Army Of 23 Million Wasps Is Winning Fight To Control the Oriental Fruit Moth In State

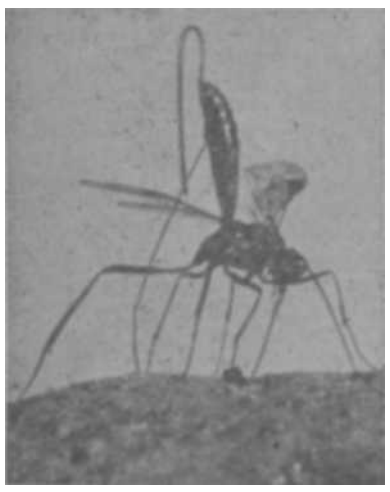
Glenn L. Finney

With a record of kills as high as 85 per cent, an army of 23 million has aided in California's battle against the dread Oriental fruit moth.

It was an army of parasites doing yeoman work to save the state's orchards. It was an army propagated and sent into the fields by the University's Division of Beneficial Insect Investigations of the College of Agriculture.

The infiltration of the twig-feeding, fruit-infesting Oriental fruit moth was discovered in the peach orchards of Orange County in 1942.

Chemical control of this pest with the use of stomach poison placed on the twigs and fruit had, up to that time, proved unsuccessful because the entering larvae of the moth, seemingly wise beyond their years, discarded the first few lethal bites before burrowing hungrily ahead into the untainted food.



The wasp probes the surface of a potato searching for a hole containing a moth larva. When one is found the wasp's stinger is thrust into the burrow to inject hypodermically a tiny microscopic egg into the body of the larva.

The State Legislature allocated a sum of money to the California State Department of Agriculture, part of which was turned over by that Department to the Division for the study of insect enemies of the moth. Economic methods for rearing a parasite of the moth were to be devised for large scale production.

By the spring of 1944 techniques for quantity production were in operation and shipments were made during the year to the known infested areas in Orange, Los Angeles, San Bernardino, Kern, Tulare, and Stanislaus counties.

Moth Enemy Selected

The most aggressive of several enemies of the moth seemed to be the reddish-brown parasite, **Macrocentrus ancylivorus,** a wasp with an egg-laying stinger half an inch long—as long as the rest of the insect itself. Its native home is New Jersey, where it preys upon the strawberry leaf-roller and also upon the Oriental fruit moth since the latter invaded that part of the United States from Japan.

Another host had to be used in the West, since the leaf-roller was not found in California and the Oriental fruit moth did not lend itself well to efficient use in mass production methods.

After some experimentation it was discovered that the wasp looked with favor on the larvae of the potato tuber moth—a moth that had been long considered "enemy number one" by all insectary operators who used potato sprouts in their techniques.

The tiny tuber moth larvae normally enter the potato only through its eyes or abrasions in the skin surface, but not enough can get in by this means to completely utilize the potato.

Mass Production

More eyes or reasonable facsimiles are created by rolling each potato over a tack-studded board with a leather tack-studded mitt. With the addition of these artificial "eyes" as many as 100 larvae may be produced in each potato, reducing it to an empty, riddled shell.

Each day during the six months' long production season 1400 pounds of A-1, small-sized, punctured potatoes are set up among 84 production units.

In 84 special boxes groups of moths fasten approximately 20,000 eggs on each of 84 sheets of cloth—a total of over a million and a half per day! These cloths are laid egg-side down over the trayed potatoes until after the tiny larvae have hatched out and disappeared into the potatoes.

One day after the larvae have entered the potato 8,400 female wasps are turned loose in the 84 production units. The wasps immediately start probing about over the surface of the potatoes with their long flexible stingers, searching for the tiny holes made by the moth larvae. When one is found, the stinger with lightning-like rapidity is thrust down the burrow, where a tiny microscopic egg is injected hypodermically into the squirming body of the worm.

With 48 hours over 60 per cent of the larvae are carrying the eggs of the parasite wasp. Two days later these eggs have hatched and tiny parasite "worms" are floating around in the bodies of the moth larvae. They do not grow, however, until their hosts have completed their feeding on the potato and have grown to ½ inch in length.

When the tuber moth larvae have become fully fed, as many as 400,000 drop from the potatoes each day. If these were not confined they would wander everywhere, spinning their cocoons in every niche and cranny which they could find.

