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ARTICLES

SEASONAL MONITORING OF THE PISTACHIO SEED CHALCID

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Summary

Pistachio seed chalcids have recently been found infesting commercial pistachio seed for nursery stock in Fresno and Kern counties. Trapping in 1994 and 1995 showed two distinct periods of adult occurrence, in July and September.

Introduction

The pistachio seed chalcid, *Megastigmus pistaciae* Walker, was first noticed infesting pistachios in North America at the USDA Plant Introduction Station in Chico, California in 1967 (Robinson 1968). Following this discovery, eradication of this introduced pest was briefly considered by
state and federal regulatory agencies until it was determined that the seed chalcid was too widely distributed throughout Butte County to be effectively eradicated.

In 1984 the pistachio seed chalcid (PSC) was discovered in experimental plantings in Winters, Solano County, by University of California researchers working on a variety of insect pests in pistachios. Subsequently, monitoring with sticky traps and field collections of pistachio nuts showed the seed chalcid to be generally distributed throughout northern and central California as far south as Fresno and Tulare counties (Rice 1988, Rice and Michailides 1988).

In 1993 we became aware that the seed chalcid was infesting and causing significant economic loss to *Pistacia integerrima* seed from trees located at the Kearney Agricultural Center in Parlier. Observations on levels of

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infestation indicated viable seed loss at approximately 2% in 1993 and 1994. As a result of these observations it was determined that additional seasonal monitoring of the

pistachio seed chalcid in the San Joaquin Valley was necessary to validate the previous findings of Rice and Michailides and to develop a larger database on the seasonal phenology of this potentially severe pest.

Materials and Methods

In 1994 and 1995 yellow panel apple maggot (AM) (Trécé, Inc., Salinas, CA) sticky traps, without an attractant bait were used for trapping pistachio seed chalcids in mature pistachio seed trees at the Kearney Agricultural Center. In 1994 three traps were placed at heights of 14-15.5 feet in trees that were 25-35 feet high. Four additional traps were placed at approximately 7-7.5 feet high in the same trees. These traps were placed in the trees on April 1 and removed on November 1, 1994. Traps were inspected weekly for the presence of adult seed chalcids trapped on the sticky surface.

In 1995 only four yellow panel AM traps were used for monitoring seed chalcids in the same research orchard at Kearney. Because there were no differences in collections of seed chalcids at the two different heights in 1994, the four traps in 1995 were all placed at approximately 7 feet above the ground. These traps were in place on April 3, 1995 and were removed on November 3, 1995. The traps were again monitored and serviced at 7-day intervals throughout the trapping period.

Results and Discussion

The first adult chalcid was trapped on July 12, 1994 and no other collections were made until August 23. Following the appearance of the second adult chalcid in late August, collections continued in 1994 to a peak on September 13, with the last collections occurring on October 18, 1994 (Fig. 1). The average number of seed chalcids collected in the traps placed at 14-15 feet did not differ significantly on an average per trap basis from the four traps placed at the lower height.

The results of PSC trapping in 1995 showed the first adult chalcid trapped on July 21 followed by collection of the second chalcid on September 1. The appearance of the second chalcid in September was followed by continuous emergence and collection of chalcids through October 20, 1995 with the peak of adult trapping occurring on September 21. The later emergence of PSC in 1995 compared to 1994 is probably due to the prolonged cool, wet spring weather experienced in 1995, especially in March-June.

The appearance of only single adult chalcids in mid July in both 1994 and 1995 is believed to be the result of the maturing of overwintered diapausing larvae in mature seed from the previous season. This relatively late appearance of adult chalcids in mid summer would correlate with the development and availability of seed embryos (nutmeats) that provide the only known food source for PSC larvae.

Following the initial appearance of female chalcids in July, a period of first generation larval and pupal development apparently occurs from August through mid September, during which time no adult chalcids are present in the field. This first generation of chalcids, however, appears to develop quite rapidly with the appearance of a second emergence of adults in late August and early September. These adults can then return to the current year nut crop and lay eggs that will produce overwintering mature, diapausing larvae in September, October, and November. This larval population will survive and emerge the following July.

