"KISS" - A NEW PORTABLE PNEUMATIC 'KEEP IT SIMPLE SAMPLER' FOR ROW CROP INSECTS

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Abstract

The KISS, a keep-it-simple pneumatic insect sampling device, was constructed by modifying a conventional engine-driven leaf blower with the addition of a metal frame to support an insect collection net in front of the blower outlet nozzle. In field operation the KISS is hand-carried along a row of plants with the blower outlet positioned so that the plants pass between the blower nozzle and the inlet of the insect net. High speed air at about 150 mph from the blower dislodges insects from the plants and carries them into the net. Research results indicate that the collection efficiency of the KISS for boll weevils in early season cotton is high, and that, compared to hand sampling, the efficiencies of field scouting for this insect can be increased by about ten fold with the use of the mechanical device. Other insect sampling and collection applications for the KISS are described.

Introduction

Entomologists, crop consultants, and farmers must perform in-field sampling to determine the presence of both pest and beneficial insects in order to make informed pest management decisions. Such sampling is conventionally performed with manual sweep nets or by visual examination of individual plants which is very tedious and labor intensive.

Various mechanical personal sampling aids have been developed and used by individuals over the years, and some such devices have been and are commercially available. However, few mechanical personal samplers have received wide-spread acceptance and use by the scouting community for sampling row crop insects. One of the more popular commercially-available devices has been a backpack, engine-driven vacuum sampler (D-Vac®) described by Dietrick(1961). The D-Vac® was used by several researchers during the 1970's for sampling and characterizing the insect faunas in cotton (Shepard et al. 1972, Schuster and Boling 1974, Fuch and Harding 1976, Harding et al. 1976) but the sampling efficiency of the device for various insect species has been a continuing question. Various techniques for using the D-Vac® for field sampling arthropods have been propoesed and evaluated (Richmond and Graham 1969, Smith et al. 1976, Gonnzalez et al. 1977, Bechinski and Pedigo 1982, Nuessly and Sterling 1984) with varying results reported. Currently, the D-Vac® is not widely used for routine row crop insect sampling, probably because of the problems with results interpretation and the fact that it is rather cumbersome to operate.

There are continuing needs for improved mechanical sampling devices which can be routinely used by scouting personnel to increase their accuracy and efficiency for characterizing field populations of various row crop arthropods. The construction and operation of a new portable pneumatic insect sampling device which may satisfy some of these needs is described here.

Materials and Methods

A portable insect sampler we call a KISS (keep-it-simple sampler) was constructed by modifying a conventional engine-driven leaf blower (Model PB-210E, Echo Inc., Lake Zurich, IL) with the addition of one section of curved duct and a net attachment frame (Fig. 1). The net frame is constructed of 0.25-in. O.D. steel rod that is formed to provide an auxiliary handle and a support for an insect collection net (12-in. dia. by 28-in. length, Bio Quip # 7212 NA, Bio Quip Products, Gardenia, CA). The rod frame is welded to sheet metal collars, which are, in turn, secured to the blower duct with hose clamps.

The rod handle is formed in a roughly triangular shape and is attached at two points - at the main housing blower outlet and near the nozzle at the end of the duct. The specific shape of the handle is arbitrary, and it can have vertical and horizontal bends to position it for optimizing the operator's comfort and feel for the unit. The net is attached to a rectangular hoop (seven inches high and eleven inches wide) formed in the distal end of the rod frame. The rod hoop is formed in a manner such that the plane of the net opening is approximately centered with and parallel to the plane of the blower outlet nozzle with an open space between the planes of about ten inches.

The net frame is equipped with a plant diverter/guard apparatus at the net inlet (B, Fig. 1). Full-throttle peak air velocities, specified as 150 mph at the blower outlet nozzle, causes plants to lay over into the net inlet as they are being sampled. The two free-swinging, horizontally-oriented, parallel tines of the diverter gate, positioned in the net inlet, help to guide plant branches and leaves out of the net to prevent clogging.

Performance evaluations of the KISS were conducted in the laboratory and in the field. In the laboratory, the free-flow air velocities at various locations in the sampling throat of a fully configured KISS were measured with a Pitot tube/manometer gage system to characterize key air delivery parameters of the sampler. Field evaluations included several, rather preliminary experiments, conducted during

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prototype development of the KISS, to determine the efficacy and efficiency of the sampler for detecting the presence of adult boll weevils in early season cotton plants through first bloom (Fig. 2). One group of field experiments involved release and recapture of marked laboratory-reared boll weevils. Weevils, premarked with a drop of laquer paint placed on the dorsal midline bridging the elytra to prevent flying, were hand placed on young cotton plants in test plots preliminary to recapture experiments with the KISS. In some experiments, only the performance of the KISS was evaluated, and in other experiments, weevil recoveries with the KISS were compared to results obtained by hand sampling. In a second group of experiments, the efficacy and efficiency of the KISS for detecting natural field infestations of feral weevils in early-season cotton were compared to results obtained by hand sampling conducted simultaneously in the same field. In addition, the sampler has been used as a general purpose insect collecting device for surveying populations of various insects in other crops and for collecting feral specimens of several insect species for use in laboratory experiments.

