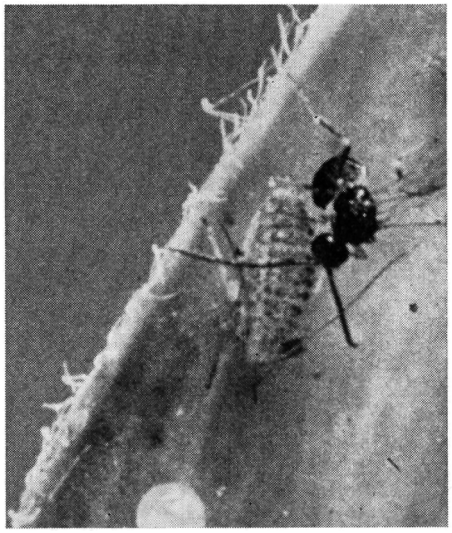
Parasites of Alfalfa Aphid

natural enemies of spotted alfalfa aphid found in search of Europe and Middle East may become established in California

Robert van den Bosch



A *Trioxys* female attacking a spotted alfalfa aphid.

Three wasp species—*Praon palitans*, *Trioxys utilis*, and *Aphelinus semiflavus* —parasites of the spotted alfalfa aphid, are being propagated in the insectaries at Riverside and Albany.

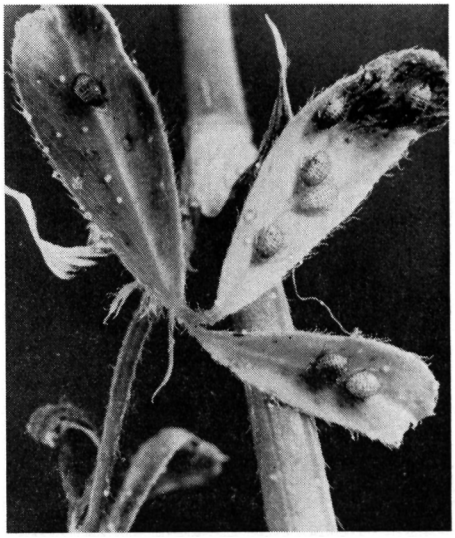
More than 500,000 wasps—most of them adults—reared in the insectaries have been liberated in release plots provided by cooperating growers in eight counties in southern California and in ten counties in central and northern California. These plots have proved ideal for releases because they have been kept free of insecticides and otherwise manipulated so as to afford optimum opportunity for the wasps to become established. The plots have been of additional value by providing areas for long-term observations on the interrelationships of the aphid and its natural enemies.

In southern California—where aphid populations were generally higher than in northern California during the 1956 spring—parasite recoveries were made in 19 of 47, or approximately 40% of the plots. In several plots the parasites have passed through two or more generations and have become very abundant in the vicinity of the release points. Wasp activity has been particularly promising on a ranch in the Antelope Valley where the parasites have spread over a substantial portion of a forty-acre alfalfa field and have moved into alfalfa on an adjoining property.

Although these developments are encouraging, it is still too early to consider the parasites as being established in any area for they have yet to survive the hardships and low aphid populations of the coming winter and then resume their buildup and spread in the spring of 1957. Nevertheless, on the basis of their performance in the release plots so far during 1956, it is believed that it will be only a matter of time before all three wasp species will become established.

During the past year and a half a search was conducted over much of the earth for natural enemies of the spotted alfalfa aphid. Areas explored include Western Europe, the Eastern Mediterranean region, Asia Minor, the Middle East, India, Pakistan, East Africa, and the midwest United States.

The parasitic wasps were found in a number of countries in the Mediterranean region and the Middle East and imported to California during the latter half of 1955 and the spring of 1956. The wasps differ strikingly in appearance and habit from the familiar ladybird beetles which already attack the spotted alfalfa aphid. The ladybird beetle destroys the aphid simply by seizing and devouring it, but the wasp destroys its host by consuming its internal organs and body fluids. This is accomplished by the larva hatched from an egg deposited within the aphid body by the female wasp. When the larva has completely devoured the internal tissues of the aphid, it pupates and the skin of the dead host changes its appearance. The dead parasitized aphids —known as mummies—remain attached to the alfalfa leaves and stems.



Mummies of spotted alfalfa aphid produced by *Trioxys utilis*.

In the case of *Praon* the parasite actually pupates beneath the aphid skin so that the dead body shell sits atop the parasite cocoon, giving the mummy a tentlike appearance. With *Trioxys* and *Aphelinus* pupation occurs within the

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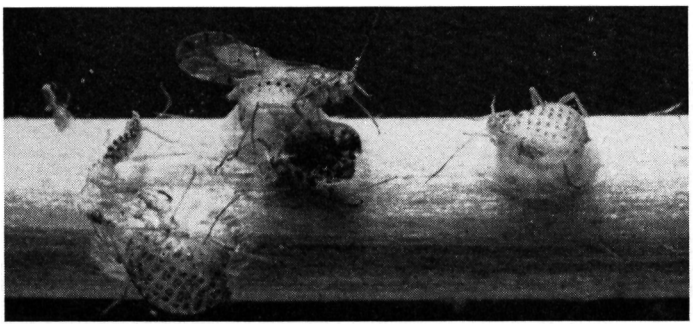
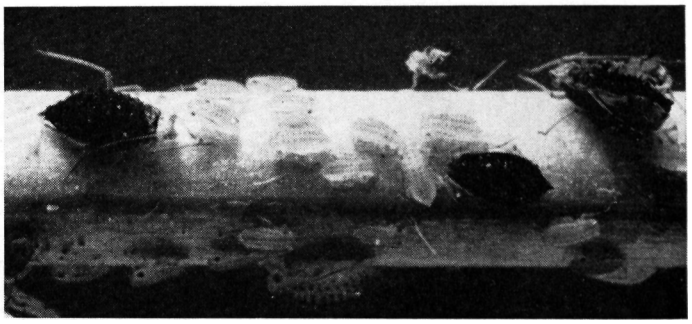
Mummies of spotted alfalfa aphid. *Left:* Produced by *Praon palitans* and *Right:* Blackened bodies of mummies produced by *Aphelinus semiflavus*.





accepted in the United States that the additional outlays for food are in the vicinity of 20% to 25% of an income increase.

