Almond Culture and Orchard Management

Correct Project Number: 99-LH-o0

Project No. **99-LH-00 Almond Culture and Orchard Management**

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Objectives

1. To evaluate training and pruning systems to maintain productivity of almonds in tightly spaced hedgerows.
2. To determine the timing and number of zinc sprays needed to correct zinc deficiency symptoms on vigorously growing young almond trees.
3. To compare survival and growth of fall transplanted potted almond nursery trees compared to spring transplanted bareroot trees.
4. To compare burning with chipping of prunings to reduce air pollution and build soil organic matter.
5. To compare the effectiveness of oil alone and Success®, Asana®, and diazinon with oil for dormant control of San Jose scale and to measure the impact on the scale parasitoid, *Encarsia perniciosi* and spider mites.
6. To control alternate bearing in 'Price' almond using Gibberellic acid treatments.
7. To evaluate the interactions of almond varieties, rootstocks, tree spacing and pruning systems.
8. To determine if supplemental pollen is beneficial to almond production.

Results

1. **SUSTAINING YIELDS IN HEDGEROW ALMONDS -- John Edstrom, U.C. Farm Advisor in Colusa County; Joe Connell, U.C. Farm Advisor in Butte County; Bill Krueger, U.C. Farm Advisor in Glenn County; Wilbur Reil, U.C. Farm Advisor in Yolo and Solano Counties; Stan Cutter, Nickels Soils Lab; and Jim Yeager, Pomology Dept. UC Davis**

The long-term evaluation of various tree spacing, training and pruning techniques continued into the 21st year. Since 1979 four training concepts have been monitored for there affect on yield of nonpareil; Price 1:1 hedgerow planting (7'x22') at the Nickels Soils Lab in Arbuckle. The following treatments began at the first dormant pruning:

1) **Temporary Hedge** – trained to three scaffolds, standard pruning for permanent trees, with alternate trees gradually whisked back and then removed after their 8^{th} year (1986), leaving a 14'x22' spacing.

2) **Permanent Hedge** – trained to three scaffolds, standard pruned and maintained at 7'x22'.

3) **Two Scaffold Hedge** – a 7'x22' hedge trained with two primary limbs growing out into the row middles and standard pruned.

4) **Unpruned Hedge** – a 7'x22' hedge trained to three scaffolds and then essentially unpruned since.

Good commercial yield continues to be maintained in this trial despite crowded tree conditions. Nonpareil production this season was 2483 lbs/ac for the 2 scaffold plots, 2307 lbs for the unpruned, 2136 lbs for the permanent hedge and 1662 lbs for the temporary hedge plots.

Noteworthy this season, is the observation that overall vigor appears to be declining in the entire plot and that the heavily shaded conditions are diminishing throughout the three tightly hedged treatments. More light is apparent on the orchard floor than in past years even beneath the unpruned trees.

The decline in yield reported last year for the unpruned areas did not continue this year, yields returned to more typical levels. The temporary hedge areas where alternate trees were removed in 1986 continued to lag far behind and again failed to regain productivity.
Accumulative yields for the Temporary Hedge through the 21^{st} leaf lag approximately 7,000 pounds behind the other three treatments (see Table I). The continued low yield from the Temporary Hedge treatment suggests that alternate tree removal is a questionable practice, even in tightly spaced hedgerow almonds. However, the peculiarities of this test site should be considered when interpreting these yield figures. This two cultivar planting (Nonpareil and Price) has developed on Class II/III gravelly loam soils under a single hose drip irrigation systems. These limitations have resulted in a restricted root zone and have possibly reduced the growth of permanent trees into their expanded space (from 7' spacing to 14' spacing). Also, the adjacent tightly spaced pollenizer rows created shaded conditions, further inhibiting fruitwood regrowth on the 14' x 22' spaced Nonpareil plots. Given more favorable "regrowth" conditions, this hedge removal treatment may have regained high productivity and proven, over time, to be an economically viable system. Certainly under our conditions with nearly 7,000 lbs. in accumulated lost production, this is not an advisable hedge management strategy.

Close spaced almond hedgerows appear to be quite forgiving with respect to pruning/training methods. Accumulative yields show no difference between trees pruned to Two-Scaffold, Permanent (3-scaffold) or left Unpruned (after scaffolds established).

Loss of lower fruitwood continues in this planting, especially in the unpruned trees. As the trees age, increasingly more crop remains high in the trees after harvest, especially in the unpruned trees. The inter-twined branches may not receive sufficient force from the shaker for complete crop removal.

We know of no other experimental data that shows unpruned almonds to produce yields equal to standard pruned trees over this length of time. Excessive overgrowth and shading has not occurred in the unpruned trees under these low vigor conditions created by tree crowding and soil/root limitations. A new study using a modified version of minimal pruning is currently underway at Nickels under vigorous conditions. However, the sustained productivity in this test of the Unpruned Hedge merits consideration when planning a pruning strategy for almond hedgerows. Our savings, in pruning costs over the span of this trial were considerable.

TABLE I. YIELDS BY HEDGEROW SYSTEMS
Kernel Pounds per Acre Leaf/Year

Treatment	11th 1989	12th 1990	13th 1991	14th 1992	15th 1993	16th 1994	17th 1995	18th 1996	19th 1997	20th 1998	21st 1999	Accum.[1/] 1984-99
2 Scaffold	2746a	3470	2992	2079	1943	2835	1598	2968	2953a	2296a	2483	36,820
Unpruned	2870a	3072	3036	2471	1804	2799	1215	2833	2680a	1958ab	2307	35,082
Permanant	2680a	3333	2254	2268	1189	2678	1297	2624	2498a	2494a	2136	34,176
Temporary	2046 b	2450	2576	1739	1280	2448	1079	2076	2081 b	1757 b	1662	27,861

[1/] Accumulative Yields Since 1984.

2. CORRECTION OF ZINC DEFICIENCY SYMPTOMS IN YOUNG ALMOND TREES -- Mario Viveros, U.C. Farm Advisor in Kern County

Introduction

Zinc deficiency symptoms are common in vigorously growing almond trees in young orchards. They are easily found in one to four year old orchards in sandy soils. The degree of deficiency varies according to the vigor of the trees and soil texture. Vigorous trees growing vigorously in a light textured soil showed more zinc deficiencies than weakly growing trees growing in a heavy soil. The purpose of this experiment was to correct zinc deficiency symptoms in young trees using one to four zinc chelate sprays.

Material and Methods

A newly planted Nonpareil orchard was selected in the Wasco Sandy Loam Soil series. The orchard had good vigor by spring. The experiment was established in a complete randomized block design with five treatments and five replications, which were made up of three trees each. The treatments were the following: untreated control, spring, spring and summer, spring, summer and fall, spring, summer, fall and winter.

Zinc chelate at a rate of one quart in 100 gallons of water was used for all treatments. The trees were sprayed using a hand gun sprayer set at 120 psi pressure. The trees were sprayed to the point of run off.

Leaf samples were taken in May before the treatments were applied. Eighty leaves were sampled from the middle tree. The samples were washed with distilled water, then dried in the oven. Once dried, they were ground and sent to our soil and tissue laboratory at UC Davis.

Results

The results from leaf analysis before and after the zinc sprays were applied are found in the following table:

	Amount of Zinc (ppm) in Leaves	
Treatment	*Before Spray*	*After Spray*
Control	13 a*	16 a
Spring	12 a	30 b
Spring + Summer	12 a	32 b
Spring + Summer + Fall	12 a	33 b
Spring + Summer + Fall + Winter	12 a	33 b

* Like letters indicate no significant difference.
Unlike letters showed a significant difference at the 95% level.

Discussion:

All pre-treatment zinc levels were low with no significant differences between them. Furthermore, the pre-treatment levels of 13 and 12 ppm are low for the month of May. Zinc concentration will decrease with the season. Therefore, to have the critical level of 15 ppm in July, one would expect higher zinc levels in leaf tissues in May.

The post-treatment zinc levels did show a significant different (95%) level between the control and all treatments. The amount of zinc doubled in all the treatments, but the zinc level in the control only increased from 13 to 16 ppm. There were no significant differences in zinc levels between treatments. This means that one zinc spray during the season can increase the zinc levels in the leaf tissue. When is the best time to apply a zinc spray? We are planning to establish a test plot that will answer this question.

3. SURVIVAL AND GROWTH OF FALL TRANSPLANTED POTTED ALMOND NURSERY TREES COMPARED TO SPRING TRANSPLANTED BAREROOT TREES -- Wilbur Reil, U.C. Farm Advisor in Yolo and Solano Counties

OBJECTIVES

Almond trees on peach/almond hybrid rootstock have been difficult to transplant and grow if the bareroot trees are planted in mid to late spring from nursery trees stored in cold storage. Death loss in some cases have been 20 to 40 %. Many years on loam and silty clay loam soils the ground is too wet to plant earlier than late spring. There are also times that growers do not complete ground preparation in the preceding year to have an ideal planting bed. Therefore, sometimes the ground must dry out in the spring to complete soil preparation before planting. One nursery currently has been growing nursery trees in containers and selling the potted trees for transplant into the orchard at any time of the year. The objective of this trial is to evaluate planting potted tree transplants in the fall compared to winter or spring planted bareroot nursery trees.

PLANS AND PROCEDURES

The trial is on class 1 silty clay loam in Yolo county on previously planted almond ground. The experiment is a randomized complete block design of five replicates of four trees per replicate. There are two treatments (potted vs. bareroot trees) and three varieties (Nonpareil, Sonora, and Butte). The five month old growing potted trees were planted on September 18, 1998 and the bareroot 5/8 inch dormant trees were planted in late January, 1999. All trees were headed at 36 to 38 inches.

A replicated trial was planted in the fall and winter of 1998-99 in a randomized complete block design with:
2 treatments: Potted 5-month grafted trees.
Bareroot 1-year grafted trees
3 cultivars: Nonpareil, Butte, Sonora.
Five replicates of four trees per replicate.

Growth and trunk cross sectional area measurements will be taken each year. Yield will also be obtained in year 3 and 4.

