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WEED CONTROL IN ALMONDS
A Progress Report

by

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Nearly 70% of the California almond acreage is now treated with herbicides. Weeds compete vigorously with young almond trees often stunting as much as 50% in the first two years due to weed competition. Well established almond trees, given sufficient irrigation, can usually compete with most annual weeds, but compete poorly against perennial weeds such as johnsongrass, bindweed and bermudagrass. The most common perennial by far in California almond orchards is bermudagrass. The high frequency of this low growing perennial grass is probably due to the sandy soils generally preferred for almond production. Here, bermudagrass spreads rapidly and grows luxuriant. So vigorous does it grow that in many heavy infestations, orchard disks ride over the top of matted bermudagrass without penetrating the heavy mats.

Common annual weeds of the San Joaquin and Sacramento valleys almond growers included barnyardgrass, Panicum species, bromegrass, crabgrass, pigweed, lambsquarter, shepherds purse, cheeseweed, filaree, puncture vine, purslane, mare's tail, and willow herb. In the winter, groundsel, shepherds purse, wild radish, cheeseweed, chickweed, scarlet pimpernel, miner's lettuce and annual blue grass are common. On the west side of the San Joaquin Valley, young almond orchards can be severely set back with infestation of perennial bindweed. North into the Sacramento Valley, johnsongrass is sometimes as troublesome as bermuda, particularly in young almond trees where competition occurs for water and nutrients, and sometimes even from shading.

Weed growth cannot be tolerated in the almond orchard at harvest time when the soil is cleared of weed growth and leveled for harvest. Often

late season preharvest irrigation or fall rains will bring up such annuals as purslane, puncture vine, and watergrass (barnyardgrass) which interfere with harvest of the nuts from the ground in the sweeping and pick up operations.

Control

Weed control in past years was done with mechanical disking. Disking had the disadvantage of causing clods in some soils, destroying shallow tree roots of the almond trees, limiting growth and probably production. Growers find that dust caused by disking in the summer increases mite populations and early defoliation. Disking has been reduced with chemical strip treatment down the tree row and close mowing or frequent shallow tillage in the centers. For the most part, a strip treatment with residual herbicides down the tree row has been used in preference to complete chemical weed control (as practiced in citrus). The lack of complete coverage weed control in almonds has been in part because of the unavailability of inexpensive and sufficiently safe herbicides.

Preemergence

Princep^{R} (simazine) applied at low rates down the tree row, especially on raised berms, has given adequate safety even under sprinkler irrigation in most soils. On soils extremely low in organic matter, such as below 1%, Princep has occasionally caused chlorosis and marginal leaf burn, particularly where sprinkler irrigation is used. The Mission and related varieties are most susceptible. Well established trees will tolerate 1/2 to 3/4 lbs/A Princep in most sandy low organic matter soils. In several years of testing, newly planted almond trees growing in Hanford fine sandy loam soils with low organic matter (0.3-0.7) have shown little or no injury from Princep at rates of 1 to 2 lbs/A. The slight chlorosis occurring at 2 lbs/A and

above has been far less detrimental than the weed competition. In most years, chlorotic symptoms have been transient, with late season growth appearing normal.

As a result of several years of screening and retesting preemergence herbicides, a number of herbicides have proven to be safer than Princep (Table 1), but often the symptoms are less injurious than the competition from weeds (Tables 2-4, 6 & 7). Rates of 2 lbs/A of Princep have usually given symptoms, but the trees grow out of the damaged leaves to give excellent final growth. In some years a 2 lbs/A rate gives less total growth than the new, more selective herbicides (Table 5). The masking effects of weed competition have sometimes been difficult to separate from herbicide phytotoxicity, but usually an idea of relative safety can be obtained from the most effective herbicide. For example, the lower rate of Rydex^{R} (prodiamine) gave a heavier average top weight than the higher excessive rate which suggests the possibility of some phytotoxicity, because the competitive effect of the weeds would have been reduced or eliminated.

Combinations of low rates of Princep with 4 lbs.. a.i. of Devrinol^{R} (napropamide), Surflan^{R} (oryzalin) and Rydex (Table 8-10, 13) have given excellent season long weed control in strip weed control, particularly where raised beds or berms have been used. At the edge of the berm and in the frequently wet furrows, several grasses often invade during the summer and fall, sometimes even where these highly effective grass herbicides were used.

