trays, etc.). The sampling plan presented here adds even more flexibility to the yellow trap as a sampling tool by decreasing the time needed to make counts. In some instances, of course, all traps may have to be counted (when no "stop" is reached). However, time usually will be saved when the sampling plan is used through total crop development. By evenly spacing traps throughout a homogeneous crop of chrysanthemums or gerberas, growers will obtain an areawide view of population changes. Having just one trap in the center of an area would provide an inaccurate reflection of adult flies present. The additional work of counting more traps can be offset somewhat by using the sampling scheme presented here.

Yellow traps to monitor adult flies provide the grower or PCA with a rapid assessment of what the population is doing in each specific greenhouse or crop area. Thus, the need to forecast treatments or to determine their effectiveness can be satisfied. Such data are vital to proper use of insecticides to control *L. trifolii*. With an ornamental crop such as chrysanthemums, knowing when to treat is extremely important. However, with a fly able to develop insecticide resistance, such as *L. trifolii*, knowing when not to treat may be just as important.

The sampling plan for live larvae (table 2) can be used as outlined here for yellow sticky traps and can yield the following additional information: knowing when to treat (numerous live larvae indicate future adult populations); knowing when not to treat (or if no larvae are found, fogging the greenhouse with insecticide directed only at adults [based on yellow trap counts] instead of a thorough wet spray); and assessing the efficacy of pesticide treatments. Finally, if parasites are being used for leafminer control, leaf samples provide data on parasite efficacy, in addition to indicating that more parasite releases are needed.

With an aesthetic value crop such as chrysanthemum, it is very difficult to establish the population level at which the grower must treat. The economic threshold varies from grower to grower and fluctuates during the year as crop value changes due to the public's association of flowers with specific holidays, such as Mother's Day and Easter. Reliable estimates of leafminer populations in chrysanthemum greenhouses will aid the grower in making treatment decisions by accurately gauging population increases or decreases.

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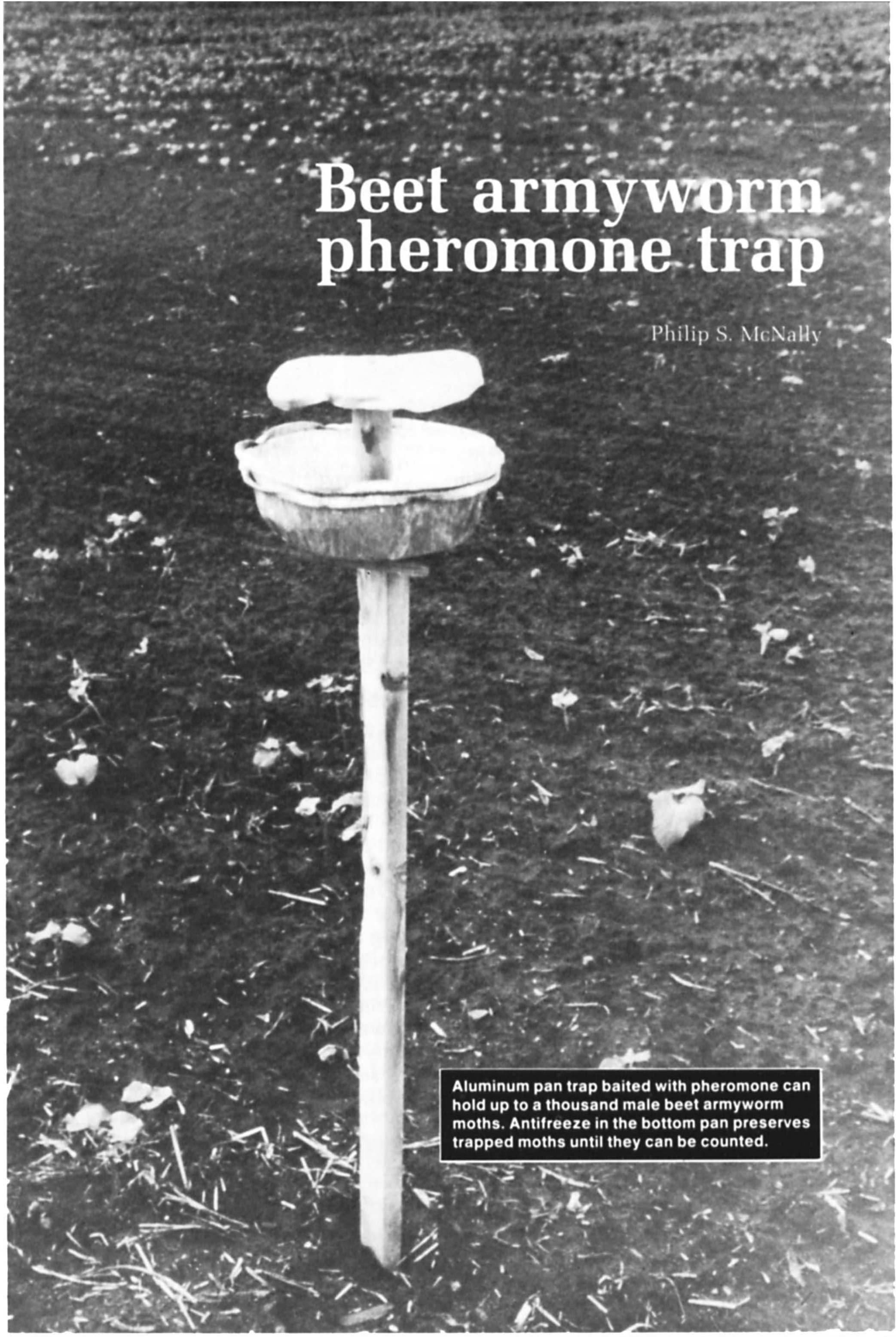
Beet armyworm pheromone trap