RESULTS and DISCUSSION

At the end of the first growing season the length of the three longest shoots that will be selected for the primary scaffolds of the tree was measured. Results are shown in Table 1.

Table 1. Average length of each of the 3 longest scaffolds at the end of the first year of growth.

	Potted		Bareroot	
Nonpareil	164.3 cm.	4.6 feet	134.5cm.	4.4 feet
Butte	135.2	4.4	136.2	4.5
Sonora	131.2	4.3	125.8	4.1
Average	135.2	4.4	132.2	4.3

During the winter following the first growing season the trunk circuference was measured at the top of the tree protector which was 14 inches tall. The measurement was then converted to trunk cross sectional area. Results are shown in Table 2.

Table 2. Average trunk cross sectional area measured approximately 14 inches above ground level at the end of the first year of growth.

	Potted	Bareroot
Nonpareil	17.8 cm. sq.	15.1 cm. sq.
Butte	14.9	14.6
Sonora	18.3	13.1
Average	17.0 *	14.3

* Statistically significant - LSD .05

Growth measurements in October 1999 showed no statistical differences between the potted trees and the bareroot trees in shoot length. The total length of the 3 longest scaffold limbs showed that the potted trees had grown and average of 406 cm. (13.3 feet total or an average of 4.4 feet per limb) compared to 397 cm. (13.0 feet total or an average of 4.3 feet per limb) for the bareroot trees. Average Trunk cross sectional area was statistically significant at 17.0 sq cm. for the potted trees compared to 14.3 sq. cm. for the bareroot trees showing that the potted trees had attained a larger trunk thickness. Currently, growth, and height of the potted and bareroot trees look the same. You cannot look at the trial and separate the nursery potted trees from the bareroot trees.

One bareroot tree died whereas no potted tree died due to transplanting. The bareroot trees were not placed in cold storage. Planting occurred shortly after digging from the nursery. Originally the trial was set up to compare the potted trees planted in September to bareroot trees that were going to be planted in late March or April after the bareroot trees were dug and placed in cold storage. There was a window in January, 1999 where weather was ideal for planting so the trial was modified to take advantage of the good planting conditions. This window does not occur every year in Yolo Co. I would expect the bareroot trees would not have grown as well if they had been placed in cold storage and planted later in the year.

4. WOOD CHIPPING TO REDUCE AIR POLLUTION AND BUILD SOIL ORGANIC MATTER -- Brent A. Holtz, U.C. Farm Advisor in Madera County, and Michael McKenry, UCCE Nematology Specialist, UC KAC

The wood chipping of almond prunings instead of burning as a method to reduce air pollution and return organic matter to soils could become an important orchard practice for almond growers. Wood chipping could provide an alternative to burning which would not contribute to PM-10 pollution while at the same time add valuable organic matter to soils. The success of wood chipping will depend on whether the chips decompose quickly and are incorporated into the soil, or whether they are harvested with the nuts and increase foreign material and industrial waste. Wood chippers and shredders have both been used and their products can be quite variable. Chips from a Brush Bandit wood chipper were compared to shreddings from a Rears Shredder. Size (area), weight, and rate of decomposition were examined. Soil analysis between chipped and non-chip soils were performed.

Average chip weight was 0.683 ± 0.11 g while average shreddings were significantly larger at 3.63 ± 0.48 g (dry weight). Average chip size (area) was 2.1 ± 0.42 cm^3 while shreddings were significantly larger at 8.12 ± 1.83 cm^3. Chips and shreddings (300g samples) were placed in nylon mesh sacks, with soil, and placed on the floor of an almond orchard in order to examine their rate of decomposition. After 20 months total chip weight was reduced by 56.21 % while total shreddings were reduced by 67.45 %. The greater decomposition rate observed in the shreddings may be related to their larger initial size.

Soils from the chipped plots were compared to soils from non chipped plots. The non-chipped soils were found to have significantly higher electrical conductivity (EC-mmhos/cm), Ca (meq/L), Mg (meq/L), and nitrate (NO3-N ppm), while the chipped soils had significantly more phosphorous (P-Olsen ppm). There was no statistical difference between the chipped vs non-chipped soils when potassium (X-K ppm), ammonium (NH4-N ppm), pH, and sodium (Na-meq/L) were compared. The Cation Exchange Capacity (CEC-meq/100g) was higher in the non-chipped soils but levels were not significant. Surprisingly, the % organic matter was also no different between the chipped vs non-chipped soils.

When nematode populations were compared there was significantly more *Rhabditia*, *Dorylaimida, Tylenchus,* and *Mononchus* populations in the wood chipped soils. There was also a noticeable increase in Ring nematode populations in the non-chipped soils. *Rhabditia* is a free living bacterial feeding nematode which may be building up in response to bacterial populations which in turn may be building up on decomposing the wood chips. Free-living nematode populations will be investigated more thoroughly.

5. A COMPARISON OF THE RESPONSES OF PEACH TWIG BORER, SAN JOSE SCALE AND THE SCALE PARASITOID, *ENCARSIA PERNICIOSI* TO DORMANT SPRAYS IN ALMOND -- Lonnie C. Hendricks, UC Farm Advisor in Merced County and Walt Bentley, UCCE Area IPM Advisor, KAC. Cooperators: David Arakelian, Arakelian Farms; Barat Bisabri, Dow AgroSciences; Peter Yu, Dow AgroSciences

Introduction:

The peach twig borer (PTB), *Anarsia lineatella* is a major pest of almonds in California and can be a significant pest in Merced County. The PTB is often controlled by dormant sprays of oil plus insecticide or with a bloom-time spray of *Bacillus thuringiensis* (Bt). The use of dormant sprays is being questioned because organophosphate (OP) insecticides are being found in local rivers. These contaminants probably originate from dormant OP applications to orchards.

Dormant sprays of oil plus insecticide are also applied to almonds for control of San Jose scale (SJS) *Quadraspidiotus perniciosus*. There is a possibility that dormant sprays could adversely impact beneficial arthropods, resulting in increased problems with San Jose scale and web-spinning summer mites. This experiment was designed to test the control of PTB and San Jose scale with several dormant sprays and to monitor the scale parasitoid, *Encarsia perniciosi.* Web spinning mites were also monitored.

Procedures:

A young, bearing almond orchard with Nonpareil, Carmel and Sonora varieties owned by Arakelian Farms in Livingston, CA was chosen to test dormant pesticide applications. Success® (derived from *Saccharopolyspora spinosa*), diazinon and Asana® each combined with oil were compared to oil-only and untreated check in dormant treatments. Treatments were applied on January 21 and 22, 1999 with one 500-gallon tank applied to 3 replications of 13 rows X 12 trees = 468 trees. A PTO-driven Aerofan was pulled by Heston hydrostatic 80-66 at 2.4 mph. Spacing is 21' X 18' = 101 trees/ac. The application rate was 108 gpa.

The following treatments were applied:
1) **diazinon** 4EC @ 2 qt/ac + supreme oil @ 5 GPA + 8 lbs. Kocide 101
2) **Success®** 2SC @ 6 oz/ac + supreme oil @ 5 GPA + 8 lbs. Kocide 101
3) **Asana®** XL @ 10 oz/ac + supreme oil @ 5 GPA + 8 lbs. Kocide 101
4) **Oil only** check @ 5 GPA + 8 lbs. Kocide 101
5) **Untreated** Control

Two PTB pheromone traps, 2 NOW bait traps and 2 San Jose scale pheromone traps were placed in each treatment replication on March 4, 1999 which provided six traps per insect per treatment. Traps were monitored weekly and counts recorded through September. Two-spotted mite *Tetranichus urticae*, the European red mite *Panonychus ulmi* and the Western orchard predator mite *Metaseiulus occidentalis* were also monitored weekly.

Samples of nuts were taken from the windrows at harvest, cracked and evaluated to determine the reject levels for NOW, PTB, ants and other causes.

Results:

In 1998 all insecticide treatments reduced PTB catches in pheromone traps by nearly 2/3 in the first flight, but did not affect the second flight catches. In 1999 the Asana treatment reduced the first flight catches by approximately ½ of the average catches for the other treatments. This reduction was only seen in the 1A flight of PTB. See **Figure 1**. The first flight of PTB began April 22nd and ended about June 26th. The much smaller second flight was seen in July. PTB damage in 'Nonpareil' nut samples collected from harvest windrows was 0.2% in the untreated check, 0% in the oil-only treatment, 0.07% for diazinon, 0.87% for Success®, and 0.53% for Asana®. PTB reject levels were very low in 1999 regardless of treatment. NOW and ant damage was also very low for all treatments. See **Figure 2.** There were no statistically significant damage levels with PTB, NOW or ants from any of the dormant spray applications.

All insecticide treatments reduced San Jose scale male counts in pheromone traps by 80% or more in the 1st flight in April, and had no apparent effect on the very small August-September flight. See **Figure 3**. However, San Jose scale has not become a problem even in the unsprayed check.

Trap counts of *Encarsia perniciosi* were very sharply reduced by the Asana® spray in April and May and few *Encarsia* were trapped from mid-May to September. See **Figure 4**. Season-long total catches of SJS males are compared with *Encarsia* catches in **Figure 5**. Note the sharp reduction in total numbers of *Encarsia* in the Asana® treatment.

Navel orangeworm eggs were almost nonexistent on the NOW bait traps, and we found only 0.1% to 0.5 % kernel damage in the samples with the highest level of damage occurring in the untreated check.

Two-spotted mite rapidly increased to high levels in July regardless of dormant treatment. Western orchard predator mites were present, but they could not bring the web-spinning mites under control quickly enough to avoid economic damage. The orchard was sprayed with 1.5 pt Omite 6E per acre on 7/30 to prevent damage, and no differences were seen between treatments. Spider mite numbers were very similar across all treatments before the orchard was sprayed.