Two new herbicides soon to be registered for winter weed control in almonds have given excellent weed control and safety on all soil types (Tables 1-7). Ronstar^{R} (oxadiazon) has been tested for 8 years in California almonds with no phytotoxicity apparent at rates up to 16 lbs/A. Excellent

annual broadleaf weed control was obtained with the exception of chickweed (Stellaria media (L.)) and a few less common species. Fall applied Ronstar is often weak on the summer grasses. The other new herbicide with 4 years of testing is Goal^{R}(oxyfluorfen) which, like Ronstar, controls most of the annual winter weeds with the partial exception of chickweed and a few other less common broadleaf weeds. It too is somewhat weak on summer grasses. Both herbicides give broadleaf weed control comparable to Princep, but the grower will enjoy increased almond tree safety. Ronstar and Goal have the added benefit of postemergence control of young standing weeds, i.e. those germinating after the first fall rain or at first preparation for harvest.

Treflan^{R}(trifluralin) is used for both pre-and post plant weed control in almonds. For good residual activity it must be incorporated.

Eptam^{R}(EPTC) has been effective for use prior to harvest, prior to final preharvest irrigation and applied in the irrigation water. As a short term grass or nutsedge control, this herbicide has been useful in almonds between the last preharvest irrigation and harvest. It is not normally used early in the season for nutsedge control because of its short residual activity. Almond trees did not show a detrimental effect from herbicidal rates of Eptam when applied in sand nutrient culture to young seedlings in greenhouse studies. No injury has been observed in commercial field applications of Eptam in almonds.

Postemergence

Paraquat^{R}has been used successfully for contact kill of weeds when they are small. Dinoseb with and without small amounts of oil and emulsifiers has been effective on slightly larger weeds than are killed with Paraquat. Care must be taken to keep weed or diesel oil from contacting tree foliage or trunks, even a fine spray mist has caused injury. Both herbicides are toxic to humans and animals and should be used according to label directions.

Perennial Weed Control

Treflan is also used for pre and post plant perennial weed control. It has been most effective on bermudagrass, johnsongrass and bindweed. When incorporated by power tiller or disk it has given fair to good results the first year and increased results with subsequent additional applications. The number of retreatments has been dependent on the degree of infestation. Layering Treflan with a spray blade has been more effective than incorporating for bindweed control as long as the Treflan treated layer remains undisturbed.

Power incorporation of Treflan has been most effective on bermudagrass in almond orchards growing on light sandy soils (Table 20).

The perennial weeds found in almonds have been controlled with Roundup^{R} (glyphosate) (Table 22). It will be an excellent additional tool when registration is finalized. As with all potent herbicides, it will be necessary to carefully follow the label since almond trees are not immune to injury from Roundup (Tables 4, 5 & 23). Injury has occurred when the spray mixture was allowed to drift or was sprayed on almond foliage. More injury has occurred as a result of fall application to the foliage of deciduous trees than when sprayed in the early spring. In field tests applications to the suckers at the base of the well established almond trees have not caused observable injury (Table 21) other than the sucker growth which was killed. Related Prunus species such as peaches and nectarines have, however, shown bark injury on newly planted trees (Table 23). It will, therefore, behoove growers to wrap or avoid spraying the trunks of newly planted almond trees to insure maximum safety. Little if any indication of soil uptake has been observed in almond or other trees, even on newly planted trees at normal and higher dosages (Table 18, 19 & 20).

MSMA has given good control of johnsongrass and yellow nutsedge in young almond orchards. Excessive rates of MSMA, however, can damage the trunks of young trees; so again, for maximum safety, wrapping should be done in an attempt to keep the spray off the foliage and trunk where spot treatment of MSMA for johnsongrass control is used. Currently MSMA is registered for non-bearing trees only. MSMA has not been thoroughly tested for bark injury on young almonds.

The low volatile forms of 2,4-D, such as oil soluble amine, have given excellent selective weed control in young almonds and have been allowed by special state authorizations in the past, however, currently all herbicides must be federally labeled. A special local need request for 2,4-D has been submitted through IR-4 for a Federal label for use in almonds. 2,4-D has been particularly effective for use in postemergence control of hard to kill broadleaf annuals and some perennial weeds, giving control comparable to Roundup on perennial bindweed in properly timed fall applications. Other growth related facts are being studied with Roundup (Table 22). When used in combination with some other herbicides, control has been improved depending on the weed species present.

