Project Number: 86-N1

Almond Research Report

1986 - 1987

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Objectives: (1) Maintain and continue present long term weed control studies initiated by Dr. A.H. Lange. (2) Conduct IPM sponsored studies on cover crop management in almonds.

Long term almond studies have been beneficial to learn the effects of cultural practices on tree growth and yield of the trees. Two herbicide/vegetation management studies on a sandy soil at the Kearney Agricultural Center have been treated consecutively since 1975 with preemergence herbicides. Herbicides commonly applied to almond orchards simazine (Princep), oryzalin (Surflan), napropamide (Dervrinol), oxyfluorfen (Goal) and norflurazon (Solicam) and the newer herbicide prodiamine (Endurance) were used. These were applied as strip treatment or over the entire orchard floor in another treatment. These herbicide treatments were compared to a tilled area between rows of Mission variety almonds.

Soil cores were taken from each of the treatments to evaluate movement of herbicides using a bioassay technique in the greenhouse. Cores were removed at 6 inch increments from 6 to 8 feet depending on the location (occurrance of a caliche layer stopped coring) in the orchard.

Yields were taken from the trees to evaluate the effects of herbicides or cultural practice on trees.

Interpretive Summary:

Two long term herbicide/vegetation management trials on sandy soil at the Kearney Agricultural Center were retreated, evaluated for growth of the trees and harvested. There has been a trend for increased yields the last three years where cover was totally removed down and between the rows. Discing between rows or allowing native vegetation to grow reduced yield and tree growth. With native cover, this reduction is probably due to the competition from the weeds and with discing, from tree root pruning. In the 1987 season it is anticipated that these trials will be evaluated for herbicide movement in soils. Soil cores will be removed from the trials to bioassay for herbicide movement. These trials have been retreated for years so it is desirable to evaluate the potential ground water concerns with herbicides.

In the second project, there are two experiments evaluating bromegrass, "Salina" strawberry clover, native vegetation and total herbicide treatments on pest interactions, water use, soil compaction, economics and tree growth and yield. This project is funded by the UC-IPM Program. There have been some significant findings in this study: (1) Water use by cover crops (native and perennial clover) is higher than that for herbicide treated areas. In one trial, blando bromegrass when mowed late in the season reduced water loss below the herbicide treated areas. (2)

Water use is different from various zones of the tree area. A previously disced orchard will have more water used from "in the row" measurements than between the rows illustrating the effects of root cutting by discing. (3) There are indications of soil compaction at the surface in solid herbicide areas. (4) Ant populations have increased in one orchard in cover areas compared to herbicide areas. (5) Ant damage to nuts has increased to over 12 percent in native vegetation areas compared to 2 percent in herbicide treated areas (this occurred in only 2-1/2 days with nuts on the ground). (6) Navel orangeworm adult emergence from overwintering mummies on the ground was lower in cover crop areas than when the soil was bare. (7) Weed species numbers have decreased in herbicide and clover areas whereas they have remained static in annual bromegrass or native vegetation areas. (8) Ant damage figures appear to be correlated with fleabane presence. (9) Gopher populations have increased in perennial clover plots and have required control measures. (10) Nematode populations were evaluated at the beginning of the study and are being reevaluated this year. (11) Depending upon the weed spectrum, the cost of maintaining the various treatments do not appear to be significantly different. The herbicide treatment costs appear to be higher than establishing a cover crop in new orchards because some of the less expensive materials like simazine cannot be used on these young trees. (12) There have been no differences in yield between treatments. Additional evaluation of these studies will generate more information on tree growth, pest interactions and vegetation changes.

Experimental Procedures:

The procedures for herbicide applications, rates and materials and the tree growth and yield evaluations are the same as in previous reports.

This year on February 19, 1987, 4 inch soil cores were taken at each 6 inch increment to a maximum depth of 6 to 8 feet (depth of core was dependent upon the hard pan - Caliche layer) within each plot. The soil was placed in plastic bags and allowed to dry. Soil samples from each treatment and depth were potted into 4 inch cups in the green house. Two species wild radish (Raphnus) and oat (Avena sativa) were planted in separate samples and germinated by subirrigating for 3 weeks. Visual evaluations were taken on germination and growth to determine if herbicides were present at phytotoxic levels.

Results:

In one study where herbicides have been applied on Mission almonds since 1975, yields (kg/tree)were not different between strip treatments and mowing, overall tillage, or overall herbicide treatment at the Kearney Agricultural Field Station. There was a trend toward higher yields with oxyfluorfen combination treatments (oxyfluorfen plus prodiamine or oxyfluorfen plus norflurazon) than simazine combination materials. Simazine plus oryzalin (3.65 kg/tree) did give higher yields than simazine plus napropamide (2.85 kg/tree). Although there were significant differences between individual cultural herbicide combinations (Table 1) there was no differences between herbicides only or cultural practices only.

Bioassays:

Oat seedlings planted in each six inch increment of soil cored from the strip treated areas did not show any effect from any treatment. (The herbicides were not treated in the fall before the February sampling). Wild radish, however, did show symptoms of norflurazon in the oxyfluorfen + norflurazon treatment in the 0-6 and 6-12 inch increments of soil. No symptoms were observed in other depths of any treatment. This would indicate that when norfluorazon has been retreated at 2 lb ai/A per year for nine years that it can be found below six inches. No other herbicide or combination of materials showed any effect. These samples will be reused with other species for bioassay.

In the second study trees that have been strip treated but mowed in the centers are compared to total herbicide treatments. This is a continued study initiated by Dr. Lange.

Harvest data showed no significant difference between the two treatments (Table 2).

There is however a major difference shown as a trend that yields on trees that the floor was chemically treated were higher than a mowing treatment. Variation was great enough in the four replications that it was not significant at the 95% level.

Results of the cover cropping research is summarized in the accompanying report.

Table 1:

Yields of almonds as affected by vegetation management practices[1]

Herbicide	Rate lba.i./A	Tillage	Strip	Overall Herbicide	Treatment mean
simazine + oryzalin	1 + 4	4.37 abc*	4.09 abc	2.49 bc	3.65 a**
simazine + napropamide	1 + 4	2.66 bc	3.66 abc	2.22 bc	2.85 a
oxyfluorfen + norflurazon	2 + 2	5.46 ab	1.61 c	5.02 abc	4.03 a
oxyfluorfen + prodiamine	2 + 2	3.28 bc	4.62 abc	7.055 a	4.99 a
oxyfluorfen + napropamide	2 + 4	3.49 bc	3.69 abc	2.30 bc	3.16 a

* L.S.D. 2.76 at 0.05

** Means followed by the same letter are not significant at P = 0.05

Retreatments annually since 1977; first two treatments continually retreated since 1975.

1 Yield (kg/tree)

Discussion:

These studies by Dr. Lange have demonstrated that herbicides that are strip treated or even treated over the whole orchard floor may give the same or greater tree growth and yield than mowing or tillage treatments. Soil, water and economic factors may be the dominant cultural concerns in established orchards rather than vegetation competition between the rows of established trees.

In the cover cropping experiments it is apparent that planted cover crops can be advantageous. They may require more water unless the crop is a winter annual and it is managed properly to minimize water use. Any cover cropping system will change the pest complex and interactions between pests and crops. It is imparative to evaluate the orchard floor cover in any pest study to understand the potential for interactions. It is feasible that unless other pest studies report the vegetation composition and management procedures that data cannot be utilized from one orchard to another. These cover crop studies should be continued so that the changes that are still occurring because of the different vegetation, can be measured. Additional winter annual cover crops should be evaluated including Zorro fescue, and subterranean clovers in almond orchards. There should be a better understanding of ant, gopher and nematode populations with weed species.

These studies would allow the planting of desirable vegetation in an orchard, removing the weeds, decreasing the undesirable effects and promote the beneficial effects of vegetation.

Table 2: Effect of Mowing Versus Chemical Treatment on Almond Yield - Parlier 1986.

Treatment	Nut Weight kg/tree
Mow	3.88 a*
Chemical	5.74 b

* Means followed by the same letter are not significant at P = 0.05.

Publications:

1. Clyde L. Elmore. September-October 1987. Cover Crops for Orchards and Vineyards. California Agriculture.

2. T. Pritchard, W. Pemberton, W. Asai, L. Hendricks and C. Elmore. September-October 1987. Orchard Floor Management Effects on Consumptive Water Use of Almonds. California Agriculture.

3. W.W. Barnett, L. Hendricks, W. Asai, R. Elkins, D. Boquist and C. Elmore. September-October 1987. The Influence of Four Vegetation Management Systems in almond Orchards on Insect and Mite Populations. California Agriculture.

4. C.L. Elmore, R. Elkins, W. Asai, L. Hendricks and D. Boquist. September-October 1987. Effects of Vegetation Management Systems on the Plant Composition of Orchard Floors. California Agriculture.

University of California/IPM Project Report

December 26, 1986

Title: Long-term Almond Orchard Vegetation Management

Investigators: Dr. Clyde Elmore, Extension Weed Scientist, UCD; Lonnie Hendricks, Farm Advisor, Merced County; William Barnett, San Joaquin Valley Research and Extension Center, Parlier, Dr. Terry Pritchard, Soil/Water Specialist, San Joaquin County; Wes Asai, Farm Advisor, Stanislaus County; Dr. Karen Klonsky, Area Farm Management Specialist, Department of Agricultural Economics, UCD; Dr. Mike McKenry, Extension Nematologist, San Joaquin Valley Agricultural Research Extension Center, Parlier, California.

Cooperators; Dr. Terry Salmon, Wildlife Specialist, UCD and Dr. Joe Ogawa, Department of Plant Pathology, UCD, Warren Mickey, Extension Pomology Specialist, UCD.