Conclusions:

Dormant treatment of Asana reduced PTB catches in the pheromone traps in the first flight, as it did in 1998. This trap response was of interest, since pheromone traps are usually not a good tool by which to estimate population size. Dormant spray effects did not modify the second flight catches. Although the reduction in flight 1A occurred with Asana applications in both 1998 and 1999, the reduction on May 11, 1999 trap counts was not statistically significant. PTB damage in the harvest samples from windrowed 'Nonpareil' nuts was low at less than 1% in all treatments. Navel orangeworm and ants were minor pests in this orchard in 1999 as shown in Figure 2. A statistical analysis of the number of damaged nuts at harvest by dormant treatment showed no statistical difference between treatments for PTB, NOW or ants.

All insecticide treatments reduced SJS male catches by about 80% in the 1st flight, but had no apparent effect on the August flight. *Encarsia* seems to be controlling the San Jose scale in the unsprayed Check. Trap counts of the SJS parasitoid *Encarsia perniciosi* were reduced by the Asana® spray throughout the trapping period from March to September in 1998 and in the April period of 1999. This indicates a potential problem with disruption of biological control of SJS. Growers and PCAs should carefully consider this possible problem when choosing a pesticide for dormant application, and carefully monitor scale populations. Success® and diazinon showed almost identical, moderate reductions of *Encarsia perniciosi* as compared to the catches in the unsprayed Check in 1998, but no distinct differences were apparent in 1999.

The dormant sprays did not seem to be an influencing factor with the web spinning mite populations. Two-spotted mites reach high levels in late July in all treatments, and were sprayed with Omite®.