Complete Nontillage

Because recent research shows several new herbicides show good safety for young almonds, complete nontillage is being evaluated. Weeds have been killed across the entire orchard floor with many advantages being demonstrated for weed control in almonds. This work is being expanded in several long term studies to evaluate the effects on tree growth, soil structure, irrigation methods and other cultural aspects.

Table A. Generic (common) and commercial names of herbicides used in this report.

Generic Names or Number	Commercial Name	Chemical Company
Chloroflurenol	Maintain	U. S. Borax
Cyperquat		Gulf
2,4-D	Many	AmChem, Diamond Shamrock, others.
Dinoseb	Several dinitro weed killers	Dow
DPX 1108	--	DuPont
DPX 3674	Velpar	DuPont
EPTC	Eptam	Stauffer
FMC 25213	--	FMC
Glyphosate - MON 2139	Roundup	Monsanto
HERC 26905	--	Hercules
MBR 15802	--	3M
MBR 11464	--	3M
MBR 16302	--	3M
MBR 12325	--	3M
Methazole - VCS 4438	Probe	Velsicol
Napropamide - R 7465	Devrinol	Stauffer
Nitralin	Planavin	Shell
Nitrofen	TOK	Rohm & Haas
Norflurazon - SAN 9789	Solicam	Sandoz
Oryzalin - EL 119	Surflan	Eli Lilly
Oxadiazon - RP 17623	Ronstar	Rhodia Chipman
Oxyfluorfen - RH 2915	Goal	Rohm & Haas
Paraquat	Paraquat	California Chem.
Pronamide - RH 315	Kerb	Rohm & Haas

Generic Names or Number	Commercial Name	Chemical Company
Prodiamine - USB 3153	Rydex	U. S. Borax
RP 15018	--	Rhodia- Chipman
RP 20810	--	Rhodia Chipman
R 37878	--	Stauffer
R 31401		Stauffer
SN 45311	--	Nor-Am
SN 49962	--	Nor-Am
Simazine	Princep	Ciba Geigy
Terbutryne	Igran	Rhodia Chipman
Trifluralin	Treflan	Eli Lilly
U 44078	--	Upjohn
VCS 3438	--	Velsicol
VCS 3207	--	Velsicol
VCS 5052	--	Velsicol

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Table 3

Table 1. Comparative effects of eight herbicides on phytotoxicity of almonds and peaches (A36-73-501-H-3-72)

Herbicides	lb/A	Average Ratings[1/] Weed Control 5/22/72	Weed Control 6/20/72	Phyto. Almonds 6/20/72	Phyto. Peaches 6/20/72
Simazine	2	9.7	9.0	1.3	3.3
Napropamide	2	6.3	5.7	0.0	0.0
Napropamide	8	6.3	6.3	0.0	0.0
Oxadiazon	2	8.3	4.3	0.0	0.0
Oxadiazon	8	9.3	8.0	0.0	0.0
Norflurazon	1	5.3	4.7	0.0	0.0
Norflurazon	2	8.7	9.3	0.0	0.0
Norflurazon	4	8.0	8.3	0.0	1.0
Oryzalin	2	6.3	6.3	0.0	0.0
Oryzalin	8	6.0	6.0	0.7	0.3
Terbutryn	2	6.3	5.0	0.0	0.0
Terbutryn	8	9.3	9.0	1.7	2.3
Prodiamine	2	5.5	4.0	1.5	2.0
Prodiamine	8	8.7	9.0	0.0	0.0
Glyphosate	1	1.3	0.3	0.0	0.0
Glyphosate	4	1.3	0.3	0.0	0.0
Check	-	1.7	0.0	0.0	0.0

1/ Average of 3 replications. Based on 0 to 10 scale where 0 = no effect and 10 = complete weed control or death of crop. O.M. 0.3%, Sand 53%, Silt 35%, Clay 12%. Trees planted 2/24/72. Treated 4/7/72. Almonds = Mission. Peaches = Lovell.