This observed seasonal phenology and development of pistachio seed chalcid indicates that this insect is well adapted to the development of its pistachio hosts. The low level of adult collections in mid July suggests that mortality of the overwintering larval population is extremely high, or perhaps that a significant portion of the overwintering population does not in fact emerge until nutmeats are completely mature in August and September.

In addition to the monitoring of pistachio seed chalcid in 1994 and 1995 at Parlier, an interesting observation was made on the appearance of pistachio seed chalcid for the first time in Kern County. A small backyard planting of *Pistacia atlantica* seed trees was discovered heavily infested with PSC during harvesting of nursery stock nuts in October 1995. This infestation was located near the small Sierra foothill community of Woody, Kern County. The method of introduction of the chalcids to this relatively isolated location is unknown but the infestation had apparently been ongoing for a number of years, based on the finding of chalcid exit holes from numerous old nuts still present beneath the trees. The discovery of seed chalcids in Kern County suggests that additional surveys for this pest could be warranted in order to better understand its distribution within the pistachio producing areas of California.

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(Figure not available)

Figure 1. Collections of adult pistachio seed chalcids, *Megastigmus pistaciae* Walker, on yellow sticky traps in 1994 and 1995; Parlier, Fresno County, CA.

POTENTIAL HERBICIDE SAVINGS USING A LIGHT-ACTIVATED SPRAYER IN ROW CROPS

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Postemergent herbicides are applied to target weeds but often large areas are sprayed that are not occupied by weeds. Some growers spot-treat specific weeds, such as yellow nutsedge or field bindweed, but efficiency should increase with an automatic spot-treatment and many weed species do not lend themselves to spot-treatment. Sprayers that are started by light wavelengths reflected from chlorophyll should increase the efficiency of postemergent herbicide application by reducing the area of bare soil sprayed with herbicide. Herbicide use should be lowest where the amount of ground occupied by weeds (% cover) is low. At some point, as % cover increases, the light activated sprayer should be on constantly, spraying at the same rate as a conventional sprayer. The purposes of these studies were to demonstrate reduction in herbicide use under field conditions and to determine the relationship of herbicide applied to % cover for a light-activated sprayer.

Methods

The light-activated sprayer unit (Patchen Selective Spray Systems, Los Gatos) used in this study uses a fast switching solenoid that can turn a nozzle on and off in a fraction of a second. Sprayer unit has its own light source, reducing the effect of ambient light conditions. The light receptor is sensitive to green light that is reflected by plant chlorophyll, once a soil background calibration is completed. The sprayer used in the study was made up of individual spray units that consist of a light source, a light receptor, a fast-switching solenoid, and a nozzle. These spray units were mounted under a spray hood with three units per hood. The spray units operate independently of each other.

Two field studies were conducted to compare a light-activated sprayer to a grower's herbicide sprayer. The first study contrasted manual spot-treatment to the light-activated sprayer, applied to yellow nutsedge in cotton. Manual spot spraying was accomplished by turning the spray boom (a 15 row sprayer) on and off when yellow nutsedge was encountered. The two treatments were arranged as a randomized complete block with 4 replications. Individual plot size was 15 rows (30 inch beds) by 0.5 miles. Data were analyzed using analysis of variance. The second study contrasted the same two sprayers but an assessment of plant cover was made before herbicide application. Ten cover measurements were made in each of 12 plots. Eight plots with varying plant cover were sprayed with the light-activated sprayer and 4 plots were sprayed with a broadcast sprayer. A cluster analysis grouped plots into 3 cover classes and then data were analyzed using a general linear model to test for difference in use for the light activated sprayer. No differences were detected among the clusters and so the sprayers were contrasted using a general linear model to detect differences between the two sprayers.

The relationship of amount of material applied to % cover was determined for the light-activated sprayer by placing live plant material on a fabric grid to obtain plant cover of 5, 10, 20, 40, 60, 80, and 100%. Four replications were made at each plant cover percentage. The sprayer's 8 gallon tank was weighed before and after each replication to determine the amount of water applied to the foliage. Regression analysis was used to develop a model to describe the application of the water carrier at the varying plant covers. The model was then used to predict potential herbicide savings at several percent covers and farm operation sizes.

