of all aspects of orchard management must be considered when designing pest management plans that rely on biological rather than chemical regulation of arthropod populations.

The taxonomic composition of the phytophagous arthropod community showed that those with chewing mouthparts (Lepidoptera, Coleoptera, Orthoptera) were proportionately more abundant on apple than peach, and those with piercing-sucking mouthparts were proportionately more abundant on peach (Fig. 4). This difference can be explained by the presence of cyanogenic glycosides in peach trees (Kaethler et al. 1982). Chewing insects cannot be selective about which cell organelles they feed on; whereas sucking insects avoid cell vacuoles where cyanogenic glycosides are stored (Saunders et al. 1977). Nectar production may also explain the smaller proportion of chewing insects on peach than on apple. It was noticed during sampling (Brown and Puterka, unpubl. data) that the young, expanding leaves were very sticky from nectar secretions. Young chewing insects, which normally prefer young foliage, may have problems walking or feeding on these sticky leaf surfaces.

The number of species of phytophagous arthropods on peach in this study was less than that on apple (Brown and Adler 1989). Gorsuch et al. (1989) did collect a much larger number of arthropods (583), from all trophic groups using a more efficient sampling method. The arthropod community described by Gorsuch et al. (1989), however, falls well below the 763 insect species found on apple in Wisconsin (Oatman et al. 1964) and the 1662 arthropod species found in Hungarian apple orchards (Mészarós 1984). The fewer arthropod species on peach than apple may be attributed to there being fewer species adapted to digest plants containing cyanogenic glycosides. Another major determining factor is the smaller potential source for immigrants. Szentkirályi and Kozár (1991) showed that surrounding habitat, in the form of wild and cultivated host plants that act as a source of immigrants into the orchard, is an important determinant for the development of an arthropod community. More apple than peach is planted in West Virginia and more wild hosts related to apple than to peach, thus providing a larger species pool from which to colonize apple.

The diversity of the phytophagous community on peach was lower than on apple in West Virginia (Table 3). This was especially true for the unmanaged orchards. As management intensity increased, the diversity of the phytophagous community on peach approached the diversity of the community on apple for all indices except species richness. These results indicate that in managed orchards, the controlling factor for community development is the use of insecticides. Historical factors, such as pesticide use in orchards, have been shown to be important determinants in the development of communities (Tanner et al. 1996) Insecticide use had the effect of making the structure, but not the number of species present, of the phytophagous community on apple and peach similar. In orchards allowed to evolve naturally, without insecticides, the communities on peach and apple diverged to reveal differences imposed by characteristics of the host plant to their respective communities.

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Brown, M. W. and B. J. Puterka. 1997. Orchard management effects on the arthropod community on peach with comparison to apple. J. Entomol. Sci. 32: 165-182.

Several corrections are noted on the galley proofs were not made by the printer resulting in the following errors.

p. 175, 1.1 The proper scientific name is *Panonychus ulmi*, not *P. umi.*
p. 175, 1.4 The proper scientific name is *Aculus cornutus,* not *Acuus cornutus*
p. 175, 1.8 The proper scientific name is *Formica subsericea*, not *F. subsdesericea.*
p. 181, 1.14 We thank P. Barbosa, not P. Barosa, from Univ. Maryland.
p. 181, 1.21 The proper citation for Brown (1993), is Ecol. Entomol 18: 169-183, not Eco. Entomol.