1985-1986 Objectives: (in relation to original objectives, 1983-1984)

1. To study the effects of various orchard floor management systems on tree growth, yield, and crop quality in new and established almond orchards over a five year period:

    A. Measure the effects of the orchard floor management systems on tree growth and health (trunk circumference, tree height, canopy area, plant tissue analysis.)

    B. Measure effects of the treatments on fruit set (% set using pre-bloom, post-set and June drop counts-limb/shoot/spurs).

2. To study the effects of cover crops versus clean orchard floor on pest (insect, disease, nematode, weed and rodent populations:

    A. Continue evaluating ground mummy degradation of navel orangeworm (NOW) in the treatments; determine % survival of overwintering larvae. Study to continue through 1988 cropping season.

    B. Continue evaluating ant colony numbers, species and distribution in the treatments; study the relationship between populations in the treatments and damage to harvested nuts. Study to continue through 1988 cropping season.

C. Sample mites in cover crops and trees. Survey for species identification and abundance; compare cover crop and tree populations. Study to continue through 1988 cropping season.

D. Continue surveying weed species present in the treatments and evaluate any species shifts that may be occurring (% presence in plots). Study to continue through 1988 cropping season.

3. Evaluate effects of orchard floor management systems on soil compaction, water penetration, and soil moisture holding capacity:

   A. Measure compaction (penetrometer, bulk density).

   B. Measure water penetration and soil moisture-holding capacity (neutron probe)

4. Evaluate the difference in consumptive water use of each cover crop, consumptive use of almonds, and the interaction between the cover crops and almonds (neutron probe). Study will be terminated after the 1987 cropping season.

5. Evaluate the economics of almond production using various orchard floor management systems:

   A. Update and refine preliminary cost study. Figures will be upgraded each year as management practices and crop yields differ.

6. Use the results of 1-5 to provide information to growers, pest management personnel, and horticulturalists involved in orchard management for making decisions regarding the use of cover crops:

   A. Continue efforts to update almond farm advisors through field and indoor meetings (FA Training).

   B. Intensify extension efforts toward growers, industry, and PCAs (field meetings and conferences).

   C. Begin publication efforts (California Agriculture, grower publications). Three articles are in draft stage for California Agriculture.

   D. Formalize linkage between this trial and work being done in other crops. Other studies using some of the information generated from these studies have been started in grapes (three locations) and another will be started in peaches (1987) and kiwi fruit (1987).

II. Summary

The long-term almond orchard vegetation management project was designed to evaluate the effect of planted and natural vegetation on tree growth, health and yield, pest problems and soil/water changes.

At one site an annual grass (Blando bromegrass), and a perennial clover ('Salina' Strawberry clover) were planted and compared to a natural vegetation and total herbicide treatment. At the second site an additional treatment of chemical mowing was added as another comparison.

The results in 1986 showed no difference in tree growth and leaf nutrient analysis between treatments, however, differences in pest populations were observed. It was found that in vegetated areas at site 1 that both pavement and southern fire ant colonies increased over the herbicide treated area. They also incurred heavy (greater than 12%) damage to kernals (significantly reducing potential income) even though the nuts laid on the ground only 2 days. At the second site populations were low thus there was little damage. When mummies containing navel orangeworm larvae were allowed to remain on the ground and in the cover crops there were more adults that emerged from nuts on the herbicide treated area compared to vegetated areas. Mite populations were low in both orchards and did not show any difference between treatments.

Populations of dagger nematode (_X. americanum_) increased in the clover and natural vegetation areas although Blando bromegrass seemed to suppress any buildup over a 3 year period.

Gophers became a problem in plots containing clover and were observed somewhat less with native vegetation and Blando bromegrass. All vegetation plots were higher in gopher populations than herbicide treated areas.

Residual herbicide reduced water use by 22 and 16% respectively at Site 1 and 2 compared to the natural vegetation. Chemical mowing reduced water use by 12% at Site 2. Water use with bromegrass was significantly higher than residual herbicide (9.2%) however there was no difference at the other location. Variation in water use with bromegrass will vary depending on the amount of vegetation that is allowed to grow before mowing and thus mulching the soil to reduce water loss.

Soil compaction in the surface 5 inches as mesured by a soil penetrometer was greater in herbicide treated areas than any of the vegetated treatments.

Weed species shifts have occurred in each cover crop regime. There have been increases in flax-leaf fleabane in natural and

III. Budget

blando bromegrass treatments. Concurrently there has been a decrease of this species in the clover and herbicide treatments. Nutsedge and spurge have increased in the herbicide treated areas in the summer. The greatest species variation is in the natural vegetation. There are decreased numbers of weed species in the bromegrass, clover and herbicide treatments respectively.

Each system has good and poor qualities associated with it using the parameters we are measuring. It would appear from these tests that we do not have a perfect system.

IV. Accomplishments

Objective:

1. To study the effects of various orchard floor management systems on tree growth, yield and crop quality.

   a. Frequently it has been shown in peaches that vegetation removed in square blocks around the base of trees increased tree growth with each increment of vegetation removed. (Welker, 1985)

   b. Truck circumference, height, canopy area, plant tissue analysis, and bud set were measured on 4 trees on each measurement row. (center row of 3 row block)

   c. No significant differences were shown on any growth or nutrient analysis between treatments at either site. There was a trend toward greater trunk circumference in the solid herbicide treatment over any planted or native cover crop in the Asai orchard (Site 1). These measurements will be continued annually. The differences are anticipated to be minimal because at Site 1 on the young orchard the herbicide treated strip has been wide enough (2.4 meters) to eliminate vegetation competition in the root zone. Fertilization by the grower has been higher than tree requirements thus stress due to nutrient requirements by the vegetation is negative. At Site 2 (Harbour) the orchard is well established and vegetation competition is again minimal because of the clean strip down the tree rows (2.4 meters). A fertilization program that exceeds the requirements of the trees and vegetation eliminate nutrient stress from the floor vegetation. Yield data will be presented under economic evaluations.

   d. Measurements will be continued in 1986-87 to determine if these assumptions continue to be upheld. Trunk measurements of the orchard in Site 1 will be the critical measurement in 1987, because of the 1986 trend.

2. To study the effects of vegetation management systems on pest populations.

   1a. By changing the flora of the orchard floor the various pest populations should also change to show the choice or adaptation to the vegetation. Though cover crops have been recommended by the Soil Conservation Service for the conservation of soil they have not studied the effects of these plants on changes in pest populations. Jordan (1983) has shown dramatic changes in pests in a citrus orchard floor study (unpublished).

1b. Methods

1. Ants

Southern fire (*Solenopsis xyloni*) and pavement ant (*Tetramorium caespitum*) colonies were surveyed at both sites prior to harvest. Samples were taken in the herbicide treated strips, in the cover crop area. The summed data for each treatment are shown by site (Table 1 and 2).

Table 1.
Southern Fire (*Solenopsis xyloni*) and Pavement ant (*Tetramorium caespitum*) colonies*

	1984	1985	1986
Blando bromegrass	8.2 ab*	30.5 a	28.8 a
'Salina' Strawberry Clover	5.2 b	19.0 bc	15.2 a
Native vegetation	11.8 a	27.0 ab	19.8 a
Chemical	3.0 b	11.2 c	15.8 a

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1. *Sum of ant colonies in the strip and cover area by each treatment

2. **Mean colonies per 3 tree spaces 26ft. X 3 X 25ft.

3. P = .05 Duncan's Multipe Range Test

Table 2.

Total ant colonies surveyed by orchard floor management system at Site 2*

Ant Colonies

	1984	1985	1986
Blando bromegrass		2.0	5.8
'Salina' Strawberry clover		7.0	6.0
Native vegetation	NA	3.8	8.0
Chemical		2.0	2.0
Chemical mow		5.2	3.8

*Sum of ant colonies in the strip and cover areas by each treatment.
**Mean colonies per 3 tree spaces 23 ft. X 3 X 19 ft.

Ant damage was measured from a randomly sampled five pound sample taken from the windrow in the Nonpareil variety. At site 1, the almonds were shaken on a Monday a.m. and sampled and picked up on Wednesday of the same week. At site 2, nuts were knocked on August 18 and picked up August 23. A 250 nut sample was cracked out and a % damage determined, Tables 3,4.

Table 3 Percent damaged almond nuts.

	1985	1986
Blando bromegrass	7.2 b*	12.6 b
'Salina' Strawberry clover	7.5 b	7.6 ab
Native vegetation	8.5 b	12.3 b
Chemical	0.2 a	2.0 a

* P = 0.01 Duncan's Multiple Range Test.

1c. Results

Ant populations and percent damage at site 1 reflect differences between herbicide plots and vegetation plots. Though 1986 colony numbers appear high, a comparison of annaul trends indicate an ant preference for vegetation plots and may be best reflected in nutmeat damage. Ant colony numbers at site 2 are low and thus no significant damage between treatments was observed.

Table 4 Percent damaged almond nuts grown under five vegetation management systems - Site 2

	1986
Blando bromegrass	1.37 a*
'Salina' strawberry clover	1.17 a
Native vegetation	0.52 a
Chemical	0.77 a
Chemical mow	0.77 a

*All means followed by the same letter are not significant using Duncan's Multiple Damage Test P=0.05

1d. Plans for 1987 include continuing to monitor both sites for ant populations. An experiment will be proposed to evaluate ant populations in a flax-leaf fleabane (Erigeron) free environment to determine if this weed species is a major contributor to the population increase.

2.2 A. Mites

Depending upon mite species it may be preferential to grow a cover of grass species to suppress Pacific mite or broadleaf crops to suppress European red mite on the orchard floor. (McGroarty and Croft, 1978) Studies have also shown that orchard floor covers increase predaceous mite populations. It is generally agreed that any floor practice that allows or promotes dust in an orchard can increase potential for mite populations.