With the population growth and income rise that are in prospect, the demand for food by 1975 may be 50% higher than in 1950. This expectation results from an estimated population growth of 36% between 1950 and 1975, accompanied by a 10% increase in per-capita food demand, which is based on the expectation of higher incomes.

In the spring of 1948, the Department of Agriculture made a nationwide survey of the food consumption of urban families. It was found that fruit took 8¢ of the consumer's food dollar and 5¢ of the 8¢ were spent on noncitrus fruits. Of the total expenditure for fruits other than citrus, about 62% was spent on fresh fruit, 26% on canned fruit, 5% on canned juices, and the remainder on frozen and dried products. Urban families with annual incomes between $1,000 and $2,000 spent $17 a week for food compared with $31 by the group with incomes between $5,000 and $7,500.

Among the food commodities to which consumers respond most readily—if they have adequate incomes—are frozen and fresh fruits. The 1948 survey indicated that the quantity of these items consumed in the home can increase as much as 3% with 10% higher incomes.

American families do not have rigid and fixed consumption habits and patterns, which—perhaps—is one of the most outstanding and significant features of the national economy. The great changes that have occurred in the American manner of living within recent decades have had their impact on every phase of economic life. The changes in food needs and preferences are certainly not the least important of these impacts. Formerly the American working force in many industries and occupations was engaged in energy-consuming physical labor now performed by machines. However, Americans continue to consume about the same total poundage of foodstuffs per capita as they did half a century ago. The adjustment has been to substitute foods that have appetite appeal and nutritional components other than carbohydrates for part of the previous energy-rich diets.

The shifting in the average diet is a gradual process likely to continue for many years to come. In addition, a further influence is the growing proportion of people in the older age categories. In coming years, it is expected that the number of persons aged 65 and over will increase almost twice as rapidly as the total population. This is in consequence of improvements in medical science.

Decreased need of energy-rich diets by older people and by a population that has less arduous physical work to do is a matter that should have far-reaching significance for the fruit industries. Fruits are a very satisfactory substitute for foods that are high in carbohydrate. The role which could be played by lemon-juice products, particularly frozen concentrated lemonade, in this changing pattern of food consumption depends in large part on the manner in which the lemon products industry takes advantage of the situation; the potential will exist.

Making projection of consumption rates for a new product—such as frozen concentrated lemonade—and particularly one which apparently caught public favor is a different problem from one of making projections for an old long-time established product. For the new product the early growth factor is significant. In relative terms, the new product can be expected to reflect a strong initial growth factor due to market penetration and extension during the early years. Then a leveling out often prevails as the product becomes established, which may be expected of frozen concentrated lemonade.

To some observers the projections set forth in the table on page 2 may seem unnecessarily conservative, and to others the rates may seem grossly overoptimistic. But the projections are not predictions; they are indicators of potential developments in light of historical experience and considered likelihood as to the future of the United States economy.

The market projections are based—in addition to the population and income levels shown in the tabulation—on the premises that national productivity and employment generally reflect current peacetime conditions and that no marked changes occur in consumers preference structure. Therefore, they may be suggestive of the longer term market potential for lemon juice products.

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The fourth article in this series will appear in the November issue.

TENDERIZERS

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These studies give some insight into the mechanism of papain tenderization of beef. Probably the most important tenderization mechanism is the hydrolysis of muscle-fiber protein, which accounts for three-fourths of the edible portion of beef. Papain hydrolyzes the sarcolemma and the muscle cell nuclei before there is any apparent digestion of the muscle fibers themselves. As measured by the transformation of soluble protein to amino acids, papain hydrolysis reaches a maximum at temperatures of 140°F to 176°F. It is probable that the heat-labile muscle proteins denature before the relatively heat-stable papain and papain hydrolizes these denatured proteins with maximum effect.

Tenderization by papain can not be ascribed to one specific reaction but rather to a general hydrolysis of all of the structural components of beef muscle.

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ALFALFA APHID

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aphid skin. The *Trioxys*-produced mummy is smooth, rounded, and grayish-brown in appearance but the mummy produced by *Aphelinus* is oblong in shape and black in color.

Several days after the mummy is formed, the parasite pupa changes to the adult which chews a hole in the aphid skin and emerges through it to continue the attack on the aphid. The adults of all three parasites are very small wasps, those of the largest species, *Praon palitans*, being no longer than one-eighth inch. Except for their lethal attack on spotted alfalfa aphid, these wasps are completely harmless, probably gaining their food from nectars and honeydews.

At present it is impossible to speculate as to the role these wasps will play in the biological control of spotted alfalfa aphid. Even after becoming established they must demonstrate the ability to spread from the release plots into adjacent commercial alfalfa fields and there survive and multiply in the face of the disruptive conditions of the alfalfa growing cycle.

Some of the factors which may tend to inhibit maximum parasite activity are: widespread insecticide applications; the mowing and baling processes; winter pasturing or dormancy of alfalfa; and periodic scarcity of aphids resulting from ladybird beetle attack or adverse climatic conditions. However, if—despite these factors—the parasites can reach the status which they have attained in a number of areas in the Mediterranean region and Middle East, their collective role should be of considerable importance in the biological control of spotted alfalfa aphid in California.

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The above progress report is based on Research Project No. 1650.