Figure 1. ARAKELIAN FARMS TEST BLOCK PTB COUNTS 1999

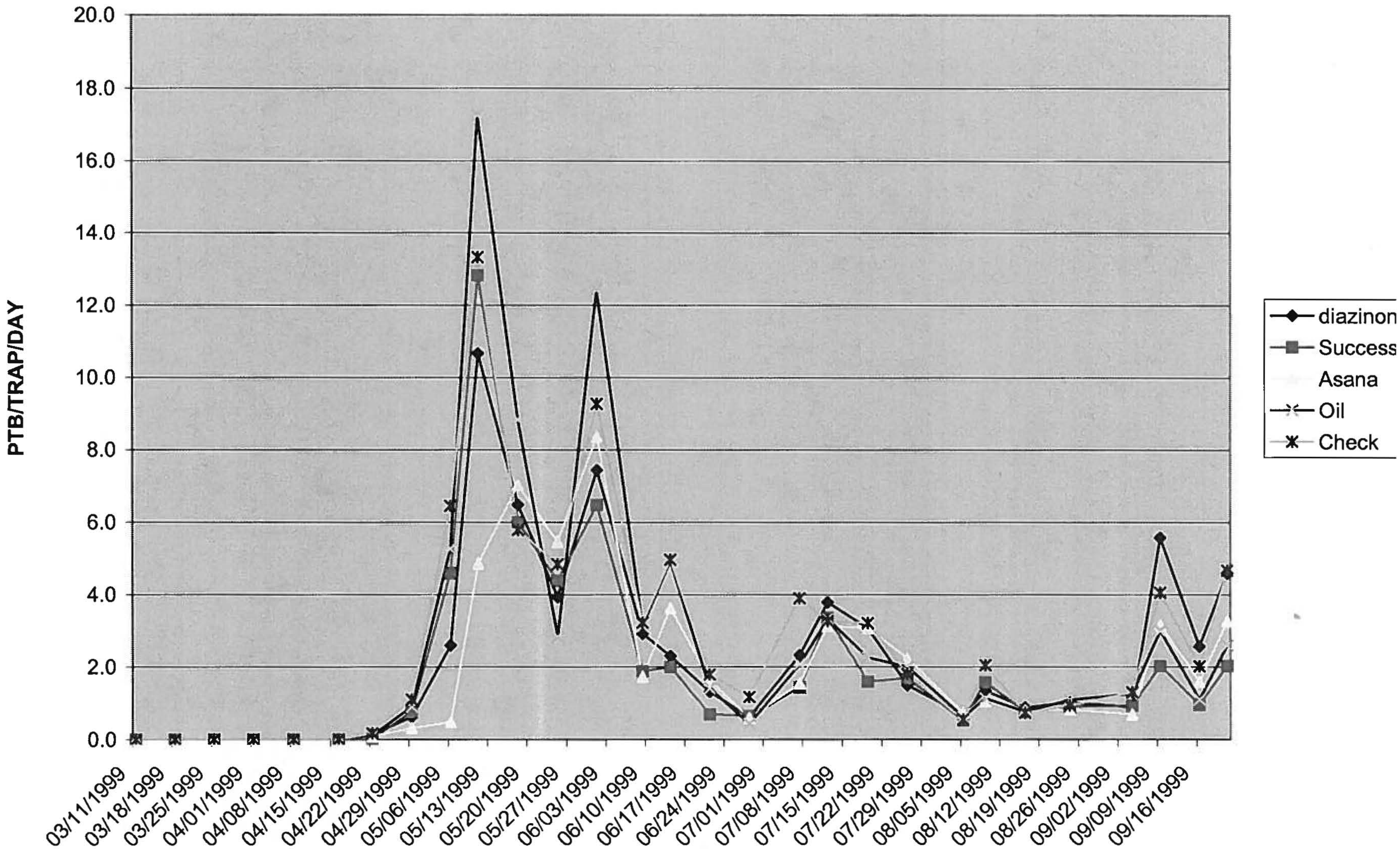


Figure 2. HARVEST REJECT PERCENTAGES - 1999

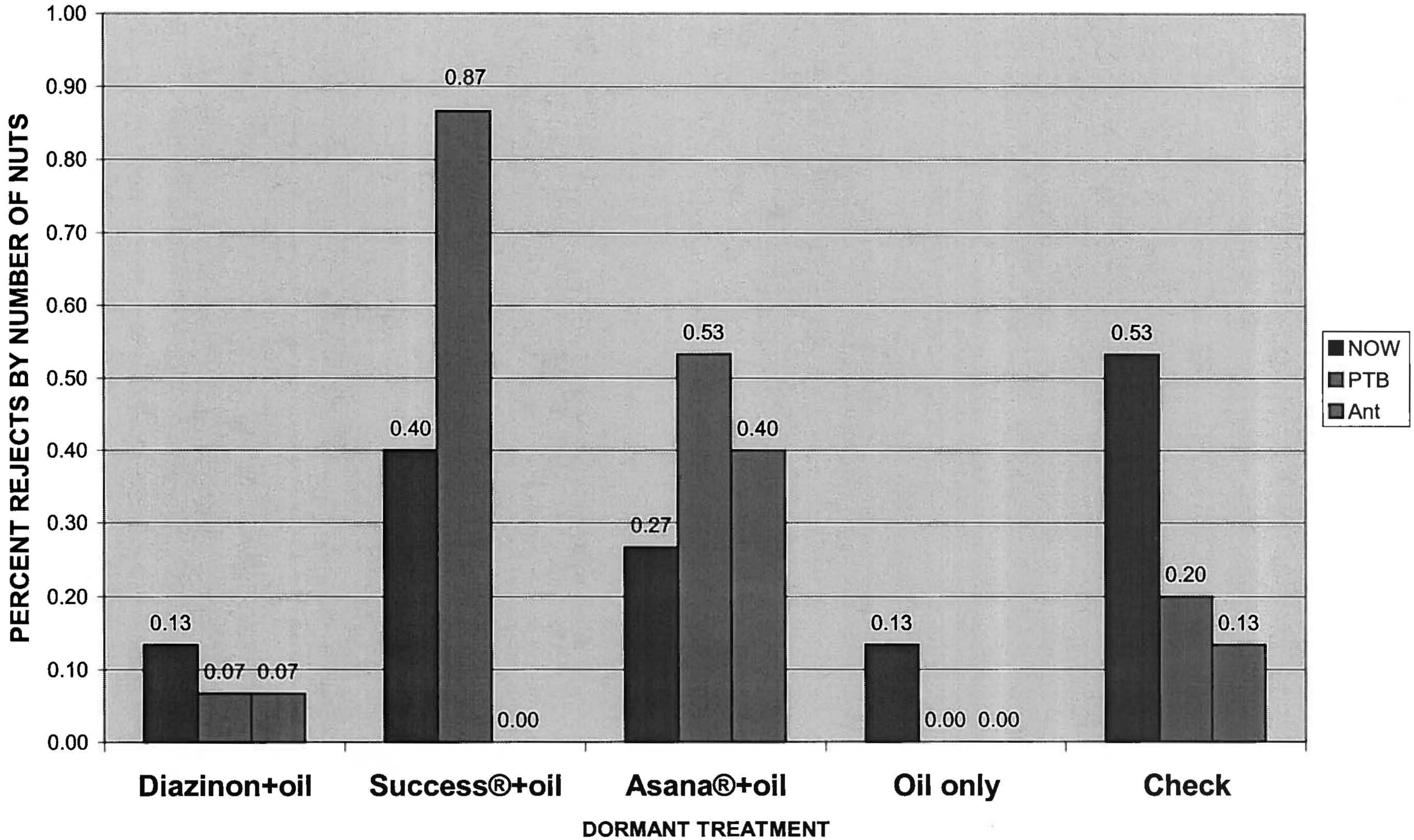


Figure 3. SAN JOSE SCALE DORMANT SPRAYS 1999

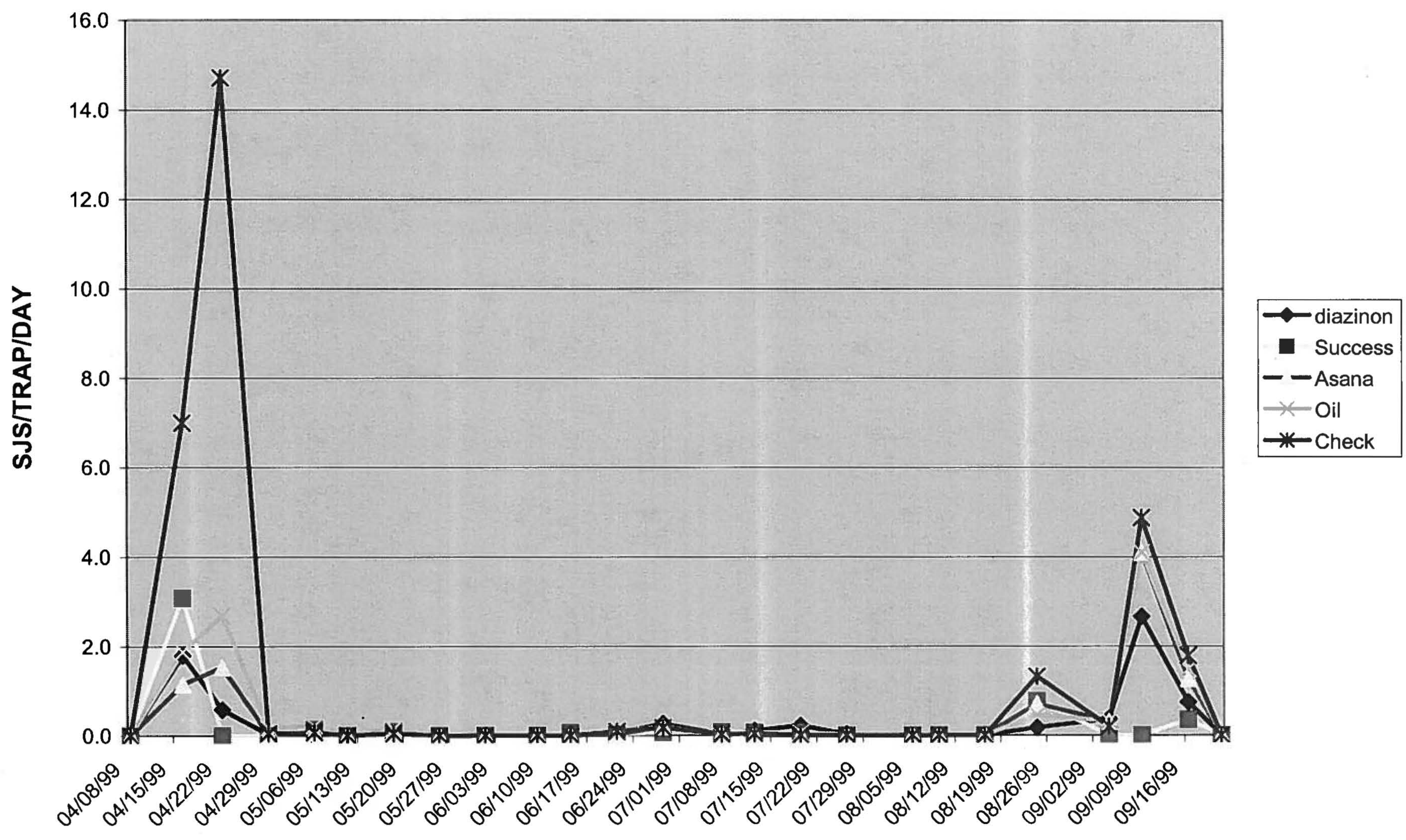


Figure 4. DORMANT SPRAY EFFECTS TO ENCARSIA 1999

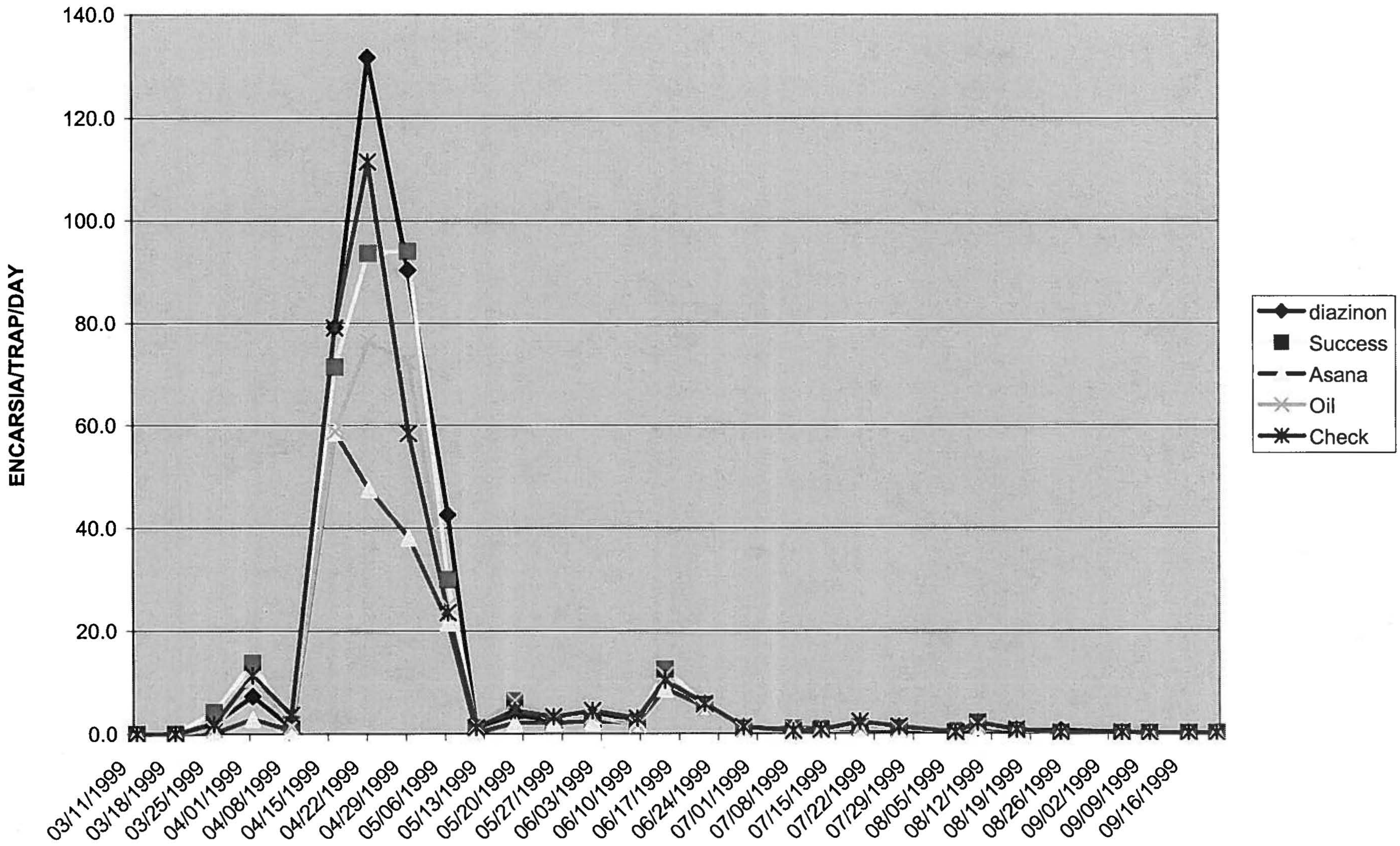
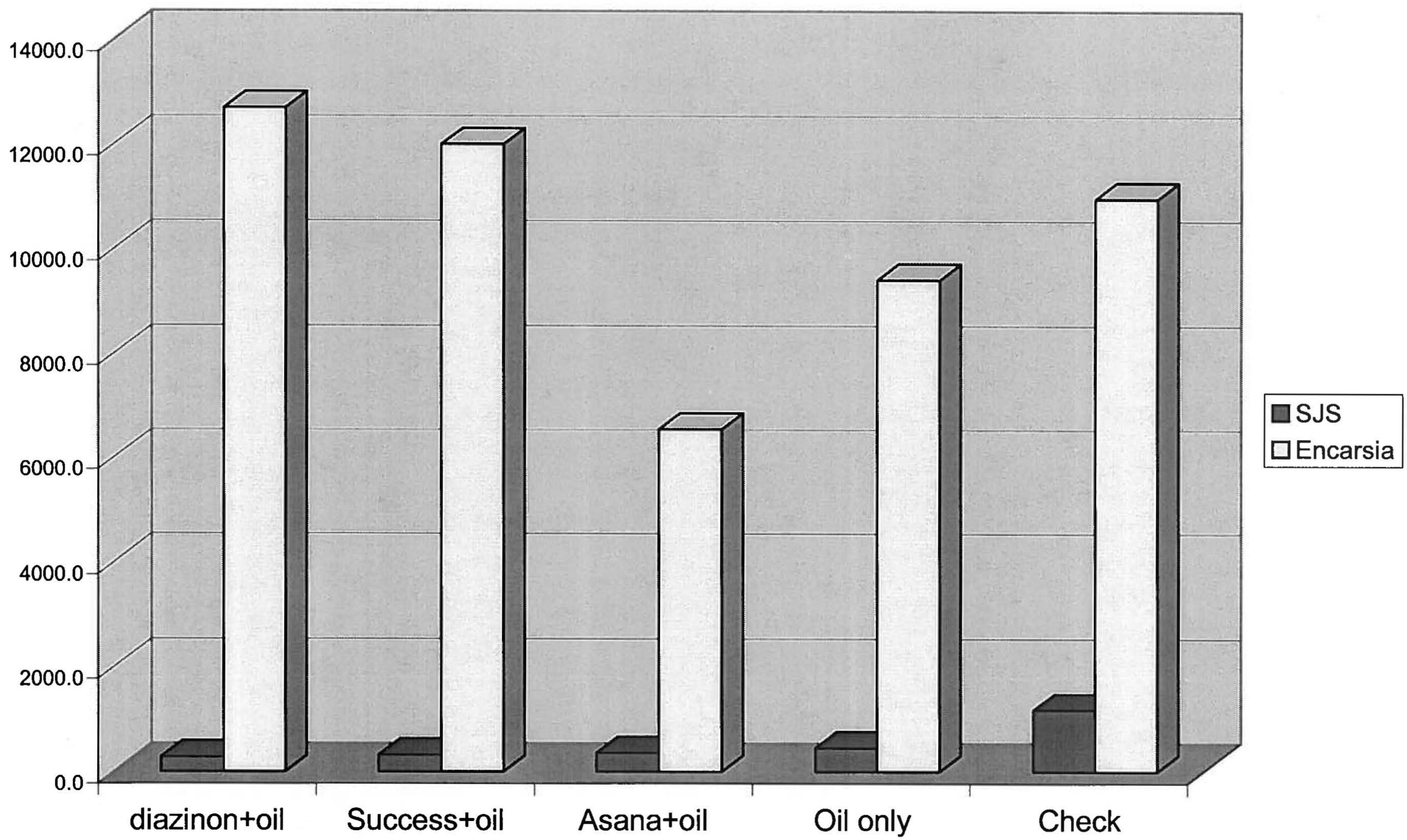


Figure 5. TOTAL SJS AND ENCARSIA 1999



6. CONTROLLING ALTERNATE BEARING WITH FOLIARLY APPLIED GIBERELLIC ACID IN ALMONDS -- Bill Krueger, U.C. Farm Advisor in Glenn County

Rationale:

Certain almond cultivars such as "Price" can be extremely alternate bearing resulting in a very light crop the "off" year and reduced pollinizer value during that year due to limited bloom. Giberellic Acid (GA) has recently been registered on certain stone fruits such as prune and peach for foliar application to control alternate bearing. In this case, GA is applied during the summer of the "off" year prior to bud differentiation for the purpose of reducing flowering and, therefore, cropping during the coming "on" year.