Table 2. Comparative effects of eight herbicides on the growth (trunk diameter) of peaches and almonds. (A36-73-501-H-3-72)

Herbicides	lb/A	Average Trunk Diameter Ratings[1/] Almonds 12/18/72	Almonds 11/29/73	Peaches 12/18/72	Peaches 11/29/73
Simazine	2	32.7	52.7	34.3	58.0
Napropamide	2	26.3	46.3	25.7	39.7
Napropamide	8	30.3	46.3	30.0	41.3
Oxadiazon	2	27.0	43.0	25.7	39.3
Oxadiazon	8	35.0	56.3	35.0	45.0
Norflurazon	1	27.0	43.0	26.0	35.7
Norflurazon	2	36.3	56.7	38.3	52.7
Norflurazon	4	30.0	44.7	25.3	36.0
Oryzalin	2	25.7	38.7	35.0	54.3
Oryzalin	8	35.0	55.0	37.0	55.0
Terbutryn	2	26.7	45.0	28.8	47.3
Terbutryn	8	32.5	45.7	34.3	54.3
Prodiamine	2	28.0	41.0	23.5	30.5
Prodiamine	8	33.7	48.0	35.3	63.0
Glyphosate	1	21.0	38.0	22.3	11.0
Glyphosate	4	17.7	36.3	21.0	17.7
Check-partially weeded	-	20.3	37.3	19.0	31.3

1/ Average of 3 replications. Diameter of trunks at 10 cm above ground level. O.M. 0.3%, Sand 53%, Silt 35%, Clay 12%. Trees planted 2/24/72. Treated 4/7/72. Almonds = Mission. Peaches = Lovell.

Table 3. A comparative effect of 5 herbicides on the top growth of 2 orchard species. (A36-73-501-H-3-72)

Herbicides	lb/A	Averages[1/] (gm) Almonds	Peaches
Simazine	2	8136	6206
Napropamide	8	7001	4122
Oxadiazon	8	5335	4690
Norflurazon	4	3746	2270
Oryzalin	8	8662	4958
Check	-	2574	1703

1/ Average fresh weights of tree top cut @ 25 cm above ground on 1/30/74. Wts. less than the check may represent a combination of phytotoxicity, tree competition and weed competition. Increases in fresh wt. over check probably due to reduced effect of weed competition due to good weed control.

2/ Herbicides applied 4/7/72. The lower wts. in the untreated check represents the effect of partial weed competition. All plots were sprayed with paraquat at 1 lb/A twice in 1973.

Table 4. A comparison of new herbicides for weed control and phytotoxicity in almonds and diameter of almond trees.

Herbicides	lb/A	Average Ratings[1] Broadleav Control 5/20/74	Cupgrass Control 7/29/74	General W/C 10/29/74	Overall Phytotoxicity 5/20/74	7/29/74	[2] Diameter 12/18/74	12/19/75
Simazine (80%)	2	10.0	7.0	2.7	1.6	2.3	31.3	55.3
Simazine (4F)	2	10.0	3.7	2.3	2.6	2.7	30.7	54.7
Oryzalin	4	9.4	8.3	5.7	0.0	0.0	40.3	68.0
Oryzalin	16	10.0	10.0	8.0	0.6	0.0	33.3	67.0
VCS-3438	2	10.0	8.3	0.0	5.3	8.3	16.0	27.0
VCS-3438	8	10.0	9.0	0.0	5.6	10.0	Dead	Dead
Oxyfluorfen	2	10.0	5.3	4.0	0.6	0.0	33.3	59.7
Oxyfluorfen	8	10.0	7.7	5.3	0.3	0.0	38.7	62.7
RP-20810	3	10.0	4.7	1.0	1.3	0.7	23.3	52.7
RP-20810	12	10.0	7.3	4.7	0.3	0.0	36.0	66.0
RP-15018	4	8.6	2.3	1.3	0.6	0.0	30.0	63.7
RP-15018	16	9.0	3.7	4.3	0.6	0.0	31.3	61.0
Oxadiazon	4	9.3	3.3	4.3	0.0	0.0	31.0	56.3
Oxadiazon	16	10.0	8.3	7.7	0.0	0.0	31.7	63.3
SN-45311	2	10.0	2.3	3.0	1.0	0.3	28.3	57.0
SN-45311	8	10.0	5.7	3.0	3.0	2.0	32.7	67.0
SN-49962	2	9.6	2.3	2.7	0.3	0.0	33.0	71.0
SN-49962	8	10.0	4.7	3.7	0.6	1.3	29.0	52.0
Prodiamine	4	6.3	8.7	8.3	0.0	0.0	38.7	76.3
Prodiamine	16	8.0	9.0	8.0	0.0	0.0	34.3	71.0
FMC-25213	4	5.0	2.0	2.0	1.0	1.6	30.0	54.3
FMC-25213	16	10.0	5.0	4.3	0.0	0.0	34.3	64.0
FMC-23486	2	10.0	7.3	4.3	3.3	8.3	19.3	18.3
FMC-23486	8	10.0	9.3	1.3	5.3	9.3	12.7	Dead
VCS-5026	½	9.3	5.0	1.7	2.6	4.3	27.3	50.7
VCS-5026	4	10.0	8.6	2.0	3.0	8.0	15.0	18.3
Norflurazon	2	4.0	10.0	5.0	2.3	1.7	27.3	73.7
Norflurazon	8	6.6	9.3	4.7	2.3	1.3	33.7	73.7
Check	-	5.6	2.0	0.0	1.4	2.3	22.0	36.7