Results

When postemergent herbicides are applied by ground, spot spraying is possible and should reduce the amount of

material applied when compared to a broadcast application. The first study demonstrated that both automatic and manual spot spraying reduced the total amount of herbicide applied (Figure 1) since a broadcast application would have applied 20 gallons per acre. The light activated sprayer applied 60% less herbicide than the manual spot spraying treatment.

(Figure not available)

Figure 1. Amount of carrier applied by the light-activated sprayer and a manual spot-treatment with a 15 row sprayer in cotton.

The second field study compared the light activated sprayer to a broadcast application and the light-activated sprayer applied 78% less herbicide (Figure 2). No relationship of % cover to amount of material applied could be developed in this second study. The 10 samples in 300 feet were not sufficient to accurately assess the % cover in each plot. These results demonstrate the difficulty in accurately assessing % cover over a large area. Growers using this spray system would need to monitor their applications to ensure that the last filling of the sprayer matches the use from previous fillings to prevent large amounts of material left in the tank after the application. A reliable metering system would alleviate the need for the operator to guess the amount of material to add to the tank.

(Figure not available)

Figure 2. Amount of carrier applied by the light-activated sprayer and a broadcast treatment.

Results from the third experiment showed small amounts of carrier applied at 5% cover with a leveling off above 40% cover. At 5% cover the sprayer applied 86% less material than it did when it was operating continuously at 100% cover. The amount of ground covered by weeds will dramatically affect herbicide savings with this sprayer. Spraying early in the growth cycle of weeds will reduce the amount of herbicide applied by applying herbicide to weeds when they occupy the least amount of ground surface.

(Figure not available)

Figure 3. Amount of water carrier applied at % covers ranging from 5 to 100%. The model for this relationship was gal/ac=0.8 + 0.948(% cover) - 0.00595(% cover)^2, with an $R^2 = 0.97$.

The reduced herbicide use has its most dramatic cost reduction at low % cover (Figure 4). Savings could be as much as $2,500 at 5% cover with a farm size of 500 acres and $5,000 at 5% cover with a farm size of 1,000 acres. Applying herbicides at 20% cover reduces savings to $1,500 (farm size of 500 acres), a difference of $1,000 dollars, emphasizing the importance of treating when weeds are small. The sprayer is expensive, ranging from $12,000 to $16,000 for a 5 row sprayer depending on spray unit configuration and row crop spacing. Using the projected savings in Figure 4, the sprayer would have to be used for 3 to 5 years to pay for itself, applying MSMA over 500 to 1000 acres (Figure 5).

(Figure not available)

Figure 4. Savings are for herbicide only and were computed on an $8.60 cost for MSMA (2.66 pints/acre of product) per acre with two applications to the cotton crop.

(Figure not available)

Figure 5. The years required to pay for the sprayer through savings in herbicide use for a range of farm sizes. Calculations are based on an $8.60 per acre cost for MSMA with 2 applications made per season to cotton.

SNAIL DAMAGE INCREASES GRAY MOLD CAUSED BY *BOTRYTIS CINEREA* IN KIWIFRUIT

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Introduction

Approximately 2,550 ha of kiwifruit (*Actinidia deliciosa*) are presently grown in California, producing 650,000 tons of fruit valued at 100 to 110 million dollars annually (Anonymous, 1994). Initially, kiwifruit was regarded as a "disease-free" crop in New Zealand (Hawthorn et al. 1982) and also in California (Sommer et al. 1983) but, with increasing acreage and expanding exports during the past 10 years, the quantity of fruit in cold storage has increased, and post-harvest rotting of kiwifruit has become a potentially serious problem.