Objective:

Evaluate the use of foliarly applied giberellic acid for the control of alternate bearing in almond cultivars prone to the condition.

Materials and Methods:

During 1998 GA was applied to mature almond trees of the Price cultivar which were in an extreme alternate bearing condition. Two timings (July 3, and Aug.3) and three rates (25, 50, and 100 grams a. i/ac.) were a applied in randomized complete block design to 5 single tree replicates using a handgun at 100 gpa.

During the 1999 bloom, 4 - 1ft. flowering shoots per tree were counted to determine treatment effect on bloom. Because no bloom differences were seen between treatments, yield data was not collected.

During 1999 it was difficult to find trees of the Price cultivar which were in the "off" year of the alternate bearing cycle. Sonora is newer cultivar which has shown tendencies toward alternate bearing. A 5^{th} leaf orchard with Sonora pollinizers which had experienced complete crop loss due to late season frost and would be expected to have a heavy bloom in 2000 was selected. Treatments were started 6/15 and applied at 3 separate timings at 3 week intervals. The single rate of 48 g a.i./ac. (the high label rate on prunes and peaches) was used and it was applied to 5 single tree replicates in a randomized complete block design using 200 gpa (at the recommendation of the chemical supplier). Bloom data and yield data (if differences are apparent in the bloom data) will be collected in 2000.

Results and Discussion:

Yield collected during 1998 averaged 1.9 meat lbs. per tree with no significant differences between treatments (Table 1). Bloom counts during 1999 showed no differences between treatments despite the fact that the highest rate (100 grams a. i.) is approximately 2 times the high label rate for prunes and peaches. Therefore, yield data was not collected in 1999.

Because it was felt that the 1998 treatments may have been unsuccessful because they were too late (after flower bud differentiation). The first treatment in 1999 was applied approximately 2 weeks earlier than in 1998.

Using the results from the 2000 bloom data as a guide for treatment selection, GA will be applied to Price cultivar trees which are in the "off" year of the alternate bearing cycle and they will be evaluated for return bloom and yield in 2001.

Table 1. Yield and Bloom Results from Almond GA Trial

Treatment Rate/Timing	Meat Yield 1998 Lbs/Acre	# Flowers/cm 1998
Control	143	2.3
25 grams ai July 3	142	1.8
50 grams ai July 3	191	2.1
100 grams ai July 3	149	1.8
25 grams ai Aug 6	243	1.7
50 grams ai Aug 6	150	2.2
100 grams ai Aug 6	142	1.9
	NS	NS

NS = No significant differences using Fisher's LSD method.

7. INTERACTIVE EFFECTS BETWEEN VARIETY, ROOTSTOCK, TREE SPACING AND PRUNING PRACTICES IN COMMERCIAL ALMOND ORCHARDS -- Roger Duncan, U.C. Farm Advisor in Stanislaus County

February, 2000
Status: first year of a multiple year study

Objective: Evaluate interactive effects between almond varieties, rootstocks, tree spacing, and pruning practices on tree size, early and long-term yield, pest dynamics, and economics.

In general, most UC field trials testing almond varieties, rootstock performance, and various pruning strategies have examined each parameter by itself. However, little has been done to study the interactions of variety, rootstock, spacing and pruning. Tree size, shape and bearing habit as well as soil/site conditions may influence suitability to a particular planting arrangement and pruning style.

In most almond orchards throughout the state, trees are pruned each year to maintain vigor and reduce shading of lower fruiting wood. A field trial currently in its twenty-second year conducted by UC Farm Advisor John Edstrom has suggested minimal or unpruned almond trees may produce as well as trees pruned "conventionally" each year without the added pruning and brush disposal costs.

A recent trend in almond planting indicates a move towards higher density to increase yields early in the life of the orchards. In years past, trees planted at 24' x 24' was the standard. Now growers commonly plant at in-row spacings down to 16 feet between trees. However, many growers end up pruning these closely planted trees heavily each year as the orchard matures to maintain productive lower limbs. Currently conducted trials in the Sacramento Valley indicate that closely planted trees can remain productive even with extensive shading. Studies also show that removal of "temporary" trees in a hedgerow system results in short-term and long-term yield reduction. This may indicate that heavy pruning in high-density orchards could be unnecessary or even counter productive. In addition, varieties such as Nonpareil, Carmel, and Aldrich have very different growth characteristics and may respond differently under various spacing and pruning regimes.

In a Merced County trial conducted by Farm Advisor Lonnie Hendricks, peach-almond hybrid rootstocks were the most productive for Nonpareil and Carmel varieties. These hybrids are vigorous and result in large trees. In theory, these larger trees will lose productivity more quickly on the lower fruiting wood and should require more extensive annual pruning in a high-density orchard.

In September 1999, an 18.5-acre trial was planted in cooperation with Duarte nursery in Stanislaus County. The sight was originally a class 2 soil with a shallow cemented hardpan prior to modification with a six-foot slip plow. With extensive soil modification and a micro-irrigation system, this orchard on virgin soil should be moderately vigorous. The trial includes three varieties (Nonpareil, Carmel, and Aldrich), three rootstocks (nemaguard, lovell, and Hansen), four tree spacings (22' x 22', 18' x 22', 14' x 22', and 10' x 22'), and four pruning strategies (1) trained to three scaffolds and conventionally pruned every year; 2) trained to three scaffolds the first year and unpruned for the life of the orchard; 3) three scaffolds with shoots tipped 2-3 times per season for the first two years and mechanically topped after that; and 4) no scaffold selection and unpruned throughout the life of the orchard).

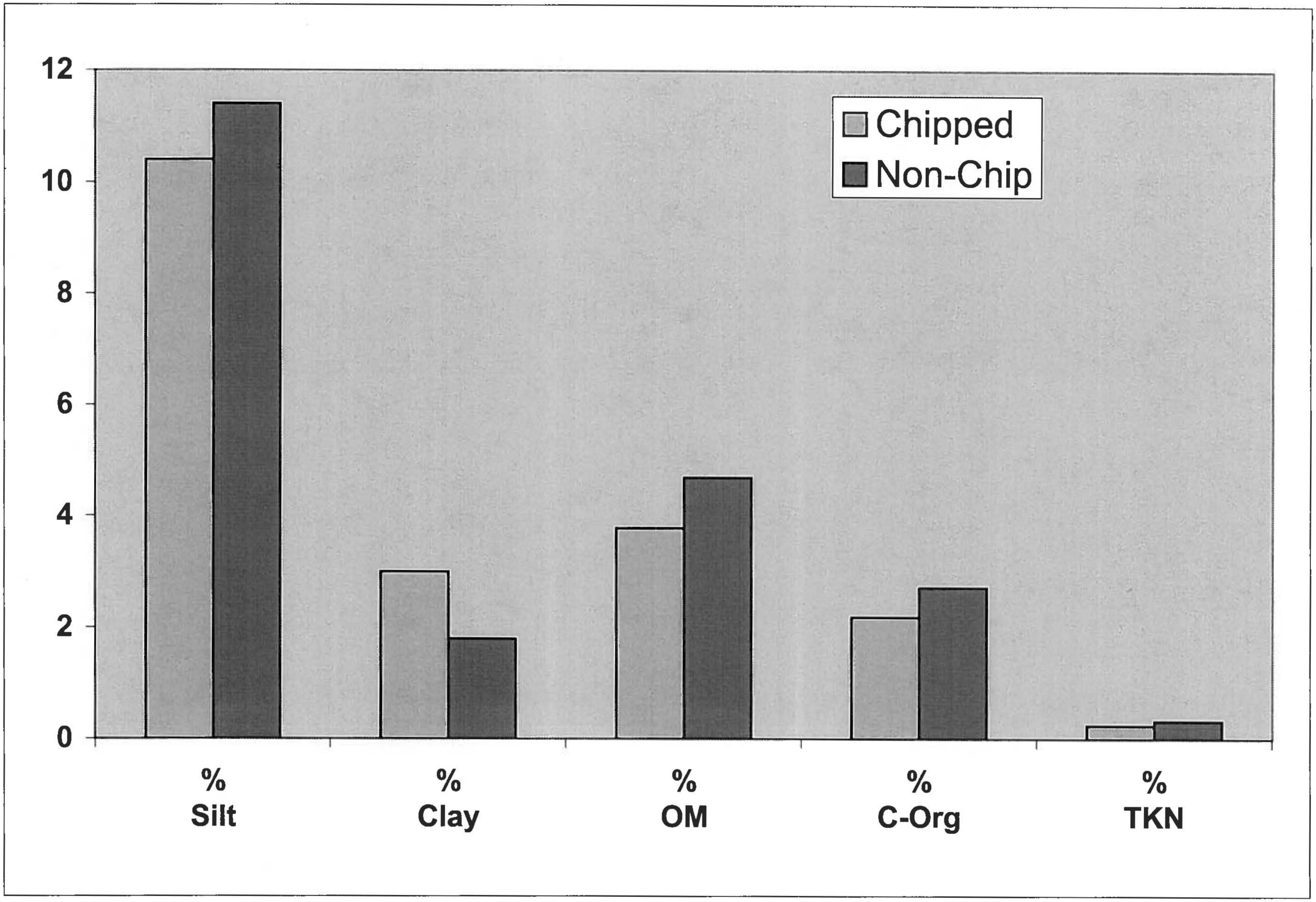
The potted trees were planted in the fall of 1999, topped at approximately 32 inches and allowed to go dormant in the field. In February 2000, side shoots were pruned back to one bud to resemble standard dormant-planted trees. Scaffold selection will occur in January/February 2001. The first collection of yield data is expected to occur in 2002. Tree growth, yield, pest dynamics, and economic data will be collected throughout the life of the orchard.

