ALMOND BOARD OF CALIFORNIA 1994 ANNUAL REPORT ABSTRACT

DATE: DECEMBER 22, 1994

PROJECT TITLE: SOIL-BUILDING WITH COVER CROPS IN CALIFORNIA ALMOND ORCHARDS

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Abstract. A covercrop trial comparing ten covercrop mixes replicated twice, was planted in fall 1992. Comparisons were also made in 5 orchards with established covercrops. Organic matter (OM) was moderate for all planted species. The two highest OM levels are in the Beneficial Blend and the Insectary Mix. In the Arnold orchard, established resident vegetation had the highest OM level. OM levels were very high in 1993 and 1994 in the established orchards. Ladybird beetles were abundant in the established vetch+clover covercrops and in the Beneficial blend, Insectary mix, vetch and clovers. Numbers were low in the resident vegetation, Blando brome, Zorro fesque, and in the sparce bur medic. Parasitic wasps numbers were highly variable. Earthworms were found in high numbers in the established covers, a few in the Takhar orchard, and none in the Arnold Farms. NOW survival was very low in all of the heavily cover cropped, non sprayed orchards.

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PROJECT TITLE: **SOIL-BUILDING WITH COVER CROPS IN CALIFORNIA ALMOND ORCHARDS**

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METHODS AND ACTIVITIES:

A cover crop trial comparing ten cover crop mixes was planted November 9, 1992 at the Arnold Family orchard on Cressey Way, Atwater. Each plot is 2 middles wide by 14 trees long, replicated twice, with the Nonpareil row in the center. Comparisons are also being made in 5 orchards with established covercrops.

The following covercrops are being compared at Arnold's:

Annual grasses: Blando brome, Zorro fesque

Annual legumes: Cahaba white vetch, sub clover mix, Rose clover, non-til clover, bur medic, annual clover mix

Mixed species: resident vegetation, Beneficial Blend, Insectary Mix

Measurements have been made for organic matter (OM) monthly in spring and summer. Leaf samples for nutrient analysis were collected in mid-June from the Nonpareil row in each cover crop plot and from each orchard. The cover crop and trees were surveyed periodically for insect, mite and spider activity. Both PTB and NOW traps were maintained to monitor these pests. Covercrop height was measured periodically, and mowings were recorded for each cover.

Tours were held April 21, 27, and May 5, 1993, and April 15, 1994 for growers, researchers, and farm advisors.

RESULTS AND DISCUSSION:

Samples show moderate OM levels for all cover crop species in the newly planted cover crop trial. See Table 1. The two highest OM levels are in the Beneficial Blend and the Insectary Mix. Both of these have a wide variety of plant species which grow over a long time period. The resident vegetation which has been established several years, shows the highest OM level in the Arnold orchard. The lowest OM levels are in the annual grass plots; Blando brome and Zorro fesque. In the five established orchards, the OM levels are very high for sandy soils in the Central Valley. The top OM averages are in the long-established vetch covers in the Ray Eck and Glenn Anderson orchards and in the resident vegetation in the Ron Anderson orchard. The young vetch and

clover cover in the Lashbrook orchard and the new BIOS "rich mix" cover in the Takhar orchard have intermediate OM levels.

Leaf samples for nutrient analysis are collected in mid-June from the Nonpareil row in each cover crop plot and from each orchard. These samples show normal levels in all orchards. Ron Anderson continues to have a borderline high 0.38% chloride. Glenn Anderson's N has increased from 1.9% N in 1993 to 2.4% in 1994. Zinc is still somewhat low at 17 ppm. Cindy Lashbrook has reduced the high sodium and chloride of 0.4% in 1993 to 0.3% each in 1994. It is interesting that the certified organic orchards of Eck and Lashbrook have very high N levels, and very good K and Zn levels as well.

The cover crop and trees were surveyed periodically for insect, mite and spider activity. See Table 2. The numbers of ladybird beetles were high in the established vetch/clover and tall resident vegetation cover crops during April and May. Ladybird beetle levels were very high in the Takhar orchard in 1994. This orchard had the BIOS "rich mix" this year. In the Arnold test planting there were high Ladybird beetle numbers in the Beneficial Blend, Insectary mix, vetch and clovers. Numbers were low in the resident vegetation, Blando brome, Zorro fesque, and in the bur medic. These results are very similar to 1993. The ladybird beetle numbers were lower in the Rose clover in 1994 than in 1993.

