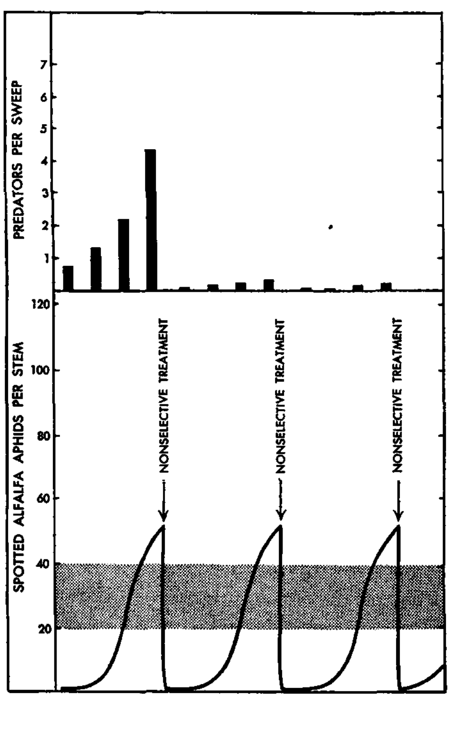
Vernon M. Stern, Ray F. Smith, Robert van den Bosch, and Kenneth S. Hagen

Effectiveness of Integrated Control Programs against pests on agricultural crops

Integrated pest control programs combine and integrate natural control factors and chemical treatments. Chemical control is used when necessary but in a manner planned to be the least disruptive to control by predators, parasites, and diseases attacking pests of agricultural crops.

Organic insecticides and acaricides are an essential part of modern agriculture and their adoption into pest control programs has been widespread. Sometimes the use of chemicals has altered the components and intricate relations of crop environments. Such alterations and the widespread use of chemicals have resulted in a number of problems: insect resistance to insecticides; rapid resurgence of the treated species, necessitating repeated applications; residues on crops; and secondary outbreaks of pests other than those against which control was originally directed.

Nonselective treatment applied in early summer when aphid population first rises above treatment level—20–40 aphids per stem—results in near elimination of natural enemies and need for repeated treatments during remainder of growing season.



The most important characteristic of biological controls—predators, parasites, and diseases—is that they are self-perpetuating and capable of response to increases in the population density of the pest they attack. The natural enemies of agricultural pests are permanent characteristics of a given crop environment and perform an important role in the biological laws of population control.

On some occasions, when the environmental pressures—from natural control factors—are inadequate, a pest outbreak may be frequent and cover a wide area; in other instances, damaging numbers occur intermittently and in restricted locations. Pest outbreaks occur during a season favorable to the pest. In such cases—where natural control is inadequate—chemical treatment is needed as a complement to biological control.

Chemicals constitute short-term control factors, in contrast to natural control factors. Predators, parasites, and diseases actively seek out the pest and adjust in numbers in response to the size of the pest population.

Chemical control can not permanently change the average density—natural balance—of the pest population nor can it restrain an increase in abundance of the pest without repeated applications. Therefore, in contrast to biological control, insecticides must be added to the environment at varying intervals of time.

Almost all insecticides act on the many organisms—beneficial and harmful—in any treated area and may disrupt the delicate relationships of beneficial insects and their hosts, particularly when large acreages are treated.

Biological control and chemical control methods can be made to augment one another. The control of an insect pest is a complex environmental problem which includes the crop plants, soil, climate and all other plants and animals present.

In most crops some potentially harmful organisms are continually held below economic levels by natural controlling forces. In other crops, the pests are held at safe levels for only part of the time. A pest species may be under satisfactory biological control over a large area or a long period of time, but not in all individual fields or during all periods. In such situations, integrated control—natural control augmented by chemical treatment—is especially important. Intermittently destructive insect populations must be reduced in a manner that permits biological control to prevail.

Where chemical treatments are necessary for both perennial and periodic pests, selective insecticides must be used to foster biological control of the pests. The insecticide itself may be selective in its toxic action or may be selective because of its formulation or dosage. Selective action can be produced on a pest-parasite complex by treating only those areas where the pest-parasite ratio is unfavorable. Proper timing of chemical treatments, also, can produce a selective

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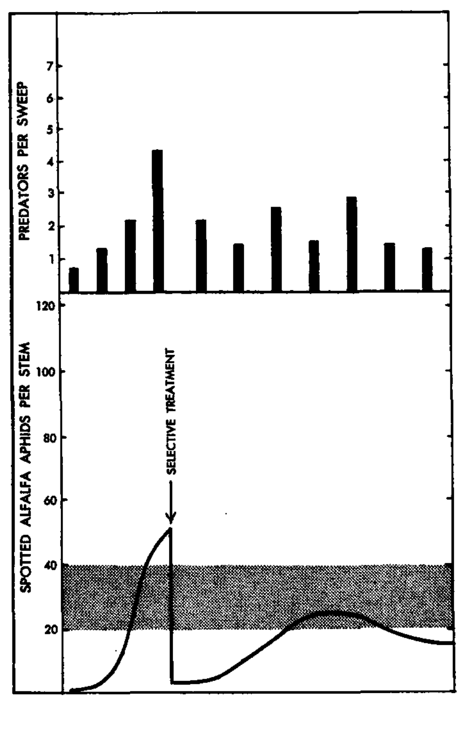
Selective treatment applied in early summer leaves a few aphids and sufficient natural enemies to hold aphid population below the treatment level for remainder of growing season. (Modified from detailed graphs in Hilgardia 29(2): 131–154.)