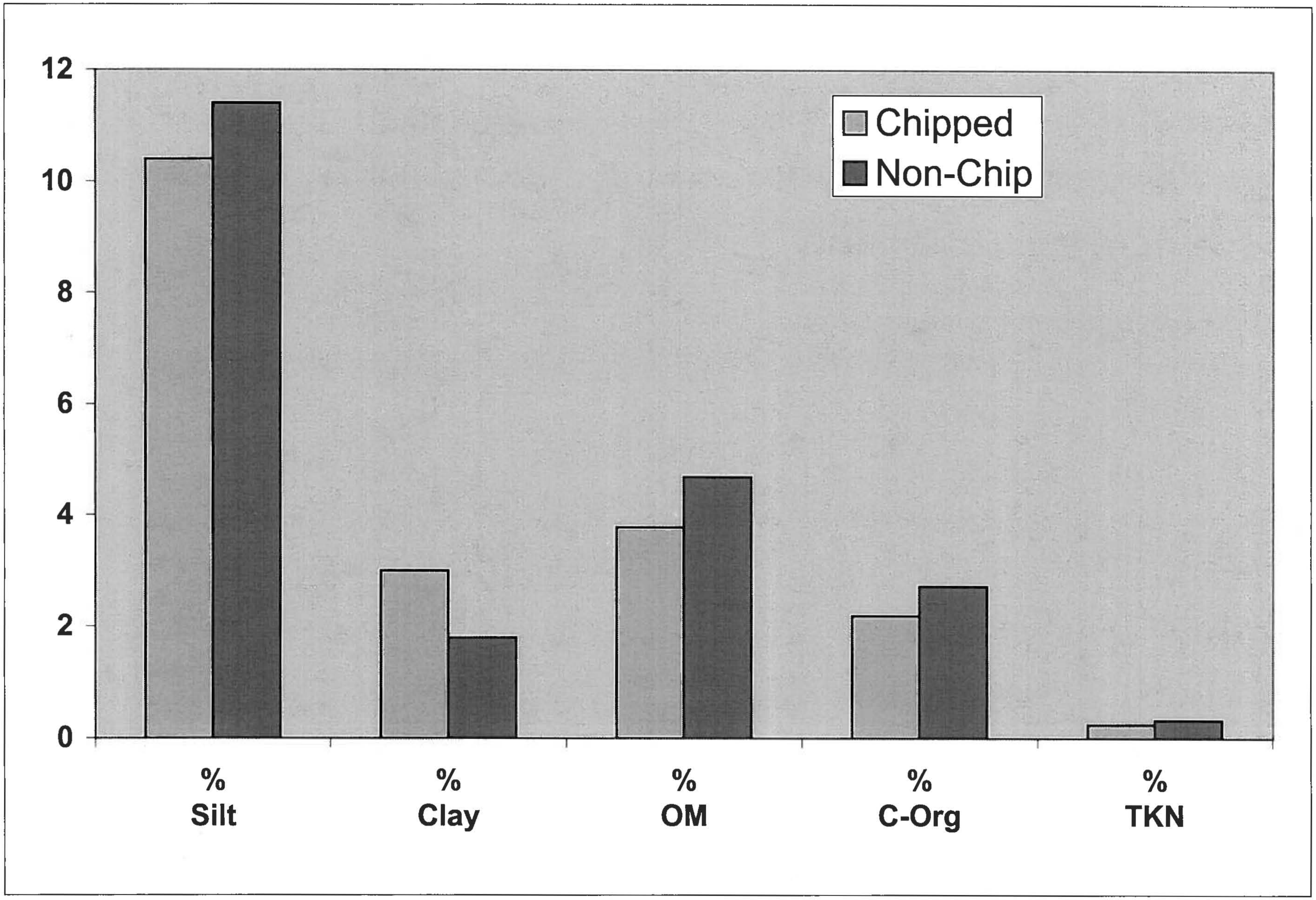
8. IS SUPPLEMENTAL POLLEN BENEFICIAL TO ALMOND PRODUCTION? -- Mark Freeman, U.C. Farm Advisor in Fresno County

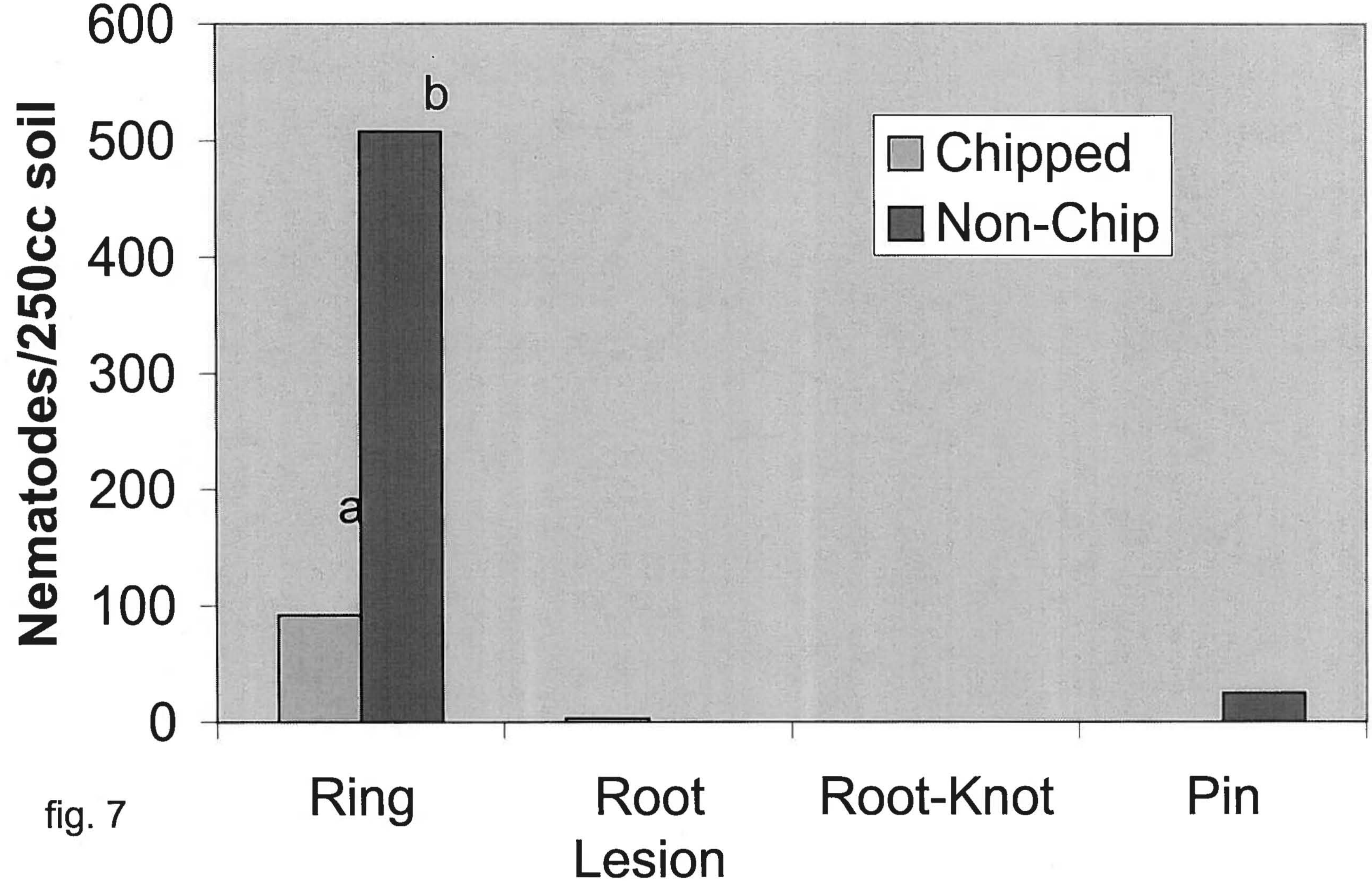
Research was not done in 1999 as all potential cooperators declined to apply supplemental pollen due to the good weather during bloom. So, the 1998 results (not previously reported) are listed in this report.

During almond bloom in 1998, the effect of applying supplemental almond pollen to increase nut set was compared to bee pollination and hand pollination. Eight replications of 100 flowers on a tree branch were used for each of the three treatments. Pollen was applied three times to "Ruby" almond trees during the bloom period by ground application before bee flight in the morning and those flowers were then covered to prevent bee pollination. Hand pollination was also done three times in the morning using the supplemental pollen source and then flowers were covered. Flowers for the bee pollination were left uncovered except for the time of supplemental pollen application.

The hand pollination treatment showed significantly higher nut set at 59.1 percent set, followed by bee pollination at 49.3 percent set. The supplemental pollen treatment was significantly lower at 3.2 percent set. The high percent set by the hand pollination showed that the pollen was viable. The extremely low percent set by supplemental pollen raises questions about the economics of using it for increasing fruit set.