Philip S. McNally



Aluminum pan trap baited with pheromone can hold up to a thousand male beet armyworm moths. Antifreeze in the bottom pan preserves trapped moths until they can be counted.

Of three types tested, a liquid trap was the most practical and effective

Monitoring the beet armyworm, a destructive pest of tomatoes, alfalfa, cotton, sugarbeets, and other crops, consists of time-consuming visual searches of foliage and fruit for eggs and larvae. Use of pheromone traps can help indicate the numbers of this insect, *Spodoptera exigua* (Hübner), in the field at a particular time.

After a sex pheromone blend from female beet armyworms was isolated and identified in 1981, a study was conducted during 1981 and 1982 in Tracy to find a suitable beet armyworm pheromone trap and to evaluate the longevity of the pheromone substrate under California field conditions.

Trap tests

Rubber septa were impregnated with two pheromone components, 0.3 mg of (Z,E)-9,12-tetradecandien-1-o1 acetate and 0.006 mg of (Z)-9-tetradecen-1-o1. (This ratio proved to be the most attractive to male moths of the pheromone blends tested to date.) During 1981, septa were aged three, nine, and twelve weeks in Pherocon 1C traps in a tomato field. They were then placed in fresh traps 30 to 40 yards apart at the canopy level of tomato plants. A randomized block design was used for each of two tests, with four replications per treatment. Catches were recorded after one night.

In three trials during 1981 and 1982, Pherocon 1C liners were placed in a tomato field, 30 to 40 yards apart, where moths were caught and removed over a period of one day and one, two, and three weeks. These liners were then tested against fresh liners in one-night tests. Rubber septa containing the same pheromone components were used in this test. Between five and ten replications were used per treatment in randomized block design.

After the liners were tested for longevity, it became apparent that another trap was needed to monitor male moths, particularly one with a larger catching surface or volume: beet armyworm adults are large and are numerous, especially during late summer and fall. A pan and liquid trap was designed with aluminum, 7-inch-diameter pie pans as the top and the bottom. The pans were connected by a wooden dowel on which was pinned the pheromone substrate. The substrate was suspended just above the liquid. Antifreeze was selected as the liquid because it preserved the moths for at least a week (unlike water), did not volatilize (unlike alcohol), and was clear and easy to handle (unlike many oils). These traps were fastened to a wooden platform and then placed at the canopy of tomato plants on stakes.

