Klamath Weed Beetles

biological control program now is in the second of three phases

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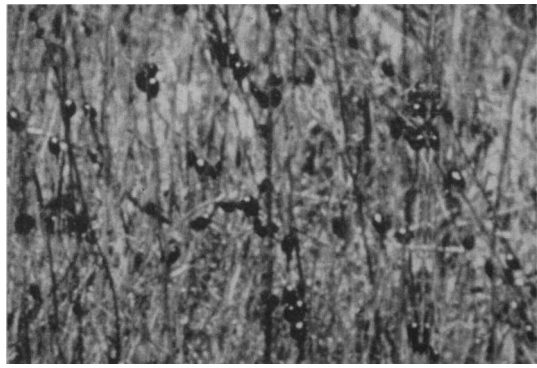

Beetles selected for release in the Klamath weed biological control program thrive on the plant pest and starve in its absence.

Approximately 97% of the 122 colonies of Klamath weed beetles released in 19 counties of the State are considered established.

The establishment of colonies of the beetles—natural enemies of the Klamath weed—completes the first part of a three-phase program designed to effect control of the noxious weed by the biological method. The program is the first of its kind in the United States and was set up as a coöperative undertaking between the United States Department of Agriculture and the University of California Division of Biological Control.

Klamath weed (*Hypericum perforatum* L.) is known in Europe, where it originates, as St. Johnswort. It was first reported in California about 1900, when it was discovered in the vicinity of the Klamath River.

It is an aggressive plant, and since its discovery along the Klamath River it has taken over about 400,000 acres of California open-range grazing lands, greatly cutting their carrying capacity.

Klamath weed is detrimental to the thrift of sheep and cattle, particularly cattle. Though the weed is not palatable, livestock will graze it when forced to do so by the absence of better forage.

The eating of the weed causes the white-skinned portions of the animal's body to become photosensitized—sensitive to the sunlight. Blisters form on these areas when the animal is exposed to the direct rays of the sun with the result that the animal becomes scabby, sore-mouthed and underweight.

Chemical control of the weed has been attempted. In most places the cost of the materials and the inaccessibility of the land to be treated have been limiting factors. The application of borax has been satisfactory in controlling new and small infestations, but this method is impractical in large-scale control programs.

Three Phase Program

Biological control of Klamath weed by insects—natural enemies—was considered possible and efficient; so a three-phase program was planned.

The first phase demanded the discovery of natural enemies of the weed and their importation and establishment in California. The second phase was concerned with the devlopment of parent colonies in each of the infested counties of the State so that ultimately each county would be independent of further introductions. The third phase would be the actual control of the weed in the field as the successful result of the first two phases.

The Commonwealth of Australia, like California, has the problem of Klamath weed—or St. Johnswort—and as early as 1920 began a search for insect enemies of the weed. The preliminary work centered in Europe, where the plant originated.

Starvation and reproduction tests of a considerable number of insect species were made on representative plants of economic importance. These tests were made on 42 species of widely distributed plants representing 19 families, to determine whether there was either feeding or reproduction upon them.

The progress of the Australian experiment was watched closely by California scientists. About eight years after the first field releases of two species of the insect *Chrysolina*, encouraging results were reported. These reports led to negotiations between the University of California and the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, which resulted in an authorization by the Department for importation from Australia to California of the two species of leaf-feeding beetles about the size of a ladybird beetle and of a

