RESEARCH ON BIOLOGICAL CONTROL OF ALFALFA WEEVIL

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During recent years, the alfalfa weevil problem has developed to enormous proportions in California. For example, an estimate by the California Department of Food and Agriculture placed weevil control costs and damage at more than $21 million in 1974, with the Egyptian alfalfa weevil accounting for about 90% of this total. As staggering as it is, this cost-loss estimate may, in fact, be conservative for it probably does not reflect the full impact of the Egyptian alfalfa weevil on bur clover in natural pastures. With the rise of this species to major pest status on bur clover, alfalfa weevils now directly affect two of California's major agriculture enterprises--the alfalfa and livestock industries. Furthermore, the massive use of insecticides against the weevils engenders secondary pest outbreaks in alfalfa and other crops, resulting in ecological and sociological impacts which greatly magnify the overall problem.

In its total aspects, the alfalfa weevil problem is probably the most serious insect crisis facing California's agro-economy today. This is a crisis which will not disappear overnight.

In the short run, the alfalfa grower would seem to be in a better position than the stockman because he can rely on chemical control as a stop-gap against threatening weevil infestations, while the latter faces formidable economic and logistical obstacles in applying the chemical tactic to large acreages of threatened rangeland. However, an economic assessment of the weevil problem by economist Yuri Regev (of University of California, Berkeley and the Ben Gurion University, Beersheba, Israel) and entomologist A. P. Gutierrez (of University of California, Davis) indicates that chemical control will not be an economically feasible control tactic in alfalfa over the long run.

It is thus becoming apparent that the solution to the weevil problem in alfalfa must lie with biotic manipulations, namely, the development of resistant alfalfa varieties and the implementation of biological control by imported natural enemies. The only solution to the problem in natural rangelands appears to be through biological control. Others on the program will speak of progress being made in resistant alfalfa research, and so this disucssion will be limited to developments in the biological control program.

Parasite Introduction

In this area, intensive activity has been maintained in the foreign search for parasites, their insectary propagation and field colonization. On the other hand, our efforts in field recovery and evaluation of the parasites have been quite limited. There are two major reasons for this: (i) with our limited support funds and manpower we have had to emphasize parasite procurement, propagation and colonization to the neglect of the recovery-evaluation effort and (ii) the slow build-up and spread of the parasites (they have only one or two generations a year) make it very difficult to sample and evaluate them at this early stage of the program.

Foreign exploration. Our emphasis in foreign exploration has been on procurement of parasite species and strains from areas of the Near and Middle East. In this connection, our activities over the past several years have centered in Egypt, Iraq, Iran and Afghanistan. We now have parasite species and strains from all of these areas, available and in production in the insectary.

Parasite propagation. Over the past two years, our propagation program has emphasized production of *Microctonus aethiops*, a parasite of the weevil adult. The propagation stock of this species was initially of Iranian origin, but during the past year we obtained a strain

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from Afghanistan. Both strains are important enemies of alfalfa weevils in their native habitats, and should become major parasites of both the alfalfa weevil and the Egyptian alfalfa weevil in California. M. aethiops affects its host with a double-barreled wallop first in castrating it (both sexes lose their reproductive systems) and eventually by killing it.

Propagation of the larval parasites, Bathyplectes curculionis and B. anurus has been hampered by tough biological problems. Our first task has been to develop a constantly cycling weevil stock, to ensure year-round availability of larvae. Research by a graduate student on parasite diapause (physiological "rest") (Jordan, 1975) provided clues which enabled us to develop an insectary stock of the Egyptian alfalfa weevil that is overwhelmingly (90%) composed of non-diapausing weevils. This means that we can now produce large numbers of B. curculionis (Egyptian, Iraqi, Iranian and Afghan strains) and B. anurus (Iranian strain) for colonization over the next several seasons. Propagation of B. anurus and B. curculionis will be stepped up during 1976, and will be emphasized thereafter

Colonization and recovery. Recent colonizations of the alfalfa weevil parasites are summarized in Table 1. The establishment status of these species is also noted. We have not attempted to pinpoint or delineate the areas of establishment and spread of the parasites, or to evaluate their impact (if any) because we simply do not have the resources to mount a meaningful recovery-evaluation program, while maintaining a propagation colonization effort.