Moths were allowed to accumulate in the pan and Pherocon 1C traps, and moths were counted after one, two, four, six, and eight nights. A randomized block design was used with four replications per treatment. Traps were separated by approximately 50 yards. These tests were also performed in Tracy during 1981 and 1982.

Two pan traps were tested against a blacklight trap in the same tomato field during 1982. To allow for the possibility that female as well as male moths might be attracted to the blacklight, the moths in the blacklight trap were sexed. Counts were made on five nights during the spring.

Results

After 12 weeks, there was no catch efficiency reduction in Pherocon 1C traps baited with the pheromone-impregnated rubber septum. High moth catches have also been observed in the pan traps baited with aged septa: nine-week-old septa have attracted as many as 700 moths during one week in 1983. The septum, however, may not last as long in such other beet armyworm inhabited areas as the southwestern deserts, where temperatures are much warmer. In California's Central Valley, however, one can monitor beet armyworms throughout a tomato growing season without having to change the septum.

The Pherocon 1C liner lost its effectiveness after one night's catch (32 moths) was removed.

The beet armyworm moth is relatively large, with a wing-span of about 1¼ inches. In removing moths from the liners, much sticky adhesive material was also removed. In addition, the moths shed many scales from their bodies and wings, covering the adhesive material and rendering it no longer sticky. It became apparent that monitoring the moths' activity continuously without having to change the liner daily required a liquid trap with a greater surface area or volume and less maintenance,

The pan trap worked effectively through at least eight days (see graph). Because beet armyworm damage has to be assessed in the field every three to seven days, this trap proved practical. The aluminum pan can hold more than a thousand moths; however, the 700-moth catch mentioned was the largest observed in the field.

The blacklight attracted significantly more moths (male and female counted together) and male moths (counted separately) than did the pan trap. The liquid trap is much better suited for a pest management program, however. It is less expensive than the blacklight trap (about $2 for the trap materials). Furthermore, the liquid trap can be placed in the field where it will not be damaged by farming equipment passing over it, and it is specific to beet armyworm — very few other insects find their way into the liquid trap.

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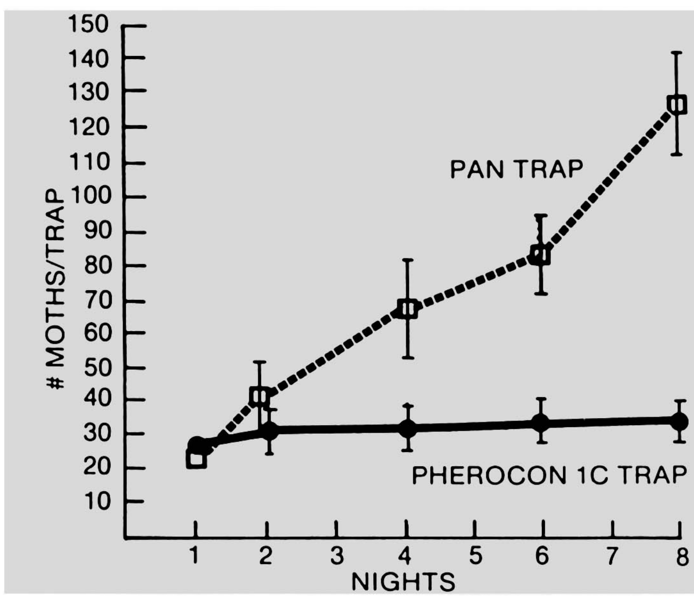
Effect of liner age on beet armyworm trap catch*

Liner age	Mean no. moths Trial I	II	III	% of fresh liner catch	Mean no. moths removed from aged liners before test
Fresh	32 a	23 a	19 a	—	—
1 day	—	4 b	—	17	32
1 week	—	—	2 b	11	53
3 weeks	2 b	—	—	6	43

*Three tests were performed in 1981 and 1982 in Tracy, California. Means followed by different letters within a column are significantly different using a t-test at the 5% level.



The liquid pan trap was significantly more effective than the commercial sticky trap on the fourth through eighth nights, as indicated by cumulative moth catches.