The numbers of beneficial, parasitic wasps are highly variable, but appear to be in lower numbers in the resident vegetation and higher in the planted covers.

Table 3 lists the numbers of earthworms per counting ring in both 1993 and 1994. High earthworm numbers indicate good soil health and viability. The highest numbers of earthworms were the Glenn and Ron Anderson orchards and in the Eck orchard. Moderate numbers were found in the Lashbrook orchard and they increased later in the summer (personal communication). Few earthworms have been found in the Takhar orchard. No earthworms have been found in the Arnold Farms. This orchard was "seeded" with earthworms from the Ray Eck orchard in mid-April.

There were very few mites in the Arnold block. The Eck and Lashbrook orchards had few 2-spotted mites and very high levels of the predator mite, *M. occidentalis*. Both Anderson orchards had a brief surge of 2-spotted mites in the heat of August 1994, but the high levels of *M. occidentalis* quickly brought these under control. Measurement over the past seven years consistently show that 2-spotted spider mites are very seldom an economic problem in heavily cover cropped, unsprayed almond orchards. The Western orchard predator mite, *M. occidentalis* can very effectively hold the 2-spotted mite to less than economic injury levels.

During the 1993 and 1994 growing seasons no insecticides were applied to the five innovative orchards, except for the Toki Takhar orchard. In the Takhar orchard a dormant spray of diazinon plus oil and copper, and a hullsplit spray of Lorsban were used.

Traps were maintained to monitor PTB and NOW. PTB catches were high in both 1993 and 1994. In 1993 damage was high statewide, but in 1994, rejects are low. High reject levels from PTB damage do not necessarily follow high PTB trap catches.

NOW egg numbers were extremely low in both '93 and '94, and damage was also very low both years. NOW survival is very low in heavily cover cropped orchards with high levels of undisrupted beneficials. The insect damage counts are tabulated in Table 4. In 1994, the Eck orchard had the lowest reject levels of the five orchards. Only the Ron Anderson orchard had reject levels higher than 1993. These were almost entirely PTB.

Covercrop height was measured periodically, and number of mowings, and timing were recorded for each cover. There is no single, "best" method of cover crop management. The following are typical timings for mowings:

COVER	JAN/FEB	MAR	APR	MAY	JUNE	JULY
RESIDENT VEGETATION:	1"	1"	1"	1"	<1"	<1"
RESIDENT INSECTARY:	2"	4"*	4"*	4"*	4"*	<1"
VETCH & CLOVER MIX:	6"				4"	<1"
CLOVERS	4"				4"	<1"
BROME & FESQUE:	4"				1"	<1"

* Alternate rows

CONCLUSIONS:

The highest soil organic matter averages are in the long-established vetch covers in the Ray Eck and Glenn Anderson orchards and in the resident vegetation in the Ron Anderson orchard. These orchards also have the top earthworm counts. In the Arnold Farms block, the highest OM levels are in the established resident vegetation, the Beneficial Blend and the Insectary mix. The lowest OM levels are in the annual grass plots; Blando brome and Zorro fesque. In the five established orchards, the OM levels are very high for sandy soils in the Central Valley.

Nutrient levels are adequate in all orchards and cover crops. It is very interesting that the certified organic orchards of Eck and Lashbrook have very high N levels, and very good K and Zn levels as well. Using certified organic methods does not need to result in low fertility.

Ladybird beetle numbers are highest in dense, diverse covers such as

the Beneficial Blend, the Insectary mix, vetches and clovers. These are covers in which plentiful supplies of prey insects flourish. Numbers were low in the resident vegetation, Blando brome, Zorro fesque, and in the poor stand of bur medic which support fewer prey insects. The numbers of beneficial, parasitic wasps are highly variable, but appear to be in lower numbers in the resident vegetation and higher in the planted covers.

High earthworm numbers indicate good soil health and viability. The highest numbers of earthworms were the Glenn and Ron Anderson orchards and in the Eck orchard where soil organic matter levels are high.

