MODIFICATION OF A LEAF BLOWER/VAC FOR SAMPLING OF ARTHROPODS

Alton N. Sparks, Jr. and John W. Norman, Jr.
Texas Agricultural Extension Service
Texas A&M Research and Extension Center
Weslaco, TX

Abstract

Modifications of a commercially available leaf blower/vac for sampling of arthropods is presented. The sampler was designed to blow air across the row into a vacuum attachment with a net for collection of arthropods. This sampling method was compared with sweep net and beat net sampling in cotton field studies and effectively collected a wide variety of arthropods.

Introduction

In 1996, a cooperative research project between USDA-ARS and Texas A&M entomologists was initiated to evaluate the effects of selected insecticides targeted at boll weevils on pest and beneficial arthropods in cotton. Although sampling methodology is well established for most pest species, use of the same techniques for beneficial arthropods often proved inadequate, particularly at low population densities. Use of a tractor-mounted pneumatic insect collector, which operates on a combination unidirectional blower and vacuum principle (Beerwinkle et al. 1997), proved effective for sampling most arthropods of concern under a variety of conditions. Although this sampler was effective, the apparatus was expensive, difficult to transport between distant sampling sites, and could not be used when the field was wet or irrigation/drainage ditches were in place. The purpose of this study was to develop a small scale blower/vacuum sampler that would be more economical and easier to transport and use, and to evaluate this sampler in field studies.

Materials and Methods

Modification of Blower/Vac

Total cost for a single blower/vac sampler, including material for over 100 sample nets, was less than $200 (Table 1). The needed modifications consisted of alterations of the blower and vacuum attachments. The vacuum attachment was modified to receive a vertical stream of air blown across the row. This modification started with a T-shaped cut consisting of a 10.5 inch slit up the vertical axis of the long side of the angled vacuum tube, with a horizontal slit half-way through the tube at the top of the vertical cut. The tube was then opened along the vertical cut and plastic sheeting used to enclose the top and bottom to produce a rectangular opening of 10.5 by 5.5 inches. This opening was positioned to receive a horizontal stream of air when the machine was held in the normal vertical operating position. To provide a more even distribution of the vacuum in the modified head, an additional sheet of plastic was placed inside the vacuum head, parallel to the opening and arranged to reach from 5 inches above the modified opening to approximately 2/3 of the length to the bottom of the opening.

The blower and gutter attachments were modified to blow a stream of air blown into the modified vacuum attachment. This was accomplished by cutting off the end of the original blower tube and attaching an elbow (turned down) a gutter attachment tube, and another elbow (pointed toward the vacuum attachment). At the end, another short section of gutter attachment tube was attached with the end compressed to an oval of approximately 1/2 inch wide (long axis aligned with the vertical vacuum attachment). The lengths of tubes in the modified blower attachment were adjusted to align the output with the center of the opening on the modified vacuum attachment with approximately 12 inches between the blower outlet and the vacuum head. Four 1-inch diameter holes were cut in the top of the original blower tube to provide a bypass, thereby reducing the air flow from the outlet and maintaining negative pressure at the vacuum attachment opening. All parts of the modified blower attachment were held together with screws through the tubes to prevent movement with plant contact.

In order to collect arthropods within the air stream, a net was designed to fit within the vacuum attachment of the sampler. Nets were made of a variety of materials. The choice of materials was based on mesh (which can be varied depending on the size of arthropods to be sampled but may interfere with air flow if too small) and durability. Nets were cut from stock material in a roughly trapezoidal shape, with an arched top measuring 16 inches in length, a base of 7.5 inches, and sides of 12 inches. When folded side-to-side and sewn across the base and side, this produced a net with an opening circumference slightly larger than the vacuum tube. The net opening was placed over the top of the modified vacuum head and the body of the net extended into the upper portion of the vacuum tube. Nets were held in place by the friction fit between the vacuum tube and the modified vacuum head. The terminal end of the net had a diameter slightly less than the tube so that the side of the net did not touch the tube. This allowed airflow throughout the length of the bag and greater net surface for airflow than a conical net. The length of the net insured no contact with the blower/mulcher fan when in place.

Sampler Evaluation

The effectiveness of the blower/vac sampler was compared with a variety of sampling techniques in conjunction with field studies on the effects of insecticides applied for boll weevils on pest and beneficial arthropods. This experiment consisted of a randomized complete block design with three

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insecticide treatments replicated four times. The four blocks (replications) consisted of four 35-acre commercial cotton fields planted with DPL 50 within a three day period. Each field was divided into three plots and each plot was randomly assigned one of three insecticide treatments: Guthion 2L at 0.25 lb AI/ac, Vydate CLV at 0.25 lb AI/ac, and endosulfan (Thiodan 3E or Phaser 3E) at 0.5 lb AI/ac. Insecticides were aerially applied in 3 GPA on April 29, June 17, and June 21.