12
10
8
6
4
2
0
Chipped
Non-Chip
% Silt
% Clay
% OM
% C-Org
% TKN


12
10
8
6
4
2
0
Chipped
Non-Chip
% Silt
% Clay
% OM
% C-Org
% TKN



Nematodes/250cc soil
600
500
400
300
200
100
0
a
b
Chipped
Non-Chip
Ring
Root Lesion
Root-Knot
Pin

fig. 7

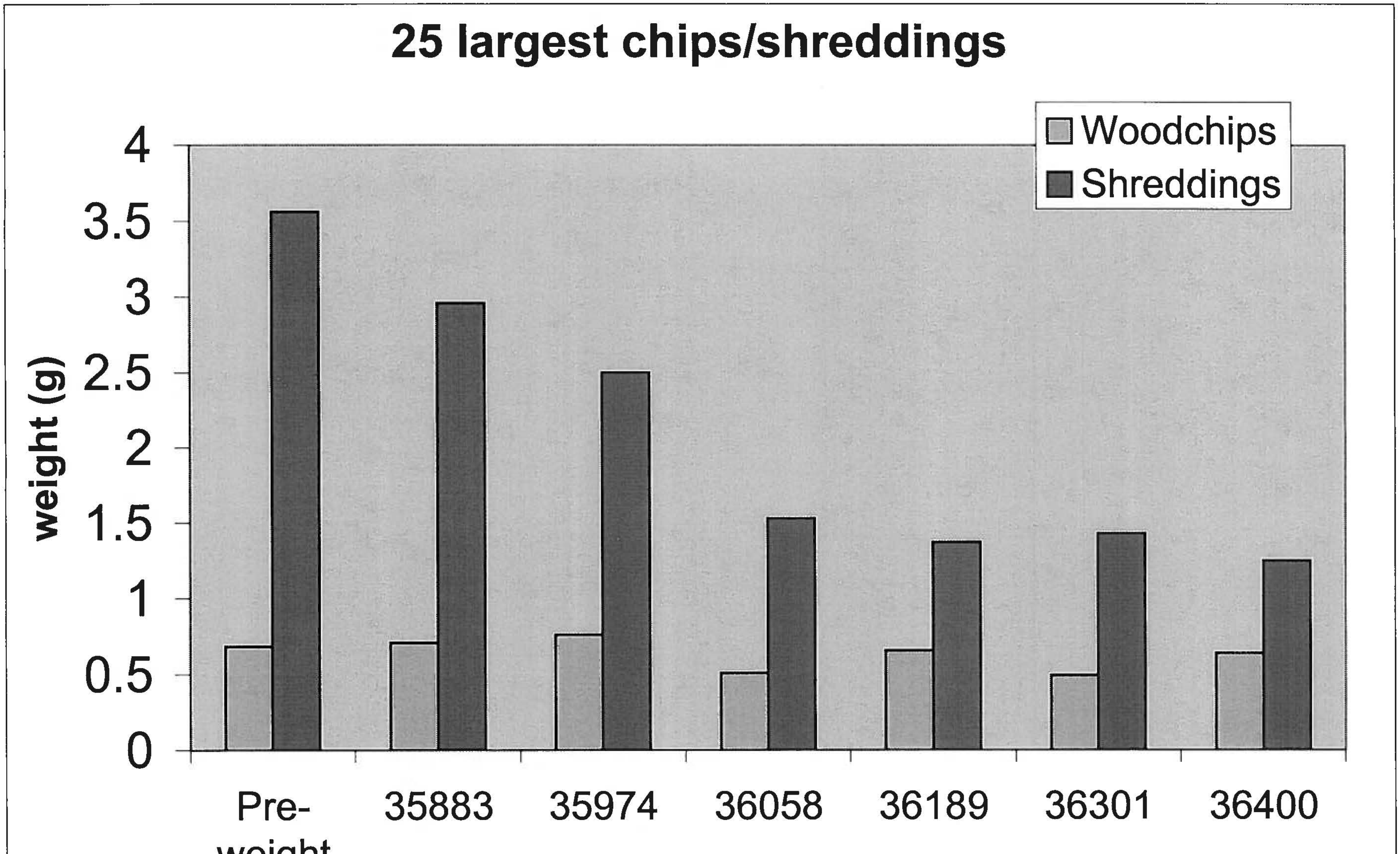

25 largest chips/shreddings
Woodchips
Shreddings
weight (g)
4
3.5
3
2.5
2
1.5
1
0.5
0
Pre-weight
35883
35974
36058
36189
36301
36400

fig. 2

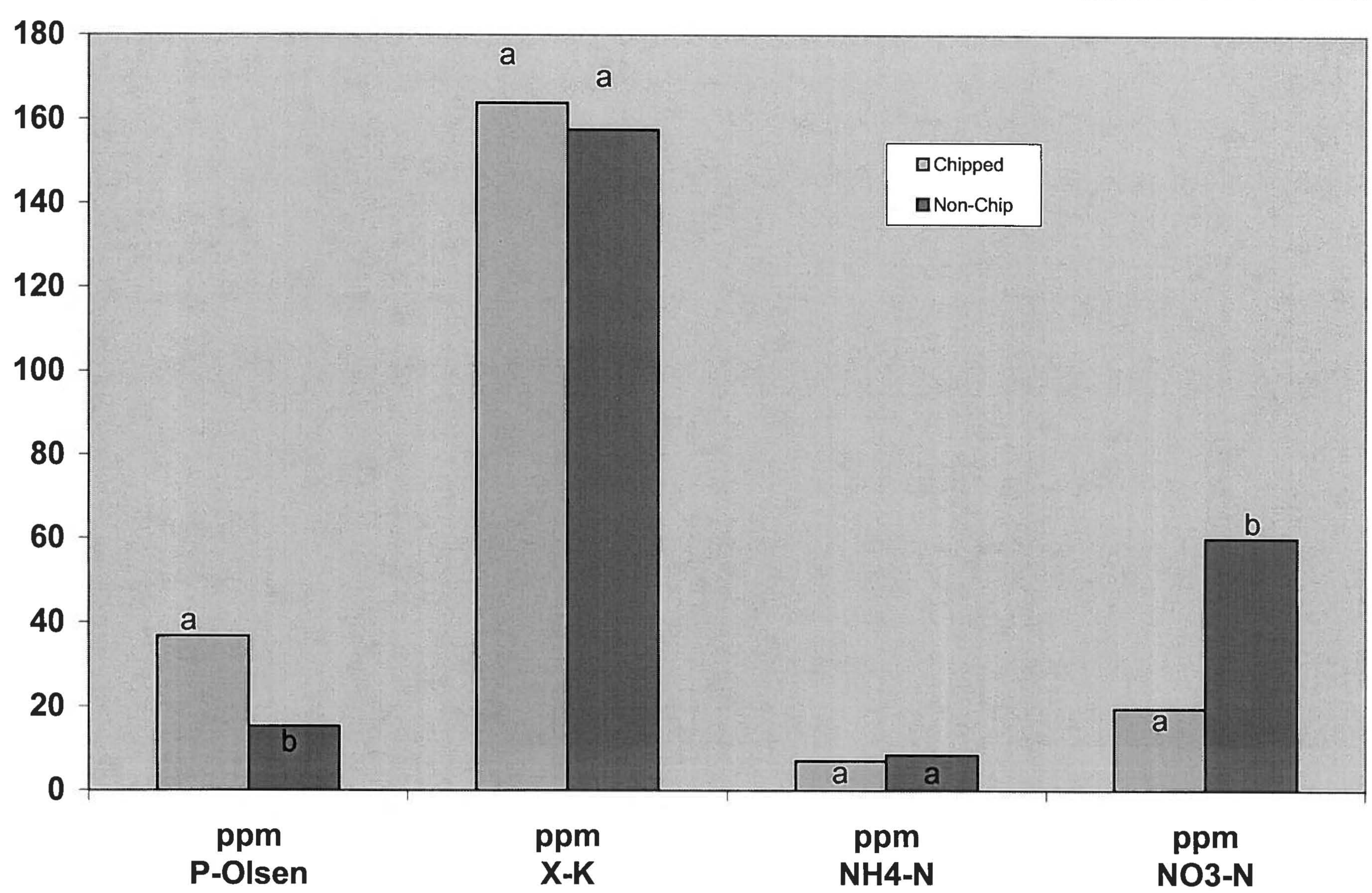

180
160
140
120
100
80
60
40
20
0
Chipped
Non-Chip
a
b
a
a
a
a
a
b
ppm
P-Olsen
ppm
X-K
ppm
NH4-N
ppm
NO3-N