Gray mold stem end decay caused by *Botrytis cinerea* is the major disease affecting California kiwifruit in storage (Sommer et al., 1983, Duncan, 1991). This fungal parasite colonizes senescent, wounded, and dead tissues of flowers, leaves, and canes (Brook, 1991). Subsequently, the pathogen invades the fruit, usually through the stem end, and continues to grow even in fruit stored at CA

(controlled atmosphere) (31 to 32 F [-0.5 to 0°C] and 8 ppb ethylene). *B. cinerea* can also infect kiwifruit through surface wounds. To avoid wounding, growers enforce pickers to wear cotton gloves and handle fruit gently during and after harvest. In addition to the losses from the direct decay of fruits, fruit infected by Botrytis gray mold produce ethylene in cold storage so that the presence of only a few fruit with gray mold accelerates softening of healthy fruit and increases the sorting costs (Brooks, 1991).

In New Zealand, Pennycook (1984) found that infection of fruit is initiated during harvesting, grading, and packing, by direct *Botrytis* contamination of the stem wound made after snapping the fruit pedicel. In California, Michailides and Morgan (1996a & b) found that infections of sepals and stem ends occur throughout the year with the highest incidence occurring close to harvest. Differences evidently exist between the behavior of Botrytis rot in kiwifruit in California and in New Zealand (Sommer et al., 1994). To the best of our knowledge there are no other reports on factors predisposing kiwifruit to gray mold except the frequency of wounds created on the fruit during harvest and infestation of kiwifruit flowers by thrips (*Thrips obscuratus*) (Fermaud et al., 1994).

Garden brown snails, *Helix aspersa*, have recently created problems in several ornamental crops as well as in commercial kiwifruit fields. These snails are sophisticated in their feeding discrimination patterns since they show abilities to feed consistently in certain hosts and avoid others based on chemotaxis (Linhart & Thompson, 1995). *H. aspersa* is characterized as a generalist moluscan herbivore (Linhart & Thompson, 1995) commonly found in the natural habitat where kiwifruit are grown and it seems that kiwifruit is one of the crops these snails prefer. Large populations of snails became of nuisance in kiwifruit vineyards, particularly in the coastal areas. The damage from snails can be significant when the kiwifruit flowers are eaten but is insignificant on fully developed fruit since the snails eat only the sepals of fruits. However, we found in this study that the effects of snails can be detrimental by increasing gray mold decay in storage.

Snails and slugs have been reported in close associations with plant fungal pathogens. For instance, garden slugs have been photographed eating *Coprinus* spp. mushrooms (Moore, 1994) and transmitted plant diseases (Hasan & Vago, 1966, Turner, 1967), and water snails enhanced germination of resting spores of *Synchytrium endobioticum* (Hampson et al., 1994) and oospores of *Phytophthora* and *Pythium* spp. (Ribeiro, 1978, Stangellini & Russell, 1973). However, there is no research suggesting that snails contribute to postharvest fruit decays. In kiwifruit vineyards, slugs and snails are easily seen feeding on fruits on the ground and on kiwifruit vines, but there is no experimental evidence suggesting that snails can facilitate postharvest decay. Recordings in three vineyards showed damage up to 35% of kiwifruit with missing sepals eaten by snails. Another sign that snails have visited kiwifruits is the deposition of slime and excrements on the fruit surface. Because in previous studies, it was shown that sepal colonization by *B. cinerea* can lead to gray mold decay, we hypothesized that removal of these sepals by snails should reduce gray mold of kiwifruit in storage. Therefore, the purpose of this study was to determine the effect of kiwifruit sepal removal by snails on the incidence of gray mold in storage.

Experiments

Incidence of *B. cinerea* in kiwifruit with signs of snail visitation. At commercial harvest time replicated samples of ripe kiwifruit with signs of snail slime and without slime or any apparent snail damage were collected and brought to the laboratory in an ice chest. Five 1-cm disks from the surface of each fruit including the snail slime were cut with a cork borer, the flesh was removed aseptically and the disks (about 2 mm thick) were placed in a test tube (1.5 x 18 cm) containing 2 ml of sterile water. Similar disks removed from fruit without slime served as controls. Five replicated tubes were used per treatment. The test tubes and their contents were vortexed for 15 sec to wash microflora from the disks. Aliquots of 100 ìl were plated on each of three Petri dishes containing acidified potato-dextrose agar (APDA). The dishes were incubated at 45 F (7°C) for 6 days when all colonies of *B. cinerea* were counted and then at 70-75 F (21-23°C) for 2-3 days more when additional colonies of *B. cinerea* were added in the original counts. Colonies of other fungi, such as *Cladosporium*, *Penicillium*, and *Epicoccum purpurascens*, and yeasts, were counted.