[1] Average of 3 replications. Based on 0 to 10 scale where 0 = no effect and 10 = complete weed control or kill of almonds. Treated 3/7/74 or 4/11/74. O.M. 0.75%, Sand 59%, Silt 33%, Clay 8%.

[2] Average diameter measured at just above the graft union. Average measured in mm.

Table 5. The effect of herbicide treatments on the fresh weight of almond trees. (425-73-501-H14-1-74)

Herbicide	lb/A	Average[1] Wt/Tree	Herbicide	lb/A	Average[1] Wt/Tree
Simazine	2	8.4	FMC-25213	4	6.6
			FMC-25213	16	9.2
Oryzalin	4	13.6			
Oryzalin	16	13.8	2,4-D	2	6.2
			2,4-D	8	12.9
Oxyfluorfen	2	11.0			
Oxyfluorfen	8	12.3	Glyphosate	2	9.5
			Glyphosate	8	6.8
RP-20810	12	11.0	Glyphosate[2]	8	11.4
Oxadiazon	4	10.1	Norflurazon	2	16.8
Oxadiazon	16	10.5	Norflurazon	8	17.9
Prodiamine	4	29.2	Check	-	2.8
Prodiamine	16	17.3	(Partially weeded)		

[1] Average of 3 replications as measured in Kg. Treated 3/7-4/17/74; evaluated 12/19/75.
[2] Soil only.

Table 6. Activity of preemergence herbicides on annual weeds, phytotoxicity of almonds and diameter of almond trees.

Herbicides	lb/A	Average Ratings[1] Broadleaf[2] 5/10/75	Grass Control 4/24/75	Grass Control 9/22/75	Phyto 8/25/75	Diameter[3] 12/19/75
Simazine	2	10.0	9.0	6.3	4.0	34.3
Oxyfluorfen	2	10.0	9.7	8.3	0.0	34.7
Oxyfluorfen	8	10.0	10.0	9.0	0.0	31.7
FMC-25213	4	10.0	6.3	3.3	0.0	32.3
FMC-25213	16	10.0	7.3	4.7	0.7	29.3
R-20810	4	10.0	8.7	7.7	0.0	32.7
R-20810	16	10.0	10.0	9.3	0.0	31.7
R-20630	4	10.0	10.0	9.3	0.0	37.3
R-20630	16	10.0	10.0	10.0	0.0	35.0
SN-45311	2	10.0	8.0	5.3	0.0	36.3
SN-45311	8	9.0	8.3	4.7	6.0	18.0
SN-52808	2	10.0	5.3	4.3	2.7	28.3
SN-52808	8	10.0	9.3	5.3	8.7	16.0
SN-49962	2	9.0	3.0	3.0	0.7	28.0
SN-49962	8	10.0	7.0	4.3	3.0	28.0
VCS-5052	2	6.6	3.3	1.3	1.0	26.3
VCS-5052	8	9.0	4.3	3.0	1.7	27.3
VCS-4207	2	7.3	4.3	2.3	4.0	22.7
VCS-4207	8	10.0	4.0	3.0	8.3	5.0
HER-26905	4	9.6	9.0	6.7	0.0	29.0
HER-26905	16	10.0	9.3	8.0	1.0	38.0
Penoxalin	4	10.0	9.7	8.0	0.0	30.7
Penoxalin	16	10.0	9.7	10.0	0.0	38.7
R-37878	2	8.3	4.0	3.0	0.0	24.7
R-37878	8	9.6	5.3	3.0	3.0	24.3
R-31401	2	10.0	8.3	4.3	4.7	21.0
R-31401	8	10.0	9.3	6.3	8.7	8.3
U-44078	2	9.3	6.3	4.0	3.7	29.3
U-44078	8	10.0	8.7	6.0	1.7	22.7
Check (partially weeded)	-	2.6	4.7	1.0	0.0	17.3