fig. 5

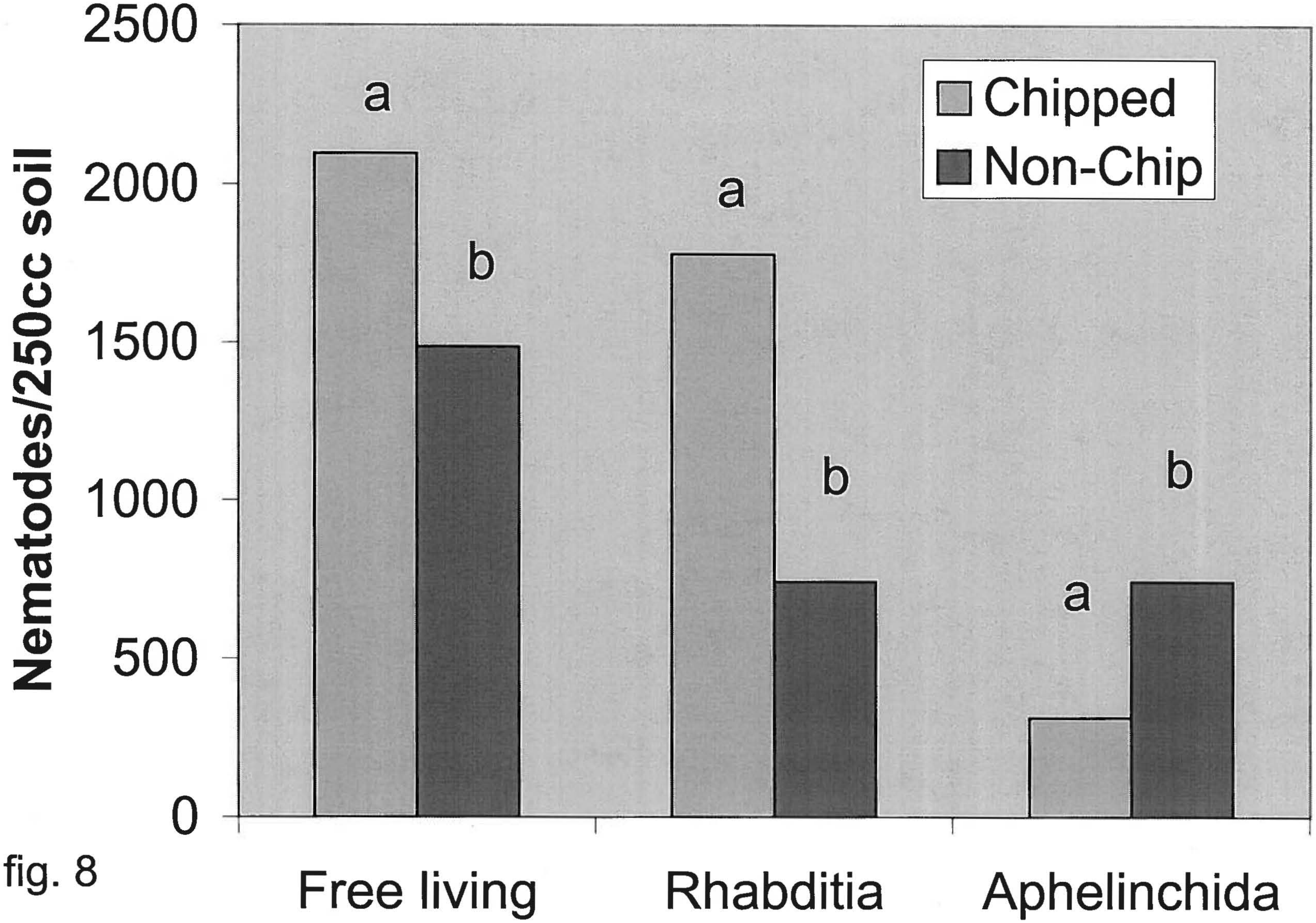
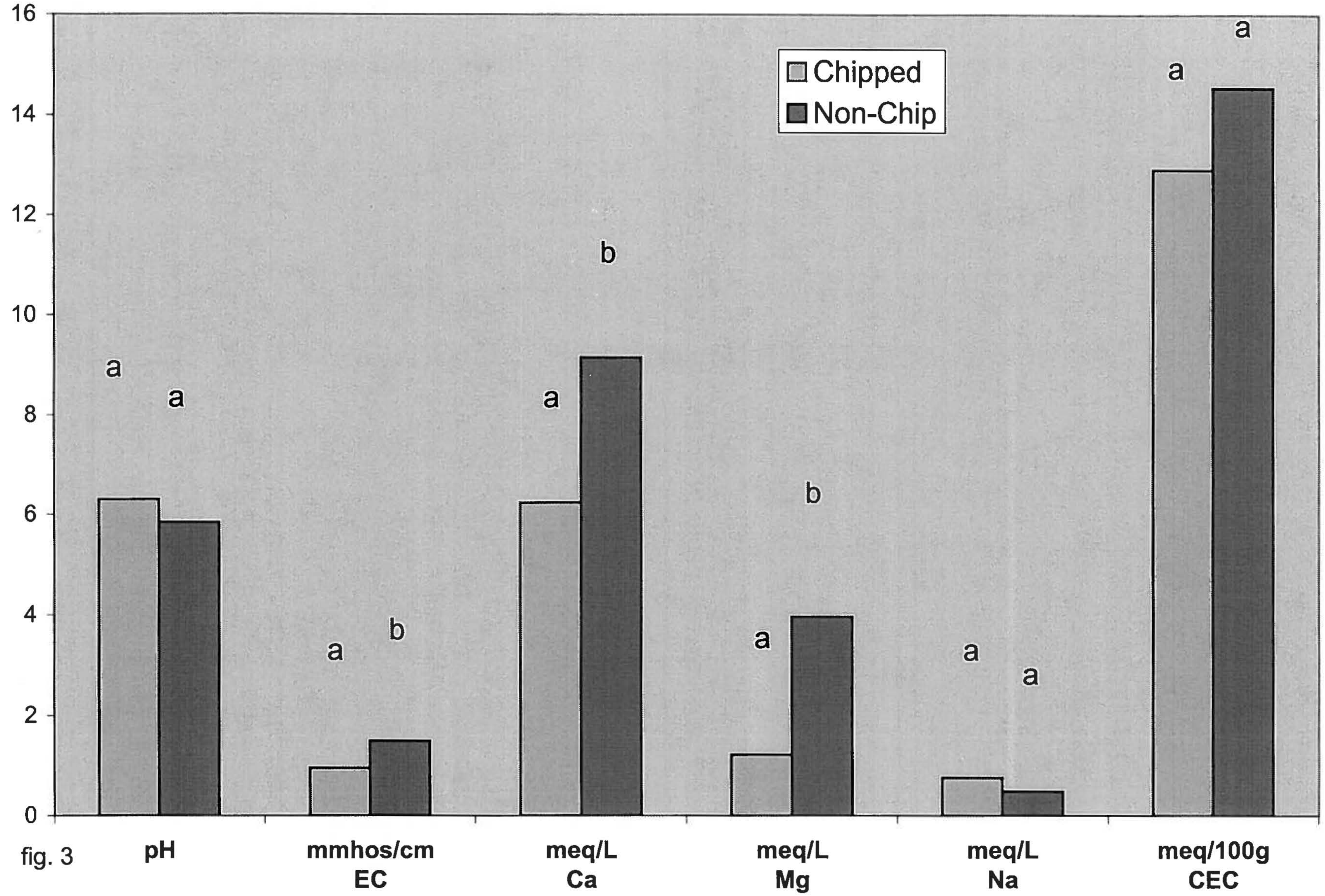
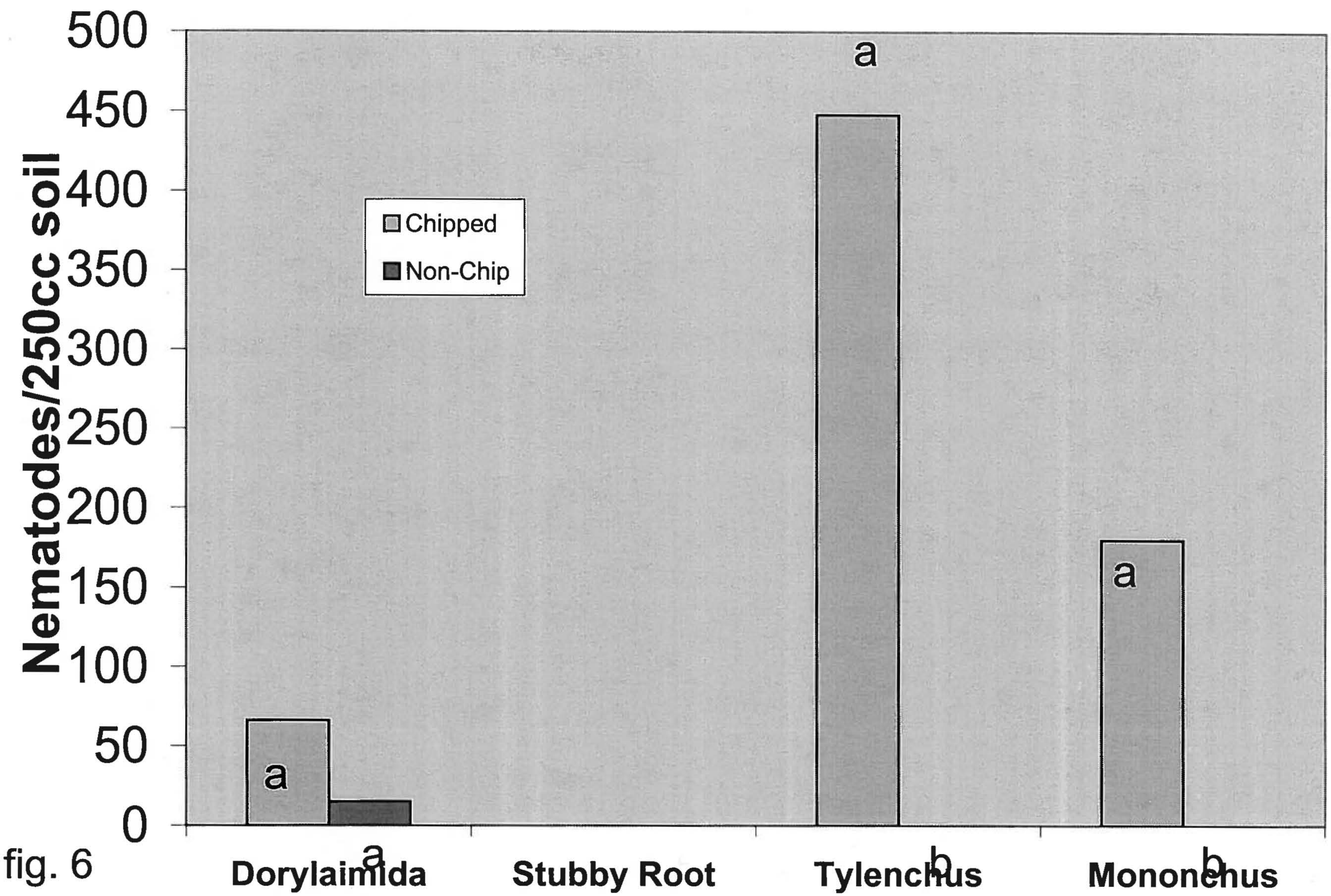

Nematodes/250cc soil
2500
2000
1500
1000
500
0
Chipped
Non-Chip
a
b
a
b
a
b
Free living
Rhabditia
Aphelinchida

fig. 8



16
14
12
10
8
6
4
2
0
Chipped
Non-Chip
a
a
a
b
a
b
a
b
a
a
a
a
pH
mmhos/cm
EC
meq/L
Ca
meq/L
Mg
meq/L
Na
meq/100g
CEC

fig. 3



500
450
400
350
300
250
200
150
100
50
0
Nematodes/250cc soil
Chipped
Non-Chip
a
a
a
a
b
b
Dorylaimida
Stubby Root
Tylenchus
Mononchus

fig. 6