Sampling fruit damaged by snails. In 1991, 1992, and 1993, from one vineyard 5, 11, and 14 boxes, respectively, of 33 to 38 fruit each with obvious snail damage (sepals were completely removed) and identical numbers of boxes with fruit having all their sepals attached, which served as controls, were collected. All fruit were packed in commercial plastic holders, wrapped with a plastic perforated bag, and stored in a commercial CA cold storage facility (31-32 F and 8 ng/ml ethylene) for 5 months. Fruit infected by gray mold was evaluated after 3 months, decayed fruit were discarded, and remaining fruit were

placed back in the CA storage for 2 more months when final recording of the incidence of gray mold was done.

Bagging experiments. Thirty five canes bearing 15 to 20 fruit and 20 canes bearing 14 to 30 fruit in 1993 and 1994, respectively, were enclosed with a nylon organdy sleeve (0.5 mm opening; 180 threads per cm^2) after the completion of pollination. Two adult snails were added in eight to nine bagged canes on 12 June, 30 July, and 6 September in 1993 and six snails each per cane on 20 June 1994. The snails used in all these experiments belonged to the species *H. aspersa.* Fruit caged as above, but without snails enclosed in the bags, served as controls. The bags were left until commercial harvest when all fruit were harvested and stored in the same commercial CA storage facility for 3 and 5 months.

Results and Discussion

Incidence of *B. cinerea* in kiwifruit with signs of snail visitation. In three repeated experiments, eight times more *B. cinerea* propagules, five times more *Cladosporium*, and three times more *Epicoccum purpurascens* propagules were recorded per cm^2 of the fruit surface showing obvious sings of snail activity (slime deposition) (Table 1). Only in one experiment (exp. #1), the population of propagules of yeasts was significantly higher (more than six times) on fruit with snail slime than without slime, but the overall values were not significant (Table 1). These results suggest that *B. cinerea* and other fungal propagules are favored by the presence of snail slime on the fruit surface. In laboratory experiments, we showed that snail slime at least in the absence of other nutrients significantly increased the percent of conidial germination of *B. cinerea* (data are not shown), suggesting that snail slime may have enough nutrients to support reproduction of fungal microflora, including *B. cinerea,* on the fruit surface.

Snail damage and gray mold decay (1991, 1992, and 1993). In 1991, fruit with sepals removed by snails had approximately four to five times greater incidence of gray mold than fruit with intact sepals (without snail damage) after 5 months in CA storage (Table 2). In 1992, although again fruit with sepals damaged by snails showed twice as much gray mold after 3 months storage as the undamaged control fruit (Table 2), the incidence of gray mold of undamaged fruit was four and ten times more in 1992 than in 1991 and 1993, respectively. The higher incidence of gray mold of fruit not damaged by snails in 1992 can be explained by the higher rainfall (33 mm) during October of that year (Table 3). In fact, two of the rain events occurred 10 and 2 days before harvest of fruit from this vineyard. In contrast, in 1991 the total rainfall in October was only 15 mm, and no rain occurred within the two-week period before the fruit harvest. Similarly, in 1993 only 6 mm rainfall accumulated in two rainfall events 8 and 3 days before harvest. In addition, weather records indicate that no rains occurred in 1991 and only 10 mm in 1993 during bloom of kiwifruit plants in the Nipomo area where these vineyards were located compared to 8 days with rainfall during the same time in 1992 (Table 3). Because of the higher incidence of gray mold in 1992 than in fruit of the other two years, the fruit was disposed after just 3-month storage. Similarly to 1991 and 1992 results, in 1993 more than five times greater incidence of gray mold was recorded on snail-damaged fruit than on undamaged fruit after 3 and 5 months CA storage, respectively (Table 2). These results strongly suggest that removal of sepals by snails results in significant increases of gray mold of kiwifruit in storage. This increase in the incidence of Botrytis gray mold in kiwifruit having their sepals removed by snails is surprising since Sommer et al (1983) showed that colonization of floral parts by *B. cinerea* contributed to high levels of gray mold and suggested that removal of floral parts should reduce decay. However, because the forced removal (eating) of sepals from fully developed fruit by snails is done at a stage when sepals are well attached to the stem end and because snails possess radular teeth, the creation of wounds is inevitable. In addition, the slime left behind can act as a nutrient that can stimulate conidial germination of *B. cinerea*, leading to successful infection of fruit. The active removal of sepals by snails may differ from the natural breaking and loss of fruit sepals that occurs during harvest in that at harvest time most of sepals are almost dried up and perhaps separated from the stem end (as shown by their easy detachment) allowing for abscission layers to develop.