FRANCIS L. SMITH and BYRON R. HOUSTON

Root rot resistance in Common Beans sought in plant breeding program

More than 1,200 introductions and commercial bean varieties were tested by inoculation with cultures of the two most prevalent organisms causing root rot in California. Only seven showed some tolerance to the Fusarium fungus, and none to the Rhizoctonia. These seven were crossed with ten commercial bean varieties in most of the 70 possible combinations. Each plant was graded on severity score of 0–4, and the average scores were used for evaluation. None of the first-generation plants showed resistance. Second-generation plants were tested from 60 of the 70 combinations. These tests indicated that hybrids from three of the resistant lines gave very few plants with low disease scores. Second-generation plants of hybrids from the other four accessions had 16%–19% resistant plants, or a ratio of 13 susceptible to three resistant. These results could be explained by assuming that resistance is due to two independent genes, one dominant and the other recessive. To test this hypothesis, four third-generation combinations were tested. To confirm the assumption, only 1/16 of the third-generation progenies would have disease scores as low as the resistant parent, and 2/16 would segregate three resistant to one susceptible and would have relatively low average scores.

Third-generation progenies from 102 second-generation plants from each of three crosses gave the following results: Sutter Pink × N203—15.7% resistant; California Red × N203—17.7% resistant and California Red × PI 165,435—14.7% resistant. The resistant plants must carry the recessive gene.

Seed from the lowest scoring second-generation plants in the greenhouse tests were planted in the breeding nursery and backcrossed to the commercial varieties. Cross pollinations were made on as many plants in each cross as was possible. From these hybridizations 38 backcrosses were obtained from Sutter Pink × N203, 35 from California Red × N203 and 24 from California Red × PI 165,435.

The F_3 plants which were used as parents in the backcrosses to the commercial varieties have been tested. Theoretically 1/3 should be homozygous for resistance and 2/3 heterozygous. A total of 17 progenies from the resistant F_3 plants were tested and five were found to be as resistant as the resistant parent. These results lend further strength to the validity of the hypothesis that was made to account for the F_2 results that resistance is governed by two independent genes, one a dominant, the other recessive. Backcrosses from these proven resistant plants will be used in the breeding program. These plants will also be used in crosses with other commercial varieties.

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INTEGRATED PROGRAMS

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action on the pest and natural-enemy complex. Nonselective materials, with short residual action, may be used if the beneficial organisms can survive in a resistant stage or in an untreated reservoir area. For some pests, a disease can be used as a selective insecticide.

In addition to selective insecticides, other steps have been developed to utilize integrated control. One successful step has been the development of supervised control programs. In such a program farmers—singly or in groups—contract with a professional entomologist who determines the status of the insect populations in their fields. On the basis of pest population counts, and conditions peculiar to each situation—including the pests and their biological controls—the time and method of control are selected.

Cooperative, statewide, long-range entomological research projects have been undertaken to investigate integrated control methods against field and forage crop pests.

In appropriate situations, integrated programs have been successful in the control of certain pests of agricultural crops and give great promise of further success.

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Rootstock breeding for new

GRAPE VARIETIES

The object of a rootstock breeding program at Davis is to find new grape varieties which meet the special needs of California agriculture. In choosing promising new rootstock varieties, selection from the seedling lots is carried out in three phases: disease and pest resistance tests; nursery performance of the seedlings; and vineyard performance of the scions on the grafted vines. The first two phases are made under controlled conditions in an experimental nursery and greenhouse; the third is studied under long-term field trials carried out under commercial vineyard conditions.

Five years ago, initial selections were made from several large populations of hybrid vines which showed promise in their phylloxera and nematode resistance. After initial resistance studies and some nursery tests, 100 of these seedling vines were retained as the most promising for further trials. Vineyard trials are now under way with these seedling rootstocks in several locations in California. As data from these tests are accumulated, further eliminations will be made and the remaining selections will be released to growers for commercial use.

At this time the most promising seedlings appear to be those which are nematode resistant and high in inherent vigor. A number of these types are being tried in sandy, low-fertility, nematode infested sites in the San Joaquin Valley, where a need exists for a satisfactory new rootstock.—*L. A. Lider, Dept. of Viticulture and Enology, Davis.*