1/ Average of 3 replications. Based on 0 to 10 scale where 0 = no effect and 10 = complete weed control or kill of almond trees. Soil O.M. 0.75%, Sand 59%, Silt 33%, Clay 8%. Treated 3/27/75.

2/ Redmaids, sow thistle, filaree, fiddleneck. The grass was mainly cupgrass.

3/ Diameter measured in mm. Treated 3/27/75.

Table 7. Comparative effect of four preemergence herbicides to trunk diameter and phytotoxicity ratings on young non-bearing almonds. (A36-73-501-H14-1-75)

Herbicides	lb/A	Trunk Diameter[1/] 5/16/75	12/19/75	Phytotoxicity[2/] 6/25/75
Simazine	2	15.6	34.3	4.0
Glyphosate + Simazine + Napropamide	4 1 4	14.3	32.0	1.0
Glyphosate + Simazine + Oryzalin	4 1 4	16.0	36.3	2.3
Oxyfluorfen	2	14.3	34.7	0.0
Oxyfluorfen	8	15.0	31.7	0.0
HER-26905	4	15.0	29.0	0.7
HER-26905	16	15.3	38.0	2.0
Check	-	14.3	17.3	1.0

1/ Average of 3 replications. Trunk measured in mm.
2/ Average of 3 replications. Based on 0 to 10 scale where 0 = no effect and 10 = complete kill of plant. Treated 3/27/75.

Table 8. The effect of 5 herbicide combinations on the control of weeds and phytotoxicity to almonds in strip treatment down the tree row. (A36-50-501-H8-1-73)

Herbicides	lb/A	Average Ratings[1/] Weed Control	Phytotoxicity
Simazine + Prodiamine	1+4	10.0	0.0
Simazine + Napropamide	1+4	9.9	0.0
Oxadiazon + Oryzalin	4+4	9.9	0.0
Simazine + Oryzalin	1+4	8.4	0.0
Norflurazon + Oryzalin	2+4	9.5	0.0
Check	-	0.0	0.0

1/ Average of 4 replications. Based on 0 to 10 scale where 0 = no effect and 10 = complete weed control or kill of almonds. Treated 12/10/73 and retreated 12/11/74. Evaluated 5/8/75. Weeds present: Lambsquarter, knotweed, filaree and sunflower. Tree age-2 years. Flood irrigation. Sandy loam O.M. 0.6%, Sand 79%, Silt 14% and clay 7%.

Table 9. Comparison of preemergence herbicide combinations on weed control activity in almonds. (A36-24-501-H8-1-70)

Herbicides	lb/A	Weed Control[1/] 2/27/74	5/15/74	9/13/74
Oxyfluorfen + Oryzalin	1+4	10.0	9.0	8.7
Simazine + Nitralin	2+4	9.5	9.0	10.0
Simazine + Napropamide	1+4	10.0	9.7	9.3
Simazine + Napropamide	2+8	9.7	9.0	9.3
Oxadiazon + Oryzalin	4+4	10.0	9.2	8.7
Simazine + Oryzalin	2+4	9.9	9.2	10.0
Methazole + Nitralin	4+4	8.9	8.0	7.3
Pronamide + Nitralin	4+4	9.7	7.7	6.3
Simazine + Norflurazon	1+2	10.0	8.7	9.7
Check	-	4.3	1.0	5.0

1/ Average of 3 replications. Based on 0 to 10 scale where 0 = no control and 10 = complete control. Treated 10/29/70, 11/24/71, 10/12/72, 12/20/73. No phytotoxicity was observed. Weeds present - (2/27/74) groundsel, filaree, shepherds purse, annual bluegrass, red maids and pineappleweed (5/15/74 & 9/13/74) flaxleaf fleabane and marestail. Soil O.M. 0.4%, Sand 54%, Silt 28% and Clay 18%.