Michailides and Morgan (1996a & b) showed that sepals and receptacles of kiwifruit were colonized by *B. cinerea* continuously from fruit set until harvest. Baudry et al. (1991), using artificial inoculations, showed that the bloom to fruit set stage is one of the phases of susceptibility of kiwifruit to *B. cinerea* for kiwifruit grown in France. Because Sommer et al. (1983) showed that the removal of flower parts (sepals and stamens which are colonized by *B. cinerea*) just before storage of fruits reduced gray mold in storage, we expected less disease in fruit whose sepals had been removed by snails. In contrast, these fruit had more gray mold than those with sepals attached (Table 2). Removal of fruit sepals by hand as early as 20 June did not result in significant reductions of gray mold in storage (Morgan & Michailides, 1992). Therefore, because typical Gastropoda, in which Class snails belong, have a

sclerotized jaw (Pennak, 1985), they can cause physical wounds which favor infections by *B. cinerea*, leading to high gray mold incidence. Therefore, these snails are able to cut, chew, and defecate lignified tissues such as kiwifruit sepals.

Bagging experiments. Fruit from canes bagged with snails in June and July showed 8.9-12.5% gray mold after 3 month storage and fruit not caged with snails showed only 1.2% gray mold (Fig. 1). However, these differences were not significant. The lack of activity by the snails can be explained by the fact that each bag contained only two snails and by the end of the season up to 30% of the snails were dead (Table 4), suggesting that they did not like being confined in closed cages. After 5-month storage, gray mold decay increased to 5.2-16.7% for fruit that had been caged with snails and increased 6.9% for fruit from the control canes but these differences were still not significant due to the large variation among the replications. In 1994, when six snails were caged per bag, they fed on all the caged fruit and these fruit showed about 2% gray mold after 3 months of CA storage but none of the fruit harvested from canes caged with no snails had any *B. cinerea* infections. After 5-month storage, fruit from vines where snails were added had 9.2% gray mold, significantly greater from the control (0% gray mold). We, therefore, were able to reproduce the damage caused by *H. aspersa* snails that is removal of fruit sepals (Table 4), resulting in gray mold increase of kiwifruit in storage (Fig. 1).

(Figure not available)

Figure 1. Effect of caging two snails (*Helix aspersa*) per kiwifruit cane on 12 and 30 July, or 6 September 1993 and six snails on 20 June 1994 on the incidence of gray mold caused by *Botrytis cinerea* after 3 and 5 months in CA (31 F and 8 ppb ethylene) storage. Differences between treatments and control (no snails) were not significant for the 1993 data but they were significant ($P < 0.05$) for the 1994 data. (Eight to 10 replicated canes bearing 14 to 30 fruit were used for each date.)

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Table 1. Effect of snail (*Helix aspersa*) slime on the surface microflora of kiwifruit.