Results and Discussion

Measured full-throttle, free-flow peak air velocities at the nozzle outlet, at the mid-point between the nozzle outlet and the net inlet, and at the net inlet were 149, 112, and 70 mph, respectively. The calculated peak velocity pressure exerted on sampled plants with an assumed air impact velocity of 112 mph is 0.22 psi (31 lb./ft^2)

Recovery rates for marked boll weevils released on cotyledon (2-leaf) cotton were variable and generally low for both the KISS and whole-plant hand sampling procedures (Table 1). A major cause for the variably poor results obtained by both sampling procedures was the fact that many of the laboratory-reared weevils did not stay on the young cotton plants where they were placed, but instead, either dropped directly or crawled along the plant stems to the ground before sampling operations were conducted. Other factors that may have contributed to the low weevil recoveries included the inexperience of student summer employees who conducted the hand sampling procedures, and the less than optimum performance of the KISS because of the short stature of the 2-leaf plants.

Efficiencies of the KISS for recapture of marked weevils placed on 4- and 6-leaf stage cotton were considerably improved over those for the 2-leaf plants (Table 1). The observed average recapture efficiencies of $\geq$70 % for the larger plants, based on the total number of marked weevils placed, would probably have been even higher if the number of marked weevils that left the plants before KISS sampling could have been quantified and considered in the calculations.

Results of experiments to compare the efficacies and efficiencies of KISS sampling and whole-plant hand sampling procedures for detecting field infestations of feral boll weevils in early season cotton indicated that the detection efficacies of the two methods were comparable (Table 2). However, the sampling efficiency of the KISS, on the basis of time required per row-foot sampled, was about 10-fold better than that for hand sampling. Additional data are needed to substantuate these relationships, but these preliminary data indicate considerable promise for the KISS as a mechanical sampling aid for quantifying boll weevil infestations in early season cotton.

Numerous specimens of both pest and beneficial arthropods, other than the boll weevil, were collected with the KISS during sampling experiments conducted on cotton through the first-bloom stage of plant development. Collected pest insects included larvae of several noctuid species, cotton fleahoppers *Pseudatomoscelis seriatus* (Reuter), and other miscellaneous species. Collected beneficials included several species in the famlies Coccinellidae, Syrphidae, Geocoridae, Chrysopidae, Arachnidae, and others. No effort was made to quantify the population densities of the various species collected, but these results indicated a potential for the KISS to be used as an aid for characterizing the relative populations of pest and beneficial arthropods in early season cotton necessary for informed IPM decisions.

As a general purpose insect collection device, the KISS has been used routinely to survey populations and collect feral specimens of several insect species, other than the boll weevil, for use in laboratory research. Insects collected with the KISS have included pepper weevils *Anthonomus eugenii* C. from pepper plants, corn rootworm adults of several species from sorghum and soybeans, cotton fleahoppers from wild host plants, and larvae of several noctuid species from chickpea. In several of these applications, the use of the KISS replaced hand collection procedures and increased the efficiencies of the collection processes by several fold. Collected insects were generally in excellent physical condition.

The KISS pneumatic sampling device described is simple to construct, very portable, and easy to operate. We have found the device to be a very versatile mechanical sampling aid for a variety of insects in our research work, and it should be useful in other insect sampling applications.

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Disclaimer

Mention of a trade name or a proprietary product is for specific information only and does not constitute a guarantee or warranty of the product by the U. S. Department of Agriculture and does not imply endorsement of the product over other products not mentioned.

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Table 1. Results of Marked Boll Weevil Release and Recapture Tests in Young Field Cotton.

Growth Date	Growth Stage	Number Replicates	Hand Sampled % recovered (range)	KISS Sampled % recovered (range)
May 6	2 leaf	4 (n=5)	------	40.0 (20-60)
May 15	2 leaf	6 (n=10)	28.3 (10-50)	3.3 (0-20)
May 6	4 leaf	3 (n=5)	------	73.3 (60-100)
May 15	6 leaf	3 (n=10)	------	70.0 (50-90)

Table 2. Comparative Efficacies and Efficiencies of KISS and Hand Sampling for Detecting Feral Boll Weevils in Squaring Cotton.

		Hand Sampled		KISS Sampled	
Period	Plant stage	Minutes/ 1000 Rf	Weevils/ 1000 RF	Minutes/ 1000 RF	Weevils/ 1000 RF
May 20 to June 5	4-6 leaf to pinhead square	90.4	1.40	6.4	0.85
to June 21	to bloom	91.4	0	7.7	0.08

RF - Row Feet

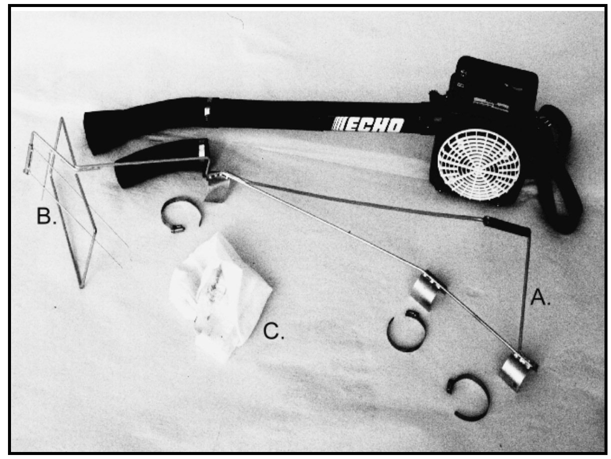

Fig. 1. KISS Components: Blower and extra curved duct section with (A) rod frame and hose clamps, (B) plant diverter/guard apparatus, and (C) net.

Figure 2. Sampling cotyledon cotton with early prototye version of the KISS.