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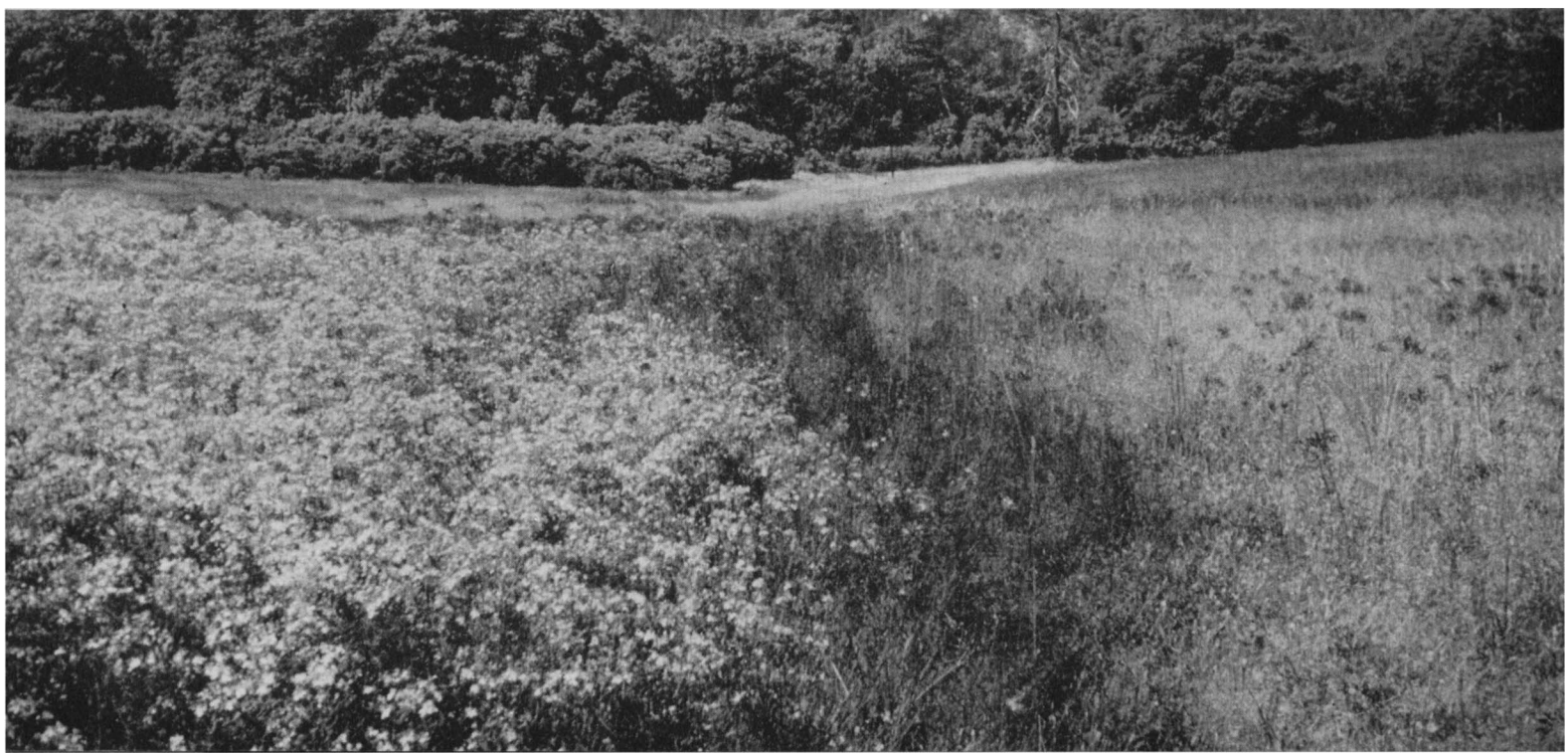
Left: **Klamath weed in bloom.** ***Center dark strip:*** **The weed dying under the attack of the hungry beetles.** ***Right:*** **Field cleared of the noxious weed.**



KLAMATH

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shiny, dark blue-green color—*Chrysolina hyperici* and *Chrysolina gemellata*—with the proviso that feeding tests be made on the following plants: Sugar beet, flax, hemp, sweetpotato, tobacco, and cotton. A coöperative project for the importation, testing and colonization of these species then was set up between the Bureau of Entomology and Plant Quarantine and the University of California.

Importations were begun in October 1944. Most of the shipments consisted of adult beetles in the estivating stage—lying dormant during the summer months—when they were shipped from the Southern Hemisphere.

The first problem encountered after the arrival of the beetles in California was to change their life cycle so it would be in accord with the seasons of the Northern Hemisphere.

By subjecting the dormant adults daily to fine sprays of water—imitating the winter rains of Australia—the beetles were brought out of their estivation and into the egg-laying stage of their life cycle, so that fertile eggs were obtained within two to three weeks after the adult beetles arrived in California.