		Propagules of fungi per cm^2 surface[y,z]			
Experiment	**Presence of Slime**	***Botrytis cinerea***	***Cladosporium* sp.**	***Epicoccum* sp.**	**Yeasts**
1	+	41 a	853 a	6a	628a
	-	6 b	249 b	2 a	297 a
$LSD_{0.05}$		15	420	4	583
2	+	39 a	1295 a	6a	351 a
	-	4 b	332 b	2 a	206 a
$LSD_{0.05}$		20	353	5	220
3	+	24 a	2301 a	5 a	1314 a
	-	1 b	243 b	1 b	208 b
$LSD_{0.05}$		13	1364	3	825
All (1,2&3)	+	35 a	1483 a	6 a	764 a
	-	6 b	285 b	2 b	238 a
$LSD_{0.05}$		15	1192	1	799

[y] Five 1-cm skin disks were cut out of kiwifruit, shook 10 sec in 2 ml of water, and 100 ìl were plated in three replicated plates.

[z] Propagules represent the average of 15 replicated plates per treatment.

Table 2. Effects of removal of kiwifruit sepals by snails (*Helix aspersa*) on Botrytis gray mold after 3 and 5 months in commercial CA storage (-0.5 C and 8 ppb ethylene)

	Gray mold (%)				
	1991[z]		**1992[x]**	**1993[y]**	
Type of Fruit v	**3 mo[z]**	**5 mo**	**3 mo**	**3 mo[z]**	**5 mo**
Sepals removed by snails	27.7 a	31.8 a	40.2 a	11.6 a	19.5 a
Sepals intact	5.0 b	7.9 b	20.4 b	2.0 b	3.5 b
$LSD_{0.05}$					

[v] All fruit were from a vineyard in Nipomo, California

[w] Averages from five boxes with 39 fruit each; harvest on 21 November.

[x] Averages from 11 boxes with 39 fruit each; harvest on 2 November. Only the 3-month storage data are presented (decay too high to continue storage for 5 months).

[y] Averages from 18 boxes of 33 fruit each; harvest on 19 October.

[z] Fruit showing gray mold were discarded to avoid secondary spread of the fungus in storage.

Table 3. Rainfall in San Luis Obispo area from May through November 1991, 1992, and 1993

	Number of rains (and total rainfall in mm)[a]		
Month	1991	1992	1993
May	0 (0)[b]	4 (32)[c]	1 (5)
June	0 (0)	4 (47)	2 (5)
July	0 (0)	2 (9)	0 (0)
August	1 (1)	1 (1)	2 (7)
September	0 (0)	0 (0)	0 (0)
October	3 (15)	3 (33)	2 (6)
November	2 (19)	0 (0)	5 (51)[d]

[a] Rainfall data were retrieved from CIMIS Station #52.

[b] Numbers in parentheses represent total rainfall in each month.

[c] On rain of 14 mm occurred after full bloom. Harvests in 1991, 1992, and 1993 were done on 21 and 2 November, and 18 October, respectively.

[d] One rain of 3 mm occurred on 3 November, two rains (total of 26 mm) on 10 and 11 November, and two rains (total of 24 mm) on 28 and 29 November.

Table 4. Removal of kiwifruit sepals by the garden brown snail and snail viability in a kiwifruit vineyard in Nipomo, California

			Sepals (%)		Snails (%)		Total number
Year	Treatment/date[a]	Reps	Removed[b]	Intact	Dead	Alive[c]	of snails
1993	Snails						
	12 June	9	84.1	15.9	27.8	72.2	18
	30 July	9	80.4	19.6	31.3	68.7	16
	6 September	8	83.1	16.9	29.4	70.6	17
	No snails (control)	9	0.0	100.0	....	....	...
1994	Snails						
	20 June	10	100.0	0.0	40.7	59.3	59
	No snails (control)	10	0.0	100.0	...	...	...

[a] One to two adult snails were enclosed in cotton organdy bags caging one or two canes with 15-20 (1993) and 14-30 (1994) kiwifruit per bag.

[b] Fruit with all sepals removed by snails.

[c] By harvest time, 3 Nov 1993 and 7 Nov 1994.