However, we are now about to embark on a new colonization-recovery program which will differ substantially from what we have been doing. In the past our policy has been to colonize the wasps in alfalfa and bur clover plots on properties of cooperating growers and stockmen under circumstances where we only asked that the small plots (usually less than an acre in size) not be sprayed or mowed during the first cutting. Thereafter, the parasites were left to survive, multiply and spread on their own devices. Under this program, it appears as though two of the parasite species Bathyplectes anurus and Microctonus aethiops have at least become locally established. However, their progress has been hampered by alfalfa production practices, particularly the plowing out of the colonization fields.

It had been our hope, to find fields in which the parasites had increased to substantial numbers and to use these plots as field insectaries from which to distribute the wasps to additional sites. We did, in fact, find such a field at Clovis in Fresno County, in 1974, and through the cooperation of farm advisor, Bob Sheesey, entomologist, Charles Summers and the grower, were able to distribute parasite material (B. anurus) to about 600 sites in both alfalfa and bur clover scattered up and down the San Joaquin Valley. But then our parasite mine was plowed under, and we lost our source of wasps. A survey in the area this past season, resulted in the recovery of wasps from a neighboring field, but they had not yet developed to significant abundance at this site.

Because of this experience and for other reasons, we have decided to revert to a colonization recovery plan which proved highly successful in the spotted alfalfa aphid biological control program. This is the controlled plot system, in which we con, cajole and wheedle a number of cooperating alfalfa growers and cattlemen into contributing patches of their alfalfa and bur clover to serve as wasp nurseries. We have asked these cooperators to give us a high degree of control (as regards spraying, mowing and plowing) over these nurseries for a period of from four to five years so that we can optimize the changes for parasite establishment and increase. In this way we hope that large parasite populations will develop so that we can harvest sufficient wasps for distribution to growers and stockmen throughout the weevil-affected areas of the State. It is envisaged that field distribution will be accomplished in a series of ag-extension sponsored field days, as was done in the spotted alfalfa aphid program.

In our program we plan to establish about a dozen strategically situated "nurseries" up the gut of the Central Valley and additional ones in Southern California in both alfalfa and bur clover. The sites are being deliberately chosen in areas of historically severe weevil infestation on the premise that the areas of heavy weevil density will produce the largest numbers of parasites. We have also tried to find cooperators who can best stand the sacrifice of several acres of forage legumes to science, and who thoroughly understand our objectives. The principal University negotiators in this program are Monte

Bell, Farm Advisor in Colusa and Glenn counties; University of California, Berkeley, entomologist, Charles Summers, posted at the Kearney Field Station; and Extension Specialist Vernon Burton.

We are quite excited about this program. First, it means that we can pour our precious insectary produced wasps into ideally located and managed plots which will remain in place long enough for the parasites to optimize their deadly calling. Second, with these managed plots we can closely monitor the wasps' progress and therefore milk the fields of parasites for re-colonization at the most opportune times. Finally, it will be a boost to our morale to know that we will be working under conditions in which there is a high probability of parasite establishment and measurable population growth.

In closing we should like to point out that this major biological control program is being supported by regular university funds, some emergency funding from university sources, short-term federal grant funds, and a grant from the California Cattlemen's Association. All of these funding sources are precarious at best, and because of this the plans just outlined are also highly precarious. In this light, it is especially ironic that the massive alfalfa industry which stands to benefit substantially from this program, has yet to contribute one dime to its support.

Reference

Jordan, W. H. 1975. The induction of diapause in three California populations of *Bathyplectes curculionis* (Thomson), an internal parasite of *Hypera postica* (Gyllenhal) larvae. Ph.D. dissertation on file University of California, Berkeley.

Table 1. Colonization of insectary produced parasites against alfalfa weevils in California since 1970.

Year	Bathyplectes curculionis	Bathyplectes anurus	Microctonus aethiops	Microctonus colesi	Tetrastichus incertus
1970		316+	--	44·	112,369+
1971	284+	858+	2,190* 4,019+		103,358+
1972			1,030+		228+
1973	--		2,578*		
1974		10♀+	2,276+		
1975 [Jan-June]	40+	53+	5,763+		150+
Totals	324	1,237:	17,856	44	216,105

Origin

+ IRAN
· EUROPE
* FRANCE

✱ Recovered and believed to be established.
° Recovered but not believed to be established.
: Predominantly mated females.