Roving Larvae Restrained

The extremely active and restless larvae are successfully confined in a "corral" with an "electric fence." The "fence" consists of a strand of electrically heated resistance wire, hot enough to repel the worms but not hot enough to injure them.

Within this area, waxed, metal sheets are placed with ridges of fine sand arranged on them. The larvae solidly pack these ridges with cocoons constructed of sand particles and silk.

One week later about 60 per cent of the moth cocoons contain the tightly woven, capsule-shaped, reddish-brown cocoons of the wasp, which has destroyed and replaced the moth larvae. The remaining 40 per cent have within them the normal pupae of the potato tuber moth.

Harvesting the Wasps

The cocoons are lifted from the tins, placed in a screen basket, and dipped into a solution of sodium hypochlorite. Within 45 seconds the flimsy, silken, moth cocoons have been penetrated and completely dissolved by the chemical, releasing the sand which sinks through the screen mesh of the basket to the bottom of the bath. The tightly spun wasp cocoons, as well as the moth pupae, are uninjured by this brief immersion.

The parasite cocoons must be separated from the tuber moth pupae. This is accomplished in 30 seconds by dipping them in a bath of 65 per cent alcohol. The wasp cocoons float on the surface; the moth pupae sink to the bottom.

Tuber moth larvae restrained by the "electric fence." The "fence" marks the edge of the white field which actually is a carpet made of the white cocoon thread trailing from each one of the roving larvae.

The moth pupae are dried on a cloth frame and placed in screen trays within a moth-emergence cabinet. More than 150,000 adult moths emerge during a single day. These practically cover the inside walls of the cabinet.

Each day the chamber is filled with an anaesthetic. The anaesthetized moths tumble down into a drawer at the bottom of the cabinet. The "sleeping" moths are removed, measured out into vials, and put into the 84 egg-laying units where they stick their eggs on the 84 sheets of cloth—thus their life cycle is made complete.

Since ether gas is highly explosive and extremely dangerous to use in large volumes, it is mixed with carbon dioxide gas in such proportion that it does not burn, and yet retains all the desired anaesthetic properties.

Laboratory to Orchard

The wasp cocoons that float on the surface of the alcohol bath are also dried on cloth frames. On the following day they are put into paper "candy" bags—1000 to a bag—packed in tightly sealed cartons and shipped to the orchards, where they are liberated with the cooperation of the State Department of Agriculture and the County Agriculture Commissioners.

In the orchards the bags are hung, two to an acre, within a half-mile radius of any point where an Oriental fruit moth has been trapped previously. The adult wasps soon emerge and begin a search for any larvae of the Oriental fruit moth feeding in the young, succulent tips of the twigs.

During the past six months' production season 250,000 pounds of potatoes have been used; over 28 million wasp cocoons have been produced and 23 million of these have been shipped to the orchards of central and southern California. In some locations at least, they have destroyed as many as 85 per cent of the feeding larvae of the Oriental fruit moth.

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Nutrients For Beef Cattle Are Outlir N

An extract from a new Agricultural Extension Service Circular, California Beef Production, now in the process of publication. Until the release of this circular, the information quoted, in part, here is available only in the limited publication of the National Research Council.

The National Research Council recently published a report entitled **Recommended Nutrient Allowances for Beef Cattle.** Table 4, taken from this report (printed in **California Beef Production.**—Ed.) gives the expected gains for different ages, sexes, and production objectives; also the necessary daily intake of total dry feed equivalent, digestible nutrients, digestible protein, calcium, phosphorus, and carotene. This table of requirements and its use, in conjunction with tables 5, 6, and 7, on the composition of feeds, is discussed in the sections on the production of feeder cattle and on fattening.

Requirements for nutrients other than those listed in the table are briefly discussed in the following paragraphs.

Vitamins—Under usual conditions of management, beef cattle receive enough vitamin D from exposure to direct sunlight or from sun-cured roughages. The requirement for young calves is reported to be about 300 international units per 100 pounds of live weight per day. Vitamin D is essential to calcium and phosphorus utilization and to the prevention of rickets and other bone abnormalities.