2b. Mite populations (Two-spot, European red and M. occidentalis have been evaluated from the center three trees of each treatment in each black. Twenty leaves were brushed for each sample. Samples were taken 5/14, 7/2, 7/17 and 7/28 at Site 1 and 7/18 and 7/28 at site 2.

2C. Results

Data on the European red mite and predaceous mites are shown in tables 5 and 6. Mite populations were low at all sampling dates and no differences could be observed.

Table 5.
European red and predaceous mite populations on almond leaves by vegetation management system - site 1

1986 Mite Counts*

Treatment	Predaceous				European Red			
	5/14	7/2	7/17	7/28	5/14	7/2	7/17	7/28
Brome	0	.01	.01	.03	.46	.10	.36	.03
Herbicide	0	.03	.01	.00	.45	.01	.28	.06
Clover	0	.03	.03	.03	.35	.03	.28	.01
Native	0	.00	.03	.05	.48	.01	.05	.05

*Average number of mites/leaf

Table 6.
European red and predaceous mite populations on almond leaves by vegetation management system - Site 2

Harbour Almond Cover Crop
1986 Mite Counts*

Treatment	Predaceous		European Red	
	7/18	7/28	7/18	7/28
Brome	.08	0	.3	.11
Herbicide	.05	0	.26	.23
Clover	.05	0	.28	.16
Native	.05	0	.45	.05
Chemical mow	.01	0	.21	.20

*Average number of mites/leaf

2d. Mite populations will be surveyed in 1987 in the almond trees. Also populations will be evaluated in 1987 in the cover crops by brushing foliage (or the soil for

Number of Weed Species W/ 5% Presence

Winter Survey (January) Site 2

	1984	1985	1986*	1987
Brome	4	7		8
Clover	3	6		8
Native Vegetation	4	7		9
Herbicide	3	7		5
Chem Mow	4	5		4

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* Not surveyed

the chemical treatment) to evaluate populations present other than on the trees.

2.3 Navel orangeworm (NOW)

3a. There has been a concern by growers that if the navel orangeworm infested mummies are not cultivated into the soil the larvae will not be killed and there will be a population increase in cover cropped areas. This increase in navel orangeworm decreases their effective cleanup program, and would increase insecticide spraying or would increase damage incurred by this pest.

3b. A 200 nut sample of naval orangeworm infested mummies were placed in 0.6m X 0.6m wire cages in each treatment at site 1. No sampling was conducted at site 2 in 1986. Samples were left overwinter in unclipped cover, removed in the spring and reared for emergence. Data are shown in table 7.

3C. Results

After rearing out the overwintered mummies it was found in unclipped vegetation that the number of emerging adults were reduced with native vegetation and strawberry clover over the herbicide treated areas. Blando bromegrass and herbicide treated areas however were not significantly different. Because the cover was not clipped in the caged areas this difference may be artifically higher than when the orchard floor is mowed during the winter.

Table 7

Effect of orchard floor management systems on overwintered naval orangeworm mummies as measured by adult emergence

Treatment	Navel Orangeworm Adult Emergence*
Blando bromegrass	3.2 AB**
Herbicide	9.5 A
'Salina' Strawberry clover	2.2 B
Native vegetation	1.5 B

*Mean number of NOW adults emerging from 200 nuts/replicate.
**All means followed by the same letter are significant at the P = 0.10 level.

3d. This experiment has been initiated at both sites for 1986-87. The samples will be overwintered in all treatments with clipping conducted at the same time that the grower would normally mow the cover crop (February). These data will more closely fit grower practice.

2.4 Nematodes

4a. Almond orchards are often affected by root lesion (Pratylenchus vulnus) or ring nematodes (Criconemoides xenoplax). Though root knot nematode is dominant in California the Nemagard rootstock has done an excellent job of controlling this species as a major problem. Dagger nematode (Xiphinema americanum) may be of conern due to its ability to transmit ring spot virus. Paratylenchus harratus (pin) is hosted by Nemagard peach roots.

4b. Nematode samples were taken when each trial was initiated as a baseline population and found to be very low. Population levels were sampled again November 26, 1986 to determine buildup.

4c. Counts from soil indicate an increase in stubby nematode in the 'salina' strawberry clover area in site 1 which is a sandy soil.

There has been an increase in dagger nematode (X. americanum) in the clover and weeds and while generally seen in grasses appears to be detered by the blando bromegrass.

Spiral nematode (Helicotylenchus dihystera) generally found in grasses in silty soils, appears to be building up in the native vegetation at site 2.

Though Pratylenchus vulnus (root lesion) is often a problem in almond orchards, this particular species is not showing up at either site. Another species of root lesion, Pratylenchus mingus is hosted at both sites by clover, weeds and bromegrass but is not normally a problem in almond orchards.

Clover will host Criconemoides xenoplax (ring nematode) and is showing this tendency at site 2.

4d. Due to high variability within treatments and a need to see clearer tendencies, sampling will be conducted again in 1987 or 1988 and include a greater number of samplings per plots. Timing and methods will be worked out by nematode specialists.

Table 8. Nematode populations in herbicide treated strips and managed vegetation centers in almond orchards -Site 1*

	Strips			Centers				
Treatment	Stubby	Pin	Lesion	Stubby	Pin	Lesion	Stunt	Dagger
Blando bromegrass	1.75	628.5	0.25	19.0B**	24.0	377.5	1.0	0.0
Strawberry clover	2.25	754.2	3.5	253.5A	354.2	164.2	0.0	10.2
Native vegetation	0.0	1224.2	1.25	94.8B	296.0	181.0	0.0	6.2
Chemical	2.5	614.5	0.0	1.25B	225.0	0.5	0.25	0.0
C.V.	94.6	72.9	184.8	93.2	179.6	196.1	302.8	244.1

*mean nematodes per 250cc of soil
**means followed by the same letter are not significantly different as determined by Duncans Multiple range 0.05%

'able 9. Nematode populations in herbicide treated strips and managed vegetation centers in almond orchards - Site 2.*

	STRIPS					CENTERS						
reatments	Stubby	Pin	Dagger	Spiral	Lesion	Stubby	Pin	Dagger	Spiral	Lesion	Tylen	Rinc
lando bromegrass	20.5	106.8	4.5	8.8	1.25ab**	12.0	0.8	0.0	0.0	0.5	2.0	0.0
trawberry clover	4.2	201.2	20.0	2.0	0.0 b	24.2	152.2	1.8	0.8	7.5	0.0	5.2
ative vegetation	2.8	5.5	8.5	26.5	5.2 a	7.0	3.5	0.0	7.5	1.5	3.8	0.2
hemical	8.5	0.8	6.2	24.0	0.0 B	7.0	0.8	1.0	1.8	0.2	0.0	0.0
hemical mow	3.8	56.0	5.0	0.0	0.0 b	6.2	5.0	0.0	1.0	0.2	10.0	0.0

mean nematodes per 250 cc of soil
*means followed by the same letter are not significantly different as determined by Duncans Multiple Range 0.05%

2.5 Weeds

5a. Whenever vegetation management systems are stressed (mowing, cultivation or herbicides) species shifts occur. To help document a vegetation-pest interaction cover crops were planted to compare to mowed native vegetation and a solid herbicide treatment. These treatments allow the greatest variation in species populations and possible pest-plant interactions.

5b. A sampling method using 100 (8 inch) rings of PVC pipe were used to sample vegetation presence. Within each treatment replicate 100 rings were tossed at random to analyze presence/absence of any species. Four samplings are taken each year.

5c. Selected data are being presented to show major changes that have occurred under the various management systems during the study.

Strawberry clover not only maintained itself as a stand in the planted area but has become a weedy component in the natural vegetation and somewhat in the bromegrass system (Table 10). It has not become a species in the herbicide treated area because of retreatment with glyphosate as necessary. Nutsedge however has become a major species in the solid herbicide treatment (Table 10) whereas because of the competition with annual species it has not appeared as a prominent species in natural or planted vegetation. Flax-leaf fleabane has become a major weed in natural vegetation and bromegrass areas. Though it is supposed to be a summer annual it can be found at all times during the year thus contributing seed at all times of the year to increase populations. It has been decreased with herbicides or in clover plantings. Populations of filaree have increased in all vegetative managed areas as a winter, and spring species. It is not present in summer. Though dandelion and smooth catsear populations are not high there is a trend toward an increase in 1986.

The summer weed species crabgrass, purslane and spurge are becoming more common in natural vegetation and Blando bromegrass.

The diversity of weed species present has generally remained highest in maintained natural vegetation (Tables 11, 13, 21) with a distinct decline where a heavy clover population (Tables 15, 19, 21) is present (site 1) or in herbicide treated areas. (Tables 11, 13, 15, 19, 21) There are also trends of increasing populations of weeds in the herbicide treated areas, principally nutsedge and spurge. (Table 10).

5d. Plans for 1987 include a continuing of weed sampling at four times per year however it appears that 3 times per year would be adequate. It is planned to evaluate some species interaction by ant populations. It is expected that certain perennial species will continue to increase namely nutsedge, dandelion and bermudagrass.