Plots were sampled for selected arthropods 12 times between April 28 and June 30. On each sample date, each plot was sampled at four sites with each of 4 sampling methods: blower/vac, sweep net, beat net, and ground cloth. Ground cloth samples generally proved poor at detection of arthropods at low density, and could not be conducted when fields were flooded, thus, only information on the sweep net, beat net and blower/vac sampling will be presented in this manuscript. Blower/vac samples were collected from 100 feet-of-row at each sample site by moving the sampler down the row at approximately 3 miles per hour. The vacuum head was held near the ground when plants were small, and with the top of the vacuum opening approximately 6 inches below the canopy when plants were larger. Sweep net samples consisted of 50 sweeps of a standard 15-inch diameter sweep net at each site, with each sweep consisting of a single pass through a row of plants (Kogan and Pitre 1980). Beat net samples were conducted as described by Sparks and Boethel (1987), with 10 beats per site. Beat net and sweep net samples were processed in the field; whereas, blower/vac samples were placed in ice chests and taken to the laboratory for counting.

Data were analyzed with the PROC GLM procedure of PC-SAS to compare the number of individuals collected per sample for each method on each date. When significant differences were indicated (P=0.05), means were separated with DMRT (P=0.05).

Results and Discussion

The blower/vac sampler proved easy to transport and use, but generally required two individuals for efficient operation. One individual operated the sampler (about two hours for all four fields) with minimal effort (total weight with a full tank of gas was < 15 lbs.). A second individual removed, labeled, and replaced the sample nets. Total in-field sampling time for the sweep net and beat net was similar to that for the blower/vac sampler, with each requiring about four man-hours for all four fields.

Most of the arthropods sampled were detected on at least 10 of the 12 sample dates (Table 2). For most species sampled, the number of individuals collected by the blower/vac sampler was generally as many or more than the numbers collected by the sweep net and beat net. The blower/vac appeared better at detecting arthropods at low population densities (likely related to area sampled), and generally collected more individuals at higher densities. The effectiveness for sampling boll weevils needs additional study, as weevil populations were low throughout this study. Parasitic wasps and flies, not counted in sweep net or beat net samples, were effectively collected with the blower/vac sampler. Wasps frequently exceeding 50 per sample (data not shown).

The blower/vac sampler was relatively inexpensive to build and proved effective for collecting a wide variety of insects from cotton. It also was easy to transport and use under a variety of field conditions. Use of this sampler for population density estimates would require considerable operation standardization and calibration for varying plant and field conditions; however, it currently appears to be a useful relative sampling tool for a variety of arthropods and may prove particularly valuable in detecting low density arthropod populations.

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Table 1. Materials used for building of blower/vac sampler for arthropods.

Equipment	Costs
Sears Craftsman model 79793 Blower/Vac Mulcher gas operated, 185 MPH (peak velocity), 385 CFM	$100 - $120
Rain Gutter Clean-out Attachment plus one elbow ($15) or two attachments	$25 each
Additional plastic (can use plastic pot material)	
Material for nets Can select mesh for sampling needs	Variable < $1 per net

Table 2. Number of sample dates (of 12 total) on which selected arthropods were detected by any sample method, and the number of dates on which the blower/vac sampler collected significantly (P=0.05) more or less than the beat net (BN) and sweep net (SN).

Arthropod	No. of dates detected	No. of dates with vacuum catch > or < BN and SN			
		>BN	>SN	<BN	<SN
Boll weevil	9	0	0	0	0
Fleahopper adults	12	10	8	0	0
Fleahopper nymphs	10	6	6	0	0
Bollworm/budworm	11	3	4	0	1
Loopers	11	4	5	0	0
Beet armyworm	12	1	0	1	3
Big-eyed bug adults	12	3	2	0	2
Big-eyed bug nymphs	7	3	3	0	0
Green lacewing adults	12	6	7	1	0
Green lacewing larvae	11	6	6	0	0
Pirate bug adults	12	7	7	0	0
Pirate bug nymphs	9	1	1	0	0
Lady beetle adults	12	3	3	0	1
Lady beetle larvae	10	5	4	0	0
Nabids	11	3	5	0	1
Assassin bugs	12	0	0	0	0
Spiders	12	11	12	0	0