The water-soluble vitamins thiamin, riboflavin, niacin, pyridoxine, pantothenic acid, and biotin, and the fat-soluble vitamin K are synthesized by micro-organisms in the rumen. So far as is known, a dietary supply of these vitamins is not essential after cattle are two months of age and rumen function has been established, provided the ration is otherwise adequate. Possibly with gross deficiencies of protein or other nutrients in the diet, conditions in the rumen may not permit the micro-organisms to produce optimum quantities of these essential vitamins. Further research is needed to show definitely what bearing this problem may have upon practical beef production.

The need of vitamin E in the diet of cattle has not been demonstrated, nor is there evidence of rumen synthesis of this vitamin, which is widely distributed in feeds. Claims made for beneficial results of vitamin-E therapy in reproduction in cattle have not been substantiated.

Minerals Other Than Calcium and Phosphorus — Besides calcium and phosphorus, cattle require magnesium, sulfur, potassium, sodium, chlorine, iodine, manganese, iron, copper, and cobalt. Information is presented on elements for which deficiency symptoms are known, or for which need of supplementation in a localized area has been demonstrated.

Common Salt—Salt supplied sodium and chlorine. The physiological requirements appear to be very low, about 1.5 grams daily of sodium and less than 5 grams daily of chlorine being sufficient for growth. Larger amounts (11 grams sodium and 15 grams chlorine for a cow producing two gallons of milk daily) are required for lactation. Since, however, salt is also used as a condiment, voluntary intake is much above these apparent physiological requirements. Consumption depends upon the amount in the feed, as well as upon other conditions, but varies usually between 1.0 and 2.5 pounds per month. Cattle should have free access to salt.

Iodine—The use of salt containing 0.015 to 0.020 per cent potassium iodide has effectively prevented goiter in iodine-deficient areas. Griem and his associates have recommended, as sufficient, iodized salt containing 0.01 per cent iodine, stabilized to prevent loss. Without stabilization, iodine is rapidly ed
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Sproul Discusses Work of College

(Continued from page 1)

grown up in other parts of the state.

Planned Expansion

The increased awareness of the importance of agricultural research and the growing demands of the agricultural industry, mean of course, that more men are needed for research, and in turn, more buildings to house them. Fortunately, money is available to care for immediate needs, in the sum of more than seven and one-half million dollars.

On the Davis campus, a plant for the School of Veterinary Medicine, is to be constructed at a cost of $2,170,000, incorporating the latest and best in building design and equipment. At Davis, too, will be built structures for plant sciences, soils and irrigation, poultry husbandry, home economics, and food technology.

At Berkeley, a Forestry Building, Forest Products Laboratory, and a Home Economics Building are to be erected.

At Riverside, one new major building is planned, and in addition, a central heating plant and a structure to house metal and woodwork shops.

Research is never completed until its results are in the hands of the men and women on the soil. Accordingly, the results of research are published in bulletins and circulars and made available to farmers as soon as possible.

A new department of Agricultural Information has been opened by the College of Agriculture. It has set itself the task of simplifying the language of bulletins and circulars and presenting them in brighter appearance.

A new periodical (This is the first issue.—Ed.) will bring the farmer knowledge of projects launched, and of progress as it is being made, fore the results are formally lished for the recording of scien accomplishment. Similar mat will be supplied to farm jour newspapers, and radio statio of may be distributed quickly. ng

Mutual Need

Looking backward over t n through which the College ar culture has served the Sta rsit you will agree with me th 1939 serves the encomium, Well e su the demands of agriculture ver sentatives have not been course, but the College has uted mightily to the welfare fornia farmers.

The interests of the College culture and the Farm Bur common interests, and for they have always been recog such. For your good as well may you continue to unders mutual need, each for the the University and California agricultural industry.

Research on the use of general contact herbicides to eliminate successfully weeds in the first cutting of alfalfa is being conducted by the Division of Botany at Davis.

Working in cooperation, th States Department of Agr the Division of Animal Hus and the Division of Agricult gineering are studying the mental influences affecti growth, health, and produ lts c livestock from the standpoint in temperatures. Work is being as st Davis and Imperial Valley. was abo rece tion

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California Agriculture, progress nost agricultural research, will be sent f cal resident of the State in response to lent sent to the University of California ble of Agriculture, 331 Hilgard Hall, B California.

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