Table 10

Weed Species Present by Cover Crop Treatments (%)

Spring Survey (April) - Site 1

Weed Species	Bromegrass 84	Bromegrass 85	Bromegrass 86	Clover 84	Clover 85	Clover 86	Natural Vegetation 84	Natural Vegetation 85	Natural Vegetation 86	Herbicides 84	Herbicides 85	Herbicides 86
Annual bluegrass	-	38	1	<1	15	8	1	70	3	-	-	-
Brome	-	97	78	-	-	14	-	1	6	-	-	-
Chickweed	-	15	46	-	6	71	1	32	74	-	1	-
Clover	1	10	18	-	100	100	1	15	48	-	-	<1
Cudweed	4	71	7	3	10	2	3	71	2	-	1	-
Dandelion	-	1	1	1	<1	<1	-	-	2	-	-	-
Filaree	-	40	86	1	10	23	1	41	88	-	1	<1
Fleabane	7	55	58	4	6	6	2	80	40	<1	-	3
Groundsel	-	2	1	2	-	<1	-	2	-	-	-	-
Henbit	-	-	-	1	1	<1	-	1	-	-	-	-
Nutsedge	-	-	-	-	-	-	-	-	-	-	5	10
Pigweed	-	-	-	-	-	-	-	-	-	-	11	-
Pineapple weed	15	41	26	39	4	<1	13	60	45	-	-	-
Purslane	-	-	<1	-	-	-	-	-	<1	-	-	1
Shephardspurse	6	50	5	4	15	6	15	61	5	-	-	1
Sow thistle	64	16	6	45	-	8	34	15	8	2	-	-
Smooth catsear	-	-	4	-	-	-	-	-	6	-	-	-
Spurge	-	-	-	-	-	-	-	-	-	-	-	11

Table 11

Number of Weed Species with Greater than 5% Presence

Spring Survey (April) - Site 1

	1984	1985	1986
Bromegrass	4	9	7
Clover	2	6	7
Natural vegetation	3	9	8
Herbicide	0	1	2

*Does not include bromegrass as weed species with brome treatment or clover within clover treatment.

Table 12 Weed Species Present by Cover Crop Treatments (%)
Spring Survey (April) - Site 2

Weed Species	Brome 85	Brome 86	Clover 85	Clover 86	Native 85	Native 86	Herbicide 85	Herbicide 86	Chem Mow 85	Chem Mow 86
Poa annua	99	96.5	100	99	100	99	6		99	
brass buttons	36	25	47	43	69	45			40	
chickweed	88	81.5	98	77	97	80	7		94	
clover	9	16	-	47	13	26	2		19	
dandelion	-	1	-	<1	-	<1				
filaree	21	23	24	29	19	19			29	
groundsel	2	-	1	-	3	-			1	
henbit	2	-	5	-	8	<1			12	
knotweed	45	5	50	5	61	3	1		61	
shep purse	5	10	4	12	3	7			9	
sow thistle	-	-	-	<1	-	-				
speedwell	19	22	6	7	14	10			4	
cudweed	2	9	1	15.5	3	13			1	
conyza	1	-	-	-	1	-				
spurge			-	<1	-	4				
brome	100	100	-	53	-	83			1	
nutsedge							9			
redmaids								*		*

*Not surveyed due to recent treatment of these plots rendering weed species unidentifiable.

Table 13 Number of Weed Species with Greater Than 5% Presence
Spring Survey (April) - Site 2

	1985	1986
Bromegrass	7	8
Clover	6	8
Natural vegetation	8	9
Herbicide	3	*
Chemical mow	8	*

*Not surveyed due to recent treatment of these plots rendering weed species unidentifiable.

Table 14 Weed Species Present by Cover Crop Treatments (%)

Winter (January) Survey - Site 1

Weed Species	Bromegrass 84	Bromegrass 85	Bromegrass 86	87	Clover 84	Clover 85	Clover 86	87	Natural Vegetation 84	Natural Vegetation 85	Natural Vegetation 86	87	Herbicide 84	Herbicide 85	Herbicide 86
Annual bluegrass	1	44	67	79	-	12	41	60	1	67	97	78	3	-	-
brome	89	95	93			-	3				1		-	-	-
chickweed	4	61	84	77	5	8	46	12	4	67	94	92	<1	-	-
clover	-	6	11		79	99	99		-	9	16		-	-	<1
cudweed	5	54	-	3	8	10	1	1	4	60	-	2	-	-	-
Dandelion	-	<1	-	.5	-	1	-	0	-	1	-	1	-	-	-
Filaree	14	35	70	92	7	-	15	35	-	27	70	91	<1	-	-
Fleabane	16	12	13	0	6	2	-	.2	1	7	13	02	-	-	-
Groundsel	1	21	11	0	1	4	<1	0	-	18	5	.2	-	-	-
Henbit	1	29	15	0	1	5	2		-	34	30	0	-	-	-
Pineapple weed	4	34	20	5	17	8	2	1.5	10	37	39	10	-	<1	-
Shepherd's purse	-	66	46	0	-	30	7	0	-	69	61	0	-	-	-
S[illegible]histle	58	18	-	.2	54	2	<1	0	28	10	-	0	-	-	-
Spurge	-	-	46		-	-	-		-	-	-	0	-	-	-

Number of Weed Species with Greater Than 5% Presence

Winter Survey (January) - Site 1

	1984	1985	1986	1987
Bromegrass	3	11	10	5
Clover	5	5	4	4
Natural Vegetation	2	11	8	6
Herbicide	0	0	0	0

---

* Does not include bromegrass or weed species within brome treatment or clover within clover treatment.

Weed Species Present by Cover Crop Treatments (%)
Winter (January) Survey - Site 1

	Bromegrass				Clover				Natural Vegetation				Herbicides			
Weed Species	84	85	86	87	84	85	86	87	84	85	86	87	84	85	86	87
Annual bluegrass	1	44	67	79	-	12	41	60	1	67	97	78	3	-	-	-
Brome	89	95	93	72		-	3	27			1	11	-	-	-	-
Chickweed	4	61	84	77	5	8	46	71	4	67	94	92	<1	-	-	-
Clover	-	6	11	22	79	99	99	92	-	-	16	32	-	-	<1	-
Cudweed	5	54	-	3	8	10	1	1	4	60	-	2	-	-	-	-
Dandelion	-	<1	-	<1	-	1	-	-	-	1	-	1	-	-	-	-
Filaree	14	35	70	92	7	-	15	35	-	27	70	91	<1	-	-	
Fleabane	16	12	13	-	6	2	-		1	7	13	<1	-	-	-	-
Groundsel	1	21	11	-	1	4	<1	<1	-	18	5	-	-	-	-	
Henbit	1	29	15	-	1	5	2	-	-	34	30	-	-	-	-	-
Pineapple weed	4	34	20	5	17	8	2	1	10	37	39	10	-	<1	-	-
Shepherdspurse	-	66	46	-	-	30	7	-	-	69	61	-	-	-	-	-
Sowthistle	58	18	-	<1	54	2	<1	<1	28	10	-	-	-	-	-	-
Spurge	-	-	46	-	-	-	-	-	-	-	-	-	-	-	-	

Weed Species Present by Cover Crop Treatments (%)
Winter Survey (January) - Site 2

ed Species	Brome 84	85	86*	87	Clover 84	85	86*	87	Native 84	85	86*	87	Herbicide 84	85	86*	87	84
a annua	31	99		54	35	100		93	31	100		72	39	98		81	34
ass buttons	25	40		64	30	42		50	25	47		30	32	47		22	25
ickweed	26	71		43	30	73		65	31	68		50	23	77		15	25
over	1	6		22	<1	2		84	1	2		21	<1	8		5	1
ndelion	<1	-		1	<1	<1		<1	<1	-		<1	-	-			<1
larea	15	31		47	<1	29		42	10	24		49	-	19		2	11
oundsel	<1	5		-	<1	2		-	1	5		-	<1	4		2	<1
nbit	1	2		<1	1	1		1	1	<1		<1	<1	<1			1
otweed	1	1		<1	-	<1		49	<1	1		23	<1	<1		8	<1
epardspurse	<1	6		6	1	10		1	<1	9		11	1	10		2	1
wthistle	<1	<1		-	<1	<1		-	1	1		-	1	1		<1	<1
eedwell	-	9		15	-	12		8	-	9		4	-	18		<1	-
dweed	<1	6		9	<1	2		9	<1	3		6	<1	7		8	<1
nyza	<1	-		-	<1	-		<1	-	-		-	<1	<1		<1	<1
dmaids	-	-		1	-	-		16	-	-		7				2	

Not surveyed

Table 20

Weed Species Present by Cover Crop Treatments (%)
Fall Survey - Site 1

	Bromegrass			Clover			Natural Vegetation			Herbicide		
	84	85	86	84	85	86	84	85	86	84	85	86
[illegible]al bluegrass	-	-	11	-	-	2	-	-	5	-	-	17
Bermudagrass	-	1	-	-	-	-	-	2	1	-	-	-
Bromegrass	50	50	49	-	-	4	-	-	3	-	-	16
Chickweed	-	-	12	-	-	18	-	-	30	-	-	4
Clover	-	6	21	80	80	82	-	11	32	-	-	20
Crabgrass	16	18	5	10	3	11	23	17	49	-	-	1
Dandelion	2	-	2	-	-	<1	-	-	4	-	-	-
False dandelion	-	-	10	-	-	2	-	-	9	-	-	-
Filaree	3	4	79	-	-	27	3	9	83	-	1	-
Fleabane	38	44	11	51	6	1	33	41	8	-	-	-
Groundsel	-	-	<1	-	-	<1	-	-	1	-	-	<1
Henbit	-	-	-	-	-	<1	-	-	1	-	-	<1
Lovegrass	11	5	12	8	2	-	-	13	11	-	-	<1
Pineapple weed	-	-	1	-	-	1	-	-	6	-	-	12
Purselane	26	20	5	40	4	1	26	31	12	1	1	-
Shepherdspurse	-	-	3	-	-	6	-	-	2	-	-	1
Smooth catsear	-	-	-	-	-	-	-	-	9	-	-	-
Sow thistle	4	-	1	3	-	2	2	-	2	<1	-	1
Spurge	-	-	4	-	-	<1	-	-	<1	-	-	12
Willow herb	-	-	30	-	-	-	-	-	-	-	-	-
Nutsedge	-	-	-	-	-	-	1	-	-	1	8	-

Table 21

Number of Weed Species with Greater than 5% Presence
Fall Survey - Site 1

	1984	1985	1986
Bromegrass	4	4	9
Clover	4	1	5
Natural Vegetation	3	6	10
Herbicide	0	1	5