During the first year of importation, sufficient numbers of the beetles were received to conduct the required feeding tests. These tests were completed in May, 1945, with no feeding or egg laying taking place on any of the test plants. It was found that both species of beetles would starve and die on any plant other than Klamath weed.

The larval, or immature, stages of both species feed and develop during the winter and spring months on the basal growth of the weed. Apparently, this destruction occurs at a very critical time for the plant, as it is later unable to send up seed stalks and the roots die during the following summer.

Late in the season of 1945 four colonies of the beetles were released in areas infested with Klamath weed. One of these colonies became established, but the survivors were so few that it was not possible to make recovery collections of the beetles until 1947.

At one test location in Humboldt County where the beetles were released in January of 1946, they have increased rapidly and have destroyed a continuous stand of about 20 acres of Klamath weed.

The successful establishment of these beetles in California completed the first phase of the biological control program.

The second phase, the distribution and development of colonies in each of the infested counties, is now well underway. During the winter and spring of 1947–48 some 557,000 adult beetles were released at 122 locations in 19 counties.

The third phase of the program, the actual control of Klamath weed on the range, will require millions of the beetles, and it will be several years before the present field colonies can grow to the necessary numbers. It is recommended that in the meantime growers and ranchers use the current control methods of cultivation, application of borax, and good management practices.

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The number of adults of two species of Klamath weed beetles and the number of locations at which beetles were released in 19 counties in California, 1947–48.

County	*Chrysolina hyperici*		*Chrysolina gemellata*	
	No. adults	No. locations	No. adults	No. locations
Amador	15,000	3	7,500	3
Butte	20,000	4	5,000	1
Calaveras	15,000	3	7,500	2
Del Norte	5,000	1		
El Dorado	10,000	2	7,500	2
Humboldt	70,000	14	112,500	23
Lake			2,500	1
Madera	5,000	2		
Mariposa			4,000	1
Mendocino	20,000	4	5,000	1
Nevada			7,000	2
Napa			5,000	1
Shasta	40,000	8	16,000	6
Siskiyou	35,000	7		
Sonoma	20,000	4	5,000	1
Tehama	10,000	2	11,000	3
Trinity	40,000	8	5,000	1
Tuolumne	10,000	2	7,500	3
Yuba	30,000	6	4,000	1
Total	345,000	70	212,000	52

CITRUS

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further support to the view that the poor growth in old citrus soils is possibly due to a build-up of detrimental organisms.

Examination of the roots of seedlings grown in these fumigated old citrus soils showed a great reduction in the amount of root rotting and in the numbers of fungi and nematodes. These results indicate that microbial factors are at least partly responsible for reduced growth in second and third citrus plantings.

Possible Explanations

In every experiment growth of seedlings in the fumigated old citrus soils was not as great as that in untreated or fumigated noncitrus soils.

There are several possible explanations. First, it is possible that the fumigants did not kill all the detrimental organisms. Second, assuming that all were killed, it is possible that conditions in the fumigated old citrus soils are more favorable for the reëstablishment of the detrimental organisms than for their establishment in noncitrus soil. Third, some toxic material may accumulate in the soil. Such a hypothetical toxic substance could originate either from the citrus roots themselves or from organisms decomposing root excretions and dead root matérial. If the latter should be the case the cause of reduced growth would be indirectly microbial in nature; that is, although the adverse microörganisms may be killed, substances produced by their previous activity could continue to retard growth of citrus, at least for a time.

Observations

Although studies suggest that detrimental soil organisms and possibly other factors cause reduced growth of citrus trees in old soils, other and interrelated factors may be involved under field conditions.

Any condition which decreases tree vigor such as adverse climatic factors, heavy bearing, insect infestation, or insecticides might render the tree more susceptible to the activities of soil organisms. Undoubtedly several interrelated factors cause reduced growth of citrus in old citrus soils. Some of these factors are primary in nature while others are of a secondary type.

A wide range of studies are currently underway both in the field and in the greenhouse to find efficient ways and means of overcoming these unfavorable conditions.

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The above progress report is based upon Research Project No. 1263.