SOIL ARTHROPOD COMPLEX IN CALIFORNIA STRAWBERRY PLANTATIONS

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California strawberry plantations are typically replanted on an annual basis, and are farmed intensively resulting in extraordinarily long production seasons and excellent yields and quality. Preplant soil fumigation of methyl bromide and chloropicrin is widely used in this system to control most soilbome pathogens and weeds that are problems in strawberry fields (Table 1). This tactic also controls nematodes and several species of soilbome arthropods that may become abundant in multiyear production systems, as well as those which are planted without the use of fumigation or other control measures. These pests directly impact strawberry yield and/or quality when present at sufficient levels.

Table 1. Important pests that are destroyed by exposure to soil fumigation mixture of methyl bromide and chloropicrin in California strawberries. 1/

Arthropods	Diseases
Root weevils	Verticillium wilt
cutworms	Phytophthora root and crown rots
Strawberry rootworms	Anthracnose
White grubs (Heplia spp)	Black root rot
Garden symphylan	Charcoal rot
Ground mealybug	
Nematodes	**Weed seeds of all species except**
Foliar nematodes	Field bindweed
Root knot nematodes	Little mallow
	Burclover
	Sweetclovers
	Filaree

1/ from University of California. 1934. Integrated Pest Management for Strawberries. Publication #335 1.

In addition, enhanced plant vigor resulting from treatments of methyl bromide and chloropicrin (due to increased root development, plant nutrition and suppression of diseases which directly affect the plant) increases tolerance to other arthropod pests such as spider mites which may not be directly killed by fumigation.

Root weevils. The larvae of several species of weevils may damage strawberry plantations by destroying root hairs and chewing the bark of larger roots. They can also burrow into crowns and destroy crown tissue. Species which may be found in California strawberries include the wood weevil *Nemocestes incomptus, the* cribrate weevil *Otiorhynchus cribricollis*, the black vine weevil *Otiorhynchus sulcatus*, and the Fuller rose beetle

godmani. In fumigated fields, root weevils are seldom a problem as most resident larvae and pupae are killed. Infestations in these fields only occur by invasion from nearby hosts, and in areas where this is a chronic problem sticky barriers or border treatments of pesticides may be used to prevent migration of adult weevils into the fields. Root weevils are problems in many strawberry production areas of the world where soil fumigation and annual plantings are not used, and were regarded as a problem in California plantations prior to the 1950's.

Cutworms. The black cutworm *Agrotis ipsilon* and the roughskinned *cutworm Athetis mindara, are the* primary cutworm species causing damage in California strawberry plantations. Cutworm larvae attack the crowns of young plants, and can cut through the stems of flower *clusters*. The larvae are most damaging later in the season when they feed on fruit. Cutworms over-winter as larvae in the *soil*, and because of their wide host range can be present following many previous crops. They can build up rapidly in weedy fields because adults are attracted to many weed species as oviposition sites.

Strawberry rootworms. Strawberry *rootworm, Paria fragariae*, adults overwinter in leaf litter on the soil or in soil cracks, and emerge to feed on strawberry foliage. Larvae produced by over-wintering adults feed on roots during the summer and kill plants.

White grubs. Larvae of white grubs, *Hoplia* spp., usually occur in strawberries planted in sandy soil that has been in or near permanent pasture. These beetles most frequently occur in the Central Valley.

Garden symphylans. The garden symphylan *Scutigerella immaculata* is usually a problem primarily on fine-textured soils that are high in organic matter, especially if plant debris from a previous host crop is not completely decomposed. High populations of this arthropod feeding on strawberry roots can cause in serious stunting or killing of plants.

Ground mealybugs. The ground mealybug *Rhizoecus fafcifer* is an emerging pest of *many* crops in California. Although its biology is not well studied, it is known to have a broad host range feeding on the roots of ornamentals, weeds, alfalfa, deciduous fruits, and berries. Damage from feeding first appears as wilted plants during periods of hot weather, often in circular areas within a field.

Although the extent of losses caused by arthropods that may result from the absence of soil fumigation on California strawberries is unknown, it is probable that resident populations of these pests would increase. Soil arthropods were serious pests of California strawberries before soil fumigation became standard preplant practice, and annual plantings were common. Soil arthropods continue to be serious pests in many areas of the world where these practices are not utilized, but most of these production areas do not use annual production systems in the absence of methyl bromide and chloropicrin fumigation. Many soil arthropods such as root weevils are particularly difficult to control once they invade strawberries. Growers would likely use registered insecticides in season to treat resident populations. Control achieved by these applications would be lower than that currently experienced, and it is possible that multiple applications would also be necessary.