Table 18

Weed Species by Cover Crop Treatments (%)
Summer Survey - Site 1

Weed Species	Bromegrass		Clover		Natural Vegetation		Herbicide	
	84	85	84	85	84	85	84	85
Annual bluegrass	-	6	-	-	-	1	-	-
Brome	80	80	-	-	-	6	-	-
Chickweed	<1	-	-	-	-	-	-	-
Clover	1	1	90	90	1	4	-	-
Crabgrass	-	37	-	7	-	49	-	2
Cudweed	4	-	3	-	8	1	-	-
Dandelion	-	-	1	-	1	-	-	-
Filaree	<1	-	-	-	-	1	-	-
Fleabane	39	93	45	3	29	92	-	4
Groundsel	-	1	-	-	-	-	-	-
Henbit	-	-	-	-	-	1	-	-
Pigweed	-	-	-	-	1	-	1	-
Pineapple weed	-	-	-	-	1	-	-	-
Purslane	28	70	21	43	19	64	1	-
Shepherd's purse	-	-	8	-	-	-	-	-
Sow thistle	28	2	24	-	28	4	-	-
Spurge	-	-	-	-	-	-	-	1
Nutsedge	-	-	-	-	-	-	2	-

Table 19

Number of Weed Species with Greater than 5% Presence
Summer Survey - Site 1

	1984	1985
Bromegrass	3	4
Clover	4	2
Natural Vegetation	4	4
Herbicide	0	0

2.6 Gophers

6a. Gophers began to appear in the orchard (site 1) late in the first year of planting. Because of the different forms of vegetation present it was determined that there should be some evaluation by management systems.

6b. Surveys were taken in April and August of 1985 and April, August and November 1986 in each of the plots. By indicating each fresh mound there is an indication of activity in each of the management systems.

6c. In April 1985 there were 5 mound systems found in clover, and 3 in blando bromegrass. In August old mounds were observed but no systems were present. In April of 1986 there were 8 mound systems in clover, 3 in bromegrass and 4 in native vegetation and with one in the herbicide treatment (this system appeared to be an extension of the bromegrass plot). After a summer of trapping there were still significant mound systems in clover and natural vegetation plots in November of 1986.

6d. Extensive monitoring of mounds and mound system will be conducted in 1987. Additional studies will be established to try to correlate gopher activity with weed species. There will be linkage between this study and the Napa-Sonoma grape study on vegetation management-/bindweed and gopher populations.

Objective

3. Evaluate effects of cover crops and weed populations on soil compaction, water penetration and soil water holding capacity.

4. Evaluate the consumptive use of the almond orchard floor management systems imposed as treatments.

Methods to Accomplish Objectives:

3. A. Soil compaction as a baseline was measured as bulk density of the soil by depth and soil strength as measured by a soil penetrometer at the onset of the experiment. Measurements are made annually to note changes as well as treatment differences.

B. Water holding capacity is measured annually for change and treatment differences.

C. Water penetration changes are evaluated at various times during the year using a method of visual observation of the time necessary to reach surface ponding during irrigation.

4. The consumptive use of water by the almond trees in each of the treatments was monitored by neutron probe and gravimetric techniques. The gravimetric method was used only near the surface. The neutron prove was used from 9 inches to 120 inches of soil depth. Soil water disappearance was measured between irrigations for the entire season to yield daily water use as well as cumulative water use by treatment.

Water use was monitored by five neutron probe wells spacially arranged to evaluate differential water use by distance from tree and cover crop versus sprayed strip.

Results

Comparative Water Use

Consumptive water use from the total profile (3.04m) was measured during the crop season. Each measurement period varied from 11-18 days. Daily use is calculated for each measurement period as well as cumulative water use. Cumulative use is a sum of the current crop water use period in addition to the preceeding periods of that particular season.

Results presented are for the 1986 season in both the young orchard (Site 1) and the mature orchard (Site 2).

The results of the daily and cumulative water use are shown below in Tables A and B and Tables C and D for Sites 1 and 2 respectively. A graphic representation of daily and cumulative water use is presented in Tables 22, 23 and 24, 25 for Sites 1 and 2 respectively.

Site 1.

Daily water use over the season varies due to treatment as well as time of year (Table 22). Reference Evapotranspiration (ETO) is also shown as an indication of environmental effects on water consumption. Differences in daily and cumulative water use due to treatment are apparent and significant (Tables A, B and 22, 23).

The clover treatment attained the highest water use for most of the season followed closely by that of the native vegetation treatment. These treatments are not signifantly different on a seasonal use basis. Again, on a seasonal use basis the brome treatment used significantly less water than clover and native vegetation although the use was significantly more than the residual herbicide treatment. (Table B). The residual herbicide treatment showed the least water use and was significantly lower in water use than all other treatments.

In comparing the means of the extremes in water use (native vegetation and clover to residual herbicide, 24.9, 25.9 vs 20.1 respectively, the residual herbicide treatment used 21-22 percent less water over the evaluation period.

Brome used more water than herbicide on a cumulative basis although was not signicantly different than that treatment.

Site 2.

Daily water use over the season varied by treatment as well as time of year (Table 24).

The clover and native vegetation treatments water use is similar and signicantly different than the other treatments for most use periods as well as on a seasonal basis.

The chemical mowing, residual herbicide and bromegrass treatments are not signicantly different from each other in water use for most periods and in the cumulative seasonal total.

In comparing the average seasonal means of the treatments significantly different from each other (native vegetation and clove versus chemical mowing, brome and residual herbicide 31.97:26.95) a reduction of 14 percent in consumptive water use was noted.

Soil Compaction

Site 1

Soil compaction was measured using a soil totalizing soil penetrometer to a depth of five inches at six inch intervals across each plot center. Values were normalized by the average soil strength measured in the non traffic spray strip of the measured treatment. A significant difference (5 percent level) exists between the residual herbicide treatment and all others (Table 27). This is a change from the initial base line data taken prior to the imposition of treatments where soil strength was found not to be significantly different. These 1986 results are in agreement with the 1985 (Table 29). It should be noted that the differences which occur from 1985 to 1986 are primarily due to differences in soil moisture at the time of measurement.

Site 2

Soil strength was found not be be significantly different between treatments in 1986 as well as 1985 before the trial was planted. However, from Table 28 a trend towards higher soil strength in the residual herbicide treatment can be seen.

Water Holding Capacity and Water Infiltration Rate

No significant differences were found to exist from 1985 to 1986.

Conclusion

An experiment was established in 1985 at two sites in orchards of different ages, soil type and ground surface coverage to evaluate five different vegetation management systems. Significant differences were found to exist between treatments in consumptive water use during the 1986 season. It is apparent in both orchards that residual herbicide or chemical mowed treatments consume less water both on a daily basis and a cumulative seasonal basis (Site 1, 22 percent; Site 2, 14 percent). These 1986 results are quite similar to those of the 1985 season (Table 26).

A significant difference in surface soil compaction, has been noted in the residual herbicide treatment at Site 1 while no differences were found to exist in soil water holding capacity or water intake rate at either site. Since changes in these soil physical characteristics of the soil are cumulative, further changes will be monitored.

DAILY WATER USE Site 2 1986
In/Day for Period Indicated *

	4/22 to 5/2	5/8 to 5/19	5/24 to 6/9	6/14 to 6/27	7/2 to 7/14	7/19 to 7/30	8/5 to 8/22
Native Veg.	.18 A	.24 A	.28 A	.31 A	.30 A	.26 A	.25 A
Clover	.18 A	.23 AB	.27 A	.29 A	.29 AB	.25 AB	.25 A
Brome	.15 B	.22 AB	.25 A	.24 B	.25 BC	.20 B	.21 B
Res. Herb.	.16 AB	.24 A	.24 A	.24 B	.24 C	.23 AB	.21 B
Chemical Mow	.16 AB	.20 B	.25 A	.27 AB	.25 BC	.21 B	.20 B

TABLE C. Daily consumptive water use, inches per day, as the treatment mean for each period of time indicated.

WATER USE BY PERIOD SITE 2 1986
In/Day for Period Indicated *

	4/22 to 5/2	5/8 to 5/19	5/24 to 6/9	6/14 to 6/27	7/2 to 7/14	7/19 to 7/30	8/5 to 8/22	Seasonal 4/22 to 8/22
Native Veg.	1.96 A	2.92 A	4.75 A	4.33 A	3.96 A	3.17 A	4.50 A	31.97 A
Clover	1.95 A	2.63 AB	4.60 A	4.13 A	3.76 AB	2.96 AB	4.43 A	30.78 A
Brome	1.67 B	2.68 AB	4.29 A	3.38 B	3.28 BC	2.44 B	3.74 B	26.62 B
Res. Herb.	1.77 AB	2.92 A	4.08 A	3.41 B	3.08 C	2.73 AB	3.70 B	27.11 B
Chemical Mow	1.77 AB	2.43 B	4.28 A	3.73 AB	3.32 BC	2.48 B	3.58 B	26.95 B

TABLE D. Consumptive water use, inches, during each time interval indicated. Season water use includes estimate of water use during irrigation periods as well as measured water use.

*Values within a column followed by the same letter are not statistically different at P<0.05 by Duncan's Multiple Range Test.