Again in 1994, it was confirmed that high reject levels from PTB damage do not necessarily follow high PTB trap catches. NOW egg numbers were extremely low in the test orchards in both '93 and '94, and damage was also very low both years. NOW survival is very low in heavily cover cropped orchards with high levels of beneficials.

Table 1. Average seasonal organic matter in surface six inches.

ORGANIC MATTER MEASUREMENTS-INNOVATIVE GROWERS		
	ORGANIC MATTER CONTENT	
GROWER, LOCATION, CULTURE	1993	1994
GA, HILMAR, VETCH, ORGANIC	1.46	1.44
RA, HILMAR, RES VEG, STANDARD	1.53	1.61
RE, HILMAR, VETCH+CLOVER, ORGANIC	1.46	1.18
PC, ATWATER, VETCH+CLOV, ORGANIC	0.96	0.89
TT, HILMAR, VETCH+CLOV, STANDARD	0.96	0.93
ARNOLD FARMS, TEST BLOCK	1993	1994
RESIDENT VEGETATION	1.10	0.88
BENEFICIAL BLEND	0.80	0.65
INSECTARY MIX	0.86	0.71
CAHABA WHITE VETCH	0.71	0.61
ZORRO FESQUE	0.62	0.53
NONTILLAGE CLOVER MIX	0.67	0.62
BLANDO BROME	0.65	0.53
BUR MEDIC (POOR STAND 1993)	0.68	0.59
SUBCLOVER MIX	0.55	0.61
ANNUAL CLOVER MIX	0.61	0.53
ROSE CLOVER	0.54	0.63
CLEAN TREE STRIPS	0.54	0.32

Table 2. Ladybird beetle larvae and adults per 25 sweeps.

GROWER, LOCATION, CULTURE	1993*	1994*
GA, HILMAR, VETCH, ORGANIC	34	37
RA, HILMAR, RES VEG, STANDARD	10	77
RE, HILMAR, VETCH+CLOVER, ORGANIC	26	34
PC, ATWATER, VETCH+CLOV, ORGANIC	29	44
TT, HILMAR, VETCH+CLOV, STANDARD	13	60
ARNOLD FARMS, TEST BLOCK	1993*	1994*
RESIDENT VEGETATION	10	25
BENEFICIAL BLEND	65	51
INSECTARY MIX	62	34
CAHABA WHITE VETCH	34	40
ZORRO FESQUE	6	25
NONTILLAGE CLOVER MIX	51	39
BLANDO BROME	18	29
BUR MEDIC (POOR STAND 1993)	8	25
SUBCLOVER MIX	34	39
ANNUAL CLOVER MIX	35	41
ROSE CLOVER	42	28

*Totals for 6 dates in 1993 and 7 dates in 1994.

Table 3. Earthworm counts per ring.

GROWER	1993 DATE			1994 DATE	
	5/15	6/7	7/12	4/25	5/9
GA HILMAR VETCH	9	15	8	6	12
RA HILMAR RESID	0	28	9	20	14
RE HILMAR VET/C	6	IRRIG	14	23	12
PC ATW VET/CLOV	0	6	0	2	4
TT HILMAR RES/C	0	0	0	.7	.3
COVER CROP TEST ATWATER SAND	0	0	0	0	0

Table 4. Almond kernel rejects due to NOW and PTB damage.

REJECTS DUE TO WORMS							
ORCHARD/CULTURE	1988	1989	1990	1991	1992	1993	1994
GA:VETCH/NO SPRAY	2.8	1.1	0.4	0.2	1.8	2.1	0.7
RA:NATIVE/NO SPRAY	2.7[a]	1.8[a]	2.9	0.6	1.6	2.7	3.4
TT:NATIVE/DORM+HSPLT		9.5[b]	6.5[b]	0.4	4.3	2.2[b]	1.7[b]
PC:VETCH/Bt+Goniozus				3.9	3.9	2.2	2.1
RE:VETCH/NO SPRAY						4.1	0.6
a: RA dormant spray 1988 and 1989 only. b: TT annual dormant plus hullsplit, BIOS 1994.							

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