Table 22

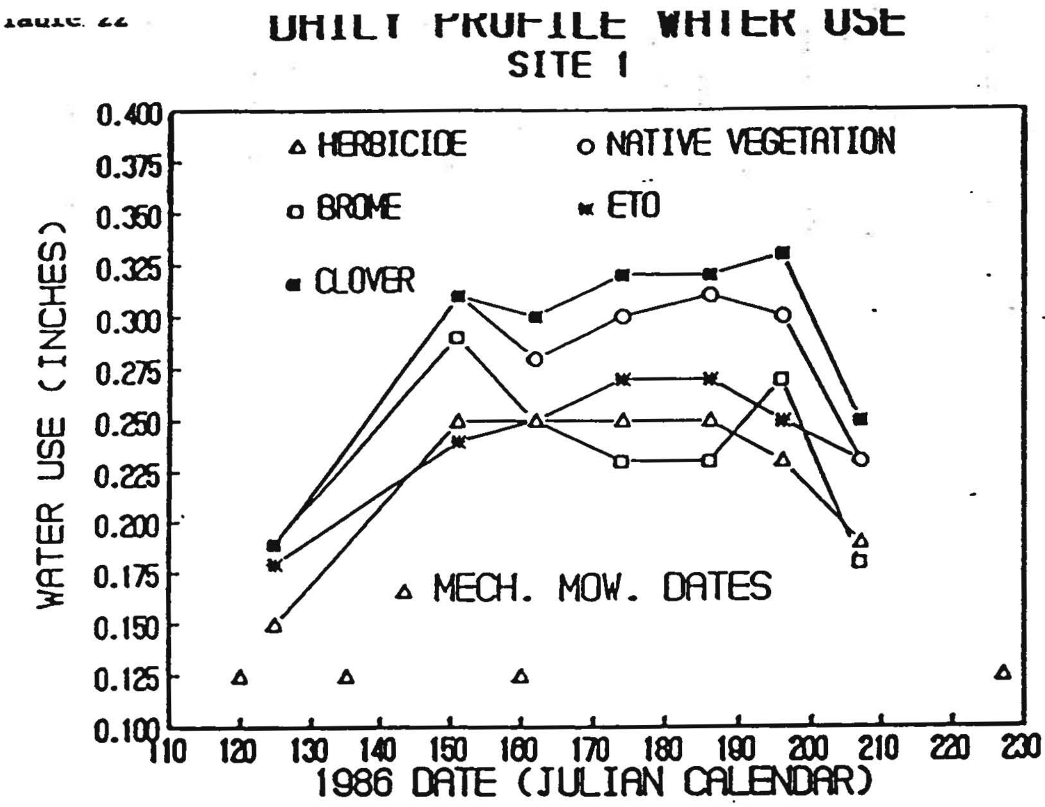


Table 23

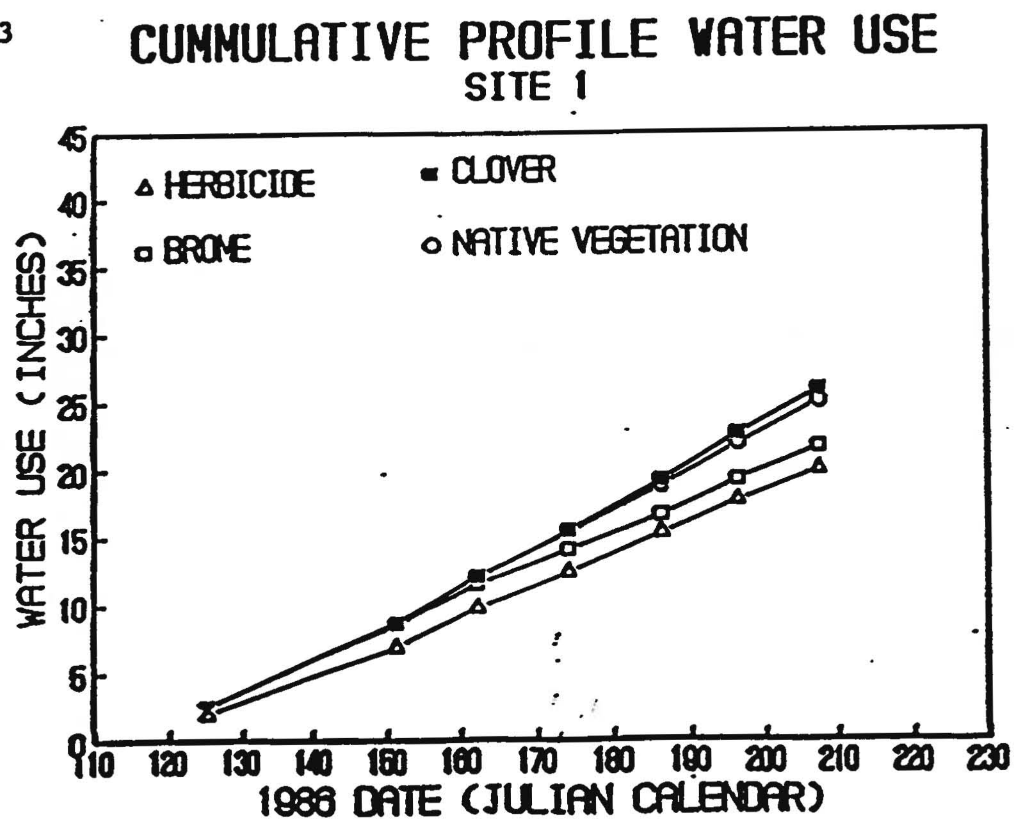


Table 24

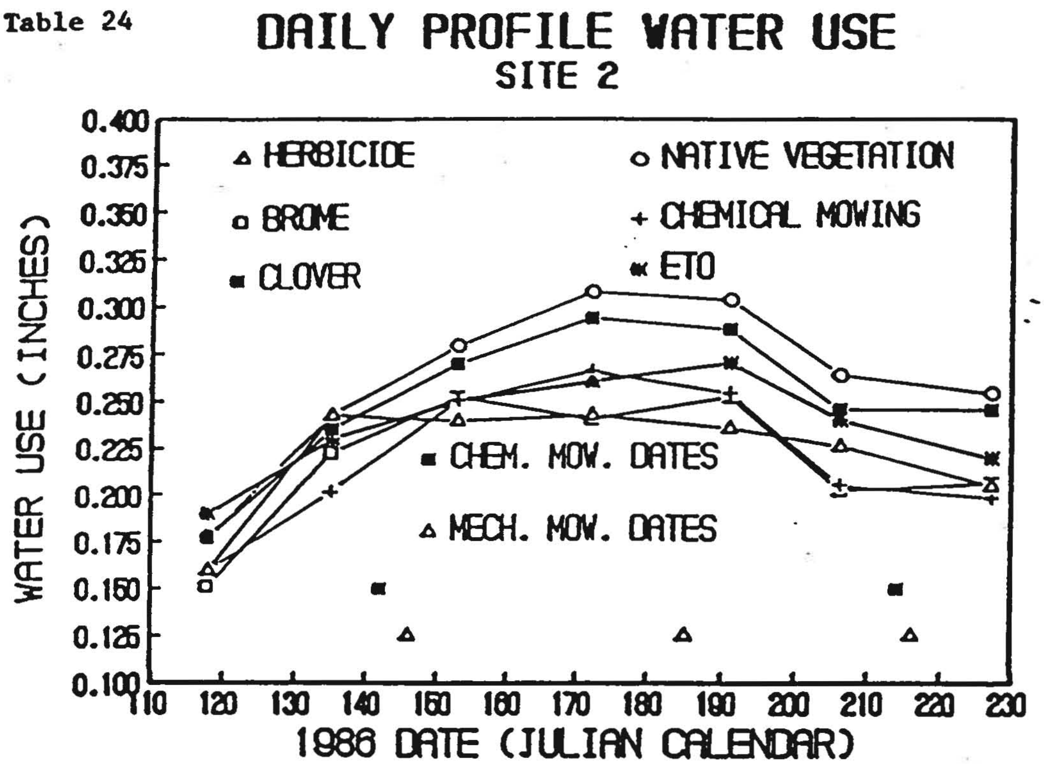


Table 25

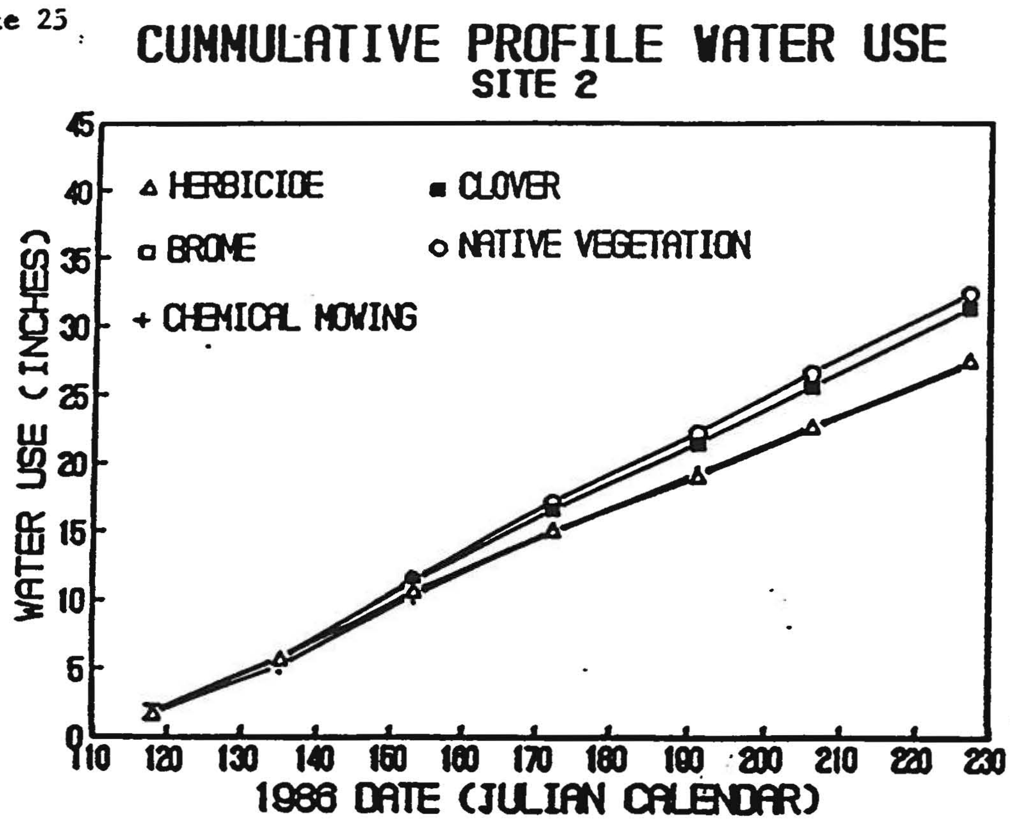


Table 26

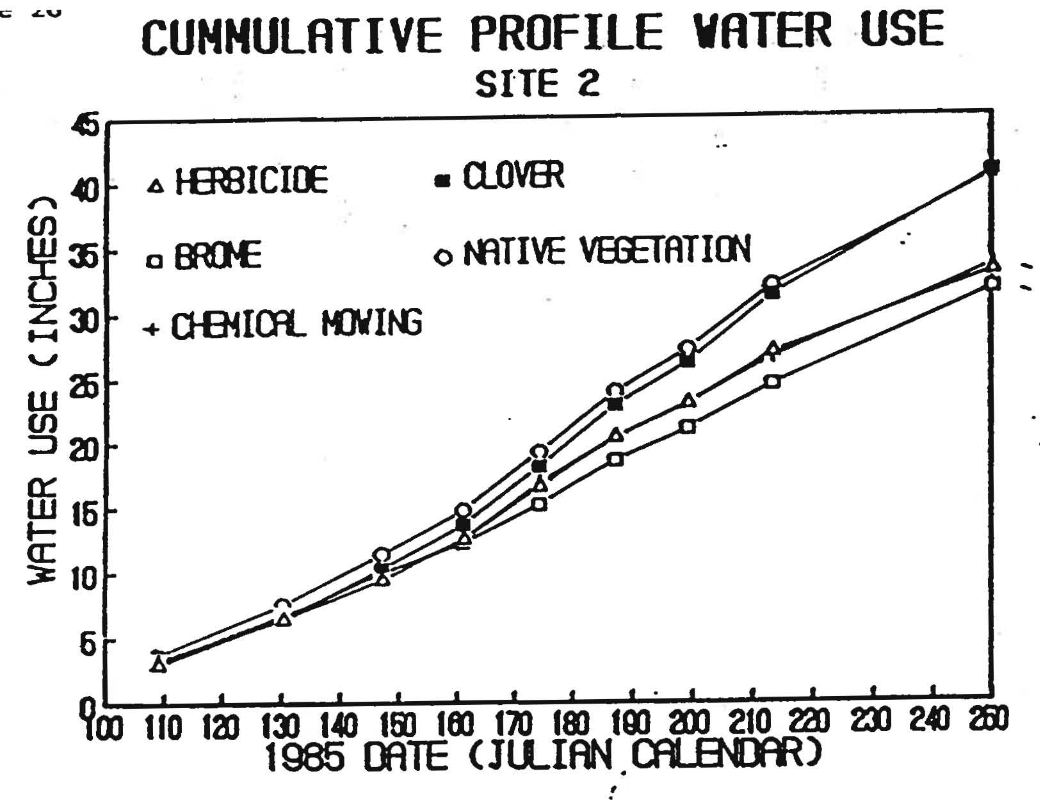


Table 27

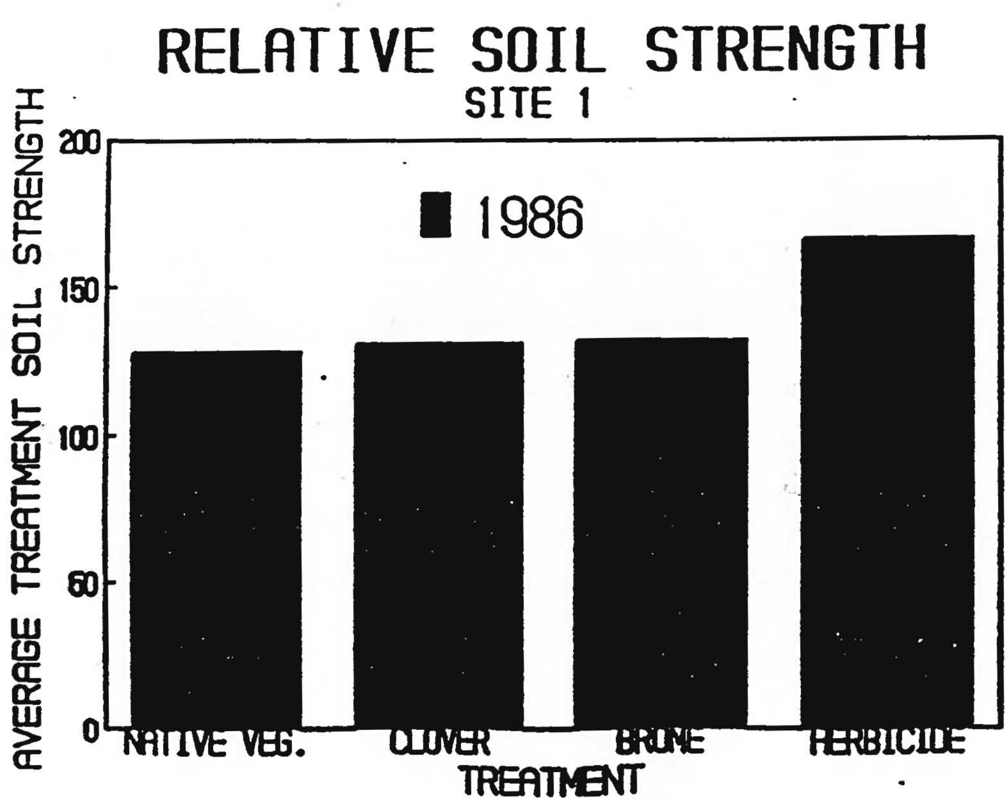


Table 28

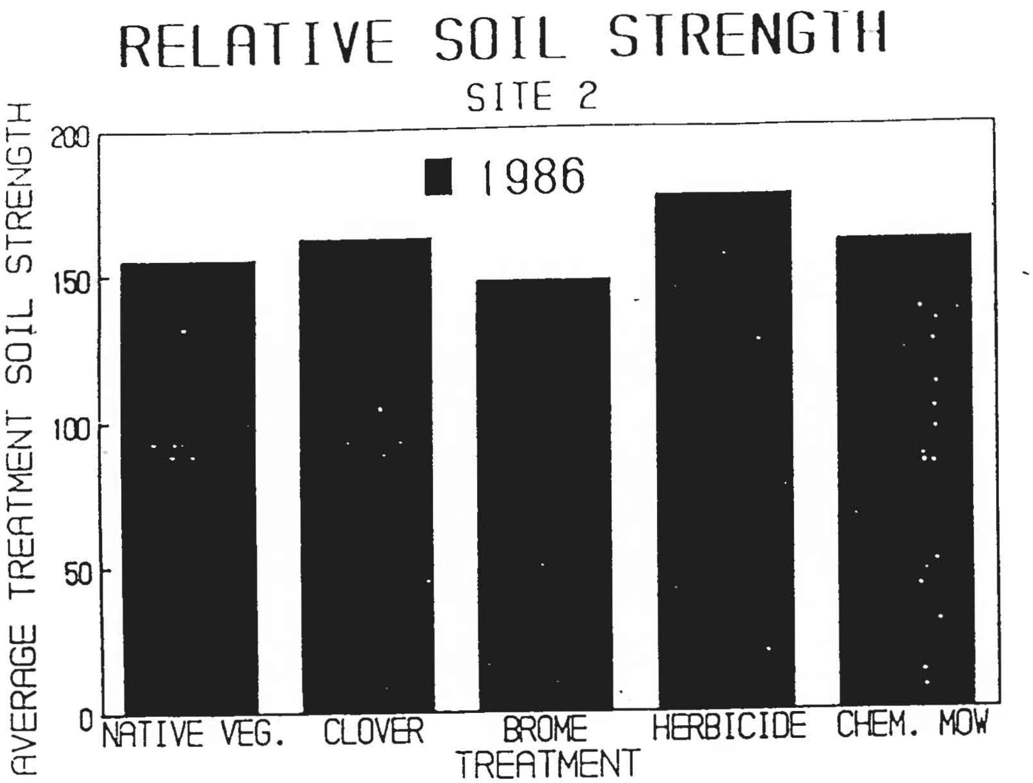
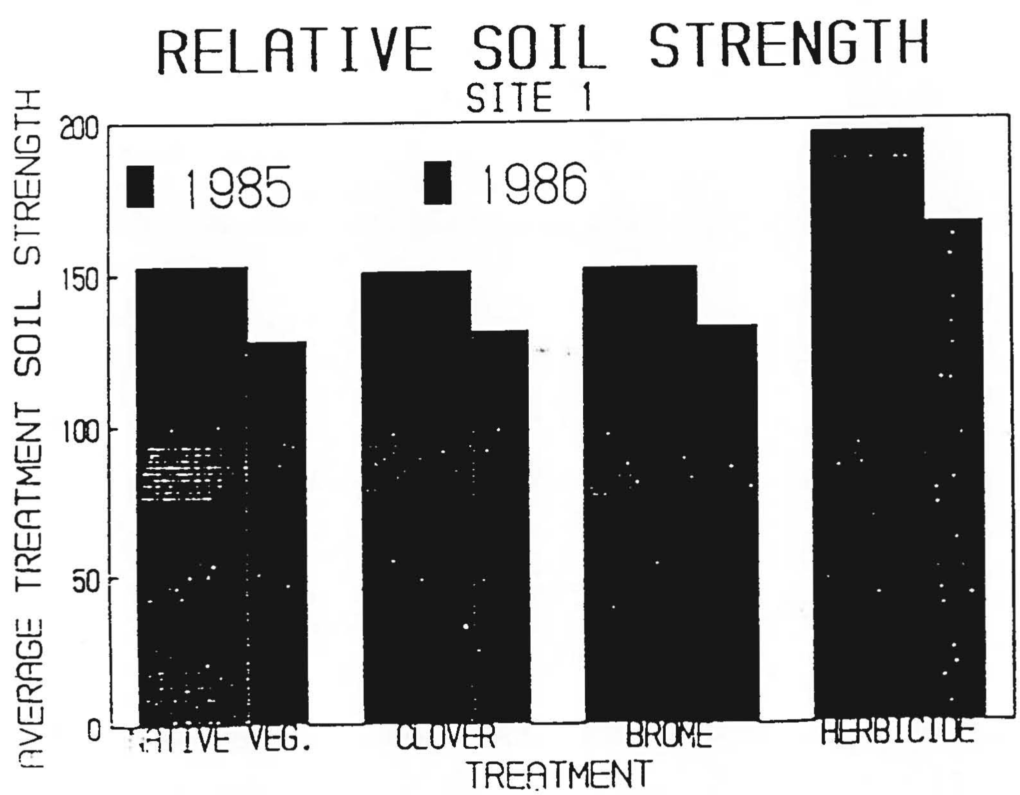


Table 29



Objective:

5. Evaluate the economics of almond production using various orchard management systems.

Cost analysis was conducted on two phases of the almond cover crop; 1)establishment costs 1st through 5th year and 2)production costs. Costs were analyzed for seven possible management systems , five of which are under study in this project; Blando bromegrass, clover cover, natural vegetation cover, total herbicide, and chemical mow (periodic spraying with low rates of glyphosate). Each of these management systems use herbicide treated strips down the tree row.

Establishment costs and production costs are summarized by management treatment in tables (previous reports). During the first 2 years of establishment there is a high cost for preemergence herbicides. Reduced costs are incurred from the 3rd year and older. Cumulative and daily water use profiles in 1986 indicate the greatest water use in clover and natural vegetation plots with a lower use in brome, herbicide, and chemical mow treatments. Cost differences due to this use are shown in table 30 and 31.

Damage figures from ants on almond nutmeats are shown in crackout data at both sites in tables 32 and 33. Yields for each site are given for individual treatments. Price per pound and reject costs are based on 1986 California Almond Growers' Exchange figures. Production costs in Table 30 and 31 involve only those that are different and specific between treatments. The cost to strip treat each area is not included in any treatment.

Table 32

Crackout and damage to nutmeats by vegetation management systems - Site 1

Treatment	Nut wt(g) 250 nuts	%crackout	%shrivel	%ant damage
Brome	298.2 a*	33.9 a	8.3 a	12.6 a**
Herbicide	305.2 a	34.2 a	5.8 a	2.0 b
Clover	309.9 a	34.6 a	7.6 a	7.6 ab
Native	305.2 a	35.5 a	7.7 a	12.3 a

*Means followed by the same letters are not significantly different using Duncan's Multiple Range Test P=0.08
**Range test, P-0.01

Table 33

Crackout and damage to nutmeats by vegetation management system - Site 2

Treatment	Nut wt. (g)/ 250 nuts	% crackout	% shrivel	% ant damage
Bromegrass	342.5 a*	34.74 a	.55 ab	1.37 a
Herbicide	337.4 ab	33.60 a	.32 ab	.77 a
Clover	331.1 b	33.39 a	.67 a	1.17 a
Native	347.8 a	34.69 a	.29 ab	.52 a
Chemical mow	343.1 a	33.67 a	.17 b	.77 a

*means followed by the same letter are not significantly different using Duncan's Multiple Range test P=0.05

Cost Figures for Ant Damage
Site 2 - 1986

	Cost of production[1]	%Ant damage	loss/gain[2] due to damage	Yield[3] lb/A	Gross[4] return/A	Net/A
Blando bromegrass	90.00	1.37	+0.03	1485.0	3014.55	2924.55
Strawberry clover	153.00	1.17	+0.03	1405.8	2853.77	2700.77
Native vegetation	101.00	.52	+0.045	1524.6	3117.80	3016.80
Solid herbicide	112.54	.77	+0.0375	1485.0	3025.68	2913.14
Chemical mow	90.88	.77	+0.0375	1485.0	3025.68	2934.8

1) Based on:

Cover crop mowings
Fertilize cover crops
Water use differences (based on 22.5 cents/acre ft.)
Chemical treatments of drive rows only

2) Dockage and premium figures from 1986 California Almond Growers Exchange

3) Based on 99 trees/A

4) Price at $2.00/lb

V. Data Collection and Filing

Data has been collected and filed on each of the subsections of this project. Frequency of collection varies considerable from almost weekly on consumptive water use to quarterly on weed surveys. All data through the 1985 season are on the prime IPM computer so each project member may access these data. The 1986 data will be put in Impact as well for access.

VI. Analysis and Linkage

A. Data reliability appears excellent except for the nematode information. Variability is exceptionally high with C.V. values above 100% in some tests. Sampling and analysis is planned again in 2 years to further evaluate any population changes. Greater sample numbers will be required to get a better value mean for each plot.

Data on NOW overwintering and emergence will be collected from both locations in 1987 to increase reliability and to also confirm the 1986 data.

Ant population, ant damage, mite counts, tree circumference, nutrient analysis, consumptive water use and weed populations data are reliable.

B. The 2 experimental sites will be used for additional research on rodents and vegetation on the orchard floor. This interest has lead to a project initiated in Napa and Sonoma counties in grapes.

Information from this research has been utilized to initiate 2 field studies in orchards in Glenn and Butte counties. This project funded by the Kearney Foundation is studying cover crops, vegetation management and soil structure, water penetration and water use under the leadership of Dr. Bill Wildman. Another location is being developed to initiate in Sutter County in the fall of 1987.

C. Data gaps include: 1)correlation of weeds and cover crops to nematode species, 2)water use data by various weedy plants, 3)effects of cover crops on other orchard floor insects 4)other cover crops (annual and perennial grasses and annual clovers) should be evaluated. 5)Do cover crops (species) attract gophers and 6)do gophers feed on the cover crops or the tree or vine roots in the presence/absence of cover crops. 7)How fast ant damage occurs once almonds are on the ground or use of plant material to confuse ants from feeding.

VII.

A. The research effort in this study will allow growers to make decisions on vegetation management in the orchard and its affect on other pests, tree growth and health and water use. Important decisions can be made on planting of a cover crop vs. using native vegetation. It is important that growers not plant perennial clovers because of the problems developed.

B. A dicussion of cover crops, their selection and effects on water use and pest control are being included in the revision of the Almond Pest Management Manual. Some of the same concepts could be utilized in other tree crops and vines.

C. Currently this information is not being prepared however it should be initiated in 1987.

D. Additional research should be generated from the interest in this project and research should be implemented further by farm advisors in 1987. Some of the information has already been implemented by pomology farm advisors and area IPM advisors. Data on ant colonies and damage has further verified threshold levels of ant populations and potential nut damage. The characteristic of how rapid this occurs however is new.

E. Work will be implemented by the Soil Conservation Service and the chemical industry because of the findings in this study. A research and implementation study will be started in orchard and vineyards in the Sacramento Valley counties of Sutter, Yuba Butte and Glenn in 1987.

Dr. Tom Lanini, Weed Ecology UCD and Dr. Lowell Jordan, Plant Science, UCR are initiating projects as offshoots of the project. Dr. Terry Salmon, Vertebrate control is being involved in a splinter project and a Nematology graduate student is testing some of our cover crops on nematode suppression and thus suppression of ring spot virus in prune.

VIII. Recommendations

1. Additional time is needed on these two research locations to maintain these cover crop trials and to measure pest interactions. It is hoped that an entomologist will help evaluate insects associated with the cover crops in 1987.

2. Additional research is needed to understand weed species relationships with nematodes. We may be able to suppress nematode (daggar) activity with Blando bromegrass as a cover crop.

3. I would like assistance from a systems analyst or mathmatics student to make additional correlations and interaction comparisons that we currently haven't conducted.

4. Support for the western regional project on cover crops and living mulches (currently a coordinating committee) will further implement this work in other states in the Western United States.

IX. Publications

1. Elmore, Clyde L. Interdisciplinary programs in cover crops in Tree Fruits and Vines. Proc. California Weed Conference, Jan. 1986. p. 171-172.

2. Pritchard, T.; L. Hendricks; W. Asai; W. Pemberton. Vegetation management: Soil-Water Relations. Proc. California Weed Conference. Jan. 1986. p. 180-187.

3. Barnett, W.W. How vegetation management influences trees and vines: An Entomologist's Viewpoint. Proc. California Weed Conference. Jan. 1986. p. 183-189.

4. Ogawa, J.M. and J.K. Uyemoto. How vegetation management influences tree growth: What the Plant Pathologists See. Proc. California Weed Conference. Jan. 1986. p. 180-187.

In Preparation:

1. Barnett, W., L. Hendricks, W. Asai, R. Elkins, D. Boquist and C.L. Elmore. California Agriculture (In progress). The influence of four cover crop management systems in almond orchards on insect and mite populations.

2. Elkins, R., W. Micke, L. Hendricks, W. Asai and C.L. Elmore. An evaluation of orchard floor management on tree growth and nutrient balance. California Agriculture (in progress).

3. Pritichard, T., W. Pemberton, L. Hendricks and W. Asai. Orchard floor management: Water use evaluation. California Agriculture (in progress).

4. Elmore, C.L., L. Hendricks, W. Asai, R. Elkins, and D. Boquist. Natural Vegetation (Weeds) versus planted cover crops. California Agriculture (in progress).