Table 10. The effect of continuous annual applications for four years on the growth of young almond trees and weed control. (A36-24-501-h*-1-70)

Herbicides	lb/A	Average[1] 9/13/74 W/C	Phyto	5/9/75[2] Almond Diameter
Oxyfluorfen + Oryzalin	1+4	8.7	0.0	22.0
Simazine + Napropamide	1+4	9.3	0.0	20.7
Simazine + Napropamide	2+8	9.0	0.0	21.7
Oxadiazon + Oryzalin	4+4	8.0	0.0	21.3
Simazine + Oryzalin	2+4	9.7	0.0	22.3
Simazine + Norflurazon	1+2	9.7	0.0	23.3
Check (growers contact)	-	8.0	0.0	22.5

1/ Average of 4 replications. Based on a 0 to 10 scale where 0 = no effect and 10 = complete weed control or death of plant. Treatments applied annually since 12/20/73 replacing prior treatments.

2/ Diameter @ 10 cm above ground level. Measured in mm.

Table 11. Comparison of preemergence herbicides on the control of weeds in almonds. (A36-50-501-H8-2-70)

Herbicides	lb/A	Weed Control[1/] Nutsedge	Grass	Broadleaf
Simazine + Oxadiazon	1+4	8.8	8.5	8.5
Simazine + Oxadiazon	1+8	8.7	10.0	10.0
Simazine + Oryzalin	1+4	7.7	8.7	9.3
Simazine + Oryzalin	1+8	10.0	9.3	9.3
Simazine + Methazole	1+2	8.7	0.0	9.0
Simazine + Methazole	1+4	9.7	6.0	9.7
Simazine + Pronamide	1+4	7.7	9.7	5.0
Pronamide	16	9.7	10.0	6.7
Nitrofen	4	3.3	5.3	4.3
Nitrofen	16	7.7	7.0	3.3
Norflurazon	2	9.0	9.7	5.7
Norflurazon	4	10.0	10.0	6.3
Napropamide	4	9.7	9.7	9.3
Oxyfluorfen	4	7.7	9.7	8.3
Check	-	3.3	4.0	0.0

1/ Average of 3 replications. Based on 0 to 10 scale where 0 = no control and 10 = complete control. Treated 12/5/73. Evaluated 5/16/74. No phytotoxicity was observed. Soil O.M. 1.9%, Sand 76%, Silt 17% and Clay 7%.

Table 12. A comparison of annual weed control with 5 herbicide combinations applied annual for 4 years under drip irrigation. (A36-73-501-H14-1-72)

Herbicides	lb/A	Annual Weed Control[1/] Time of Application: Fall Overall W/C	Fall W/C within wet spot	Winter Overall W/C	Winter W/C within wet spot	Spring Overall W/C	Spring W/C within wet spot
Simazine + Nitralin	1½+4	9.7	3.3	8.3	4.7	10.0	5.3
Simazine + Oryzalin	1½+4	9.0	3.0	10.0	5.7	9.0	5.3
Simazine + Napropamide	1½+4	6.7	0.0	9.7	4.3	7.7	2.7
Simazine + Oxadiazon	1½+4	10.0	6.0	9.0	4.3	9.3	4.7
Simazine + Norflurazon	1½+4	10.0	4.3	-	-	9.0	4.0
Check	-	0.0	0.0	0.0	0.0	0.0	0.0

1/ Average of 3 replications where 0 = no control and 10 = complete control. Evaluated 7/28/75. Soil O.M. 0.1%, Sand 72%, Silt 22%, and Clay 6%.

Rainfall: Nov. 1971 - 2.28" 1974 - 12.46" 1975 - 4.10"
Dec. 1972 - . .95" 1974 - 9.57"

Sprinkler irrigation dates: 11/7/71, 1/2/72, 1/5/72, 6/19/72, 6/29/72, 5/15/74, 7/1/74, 6/75, /75.
Amounts: 1.4", 0. ", 0. ", 0. ", 0. ", 2.0", 1.0", 2.0", 2.0"

Treatment Dates: Fall - 11/7/71, 11/10/72, 12/4/73, 11/7/74
Winter - 12/24/71, 1/ /7 , 1/17/74, 12/19/75
Spring - 3/21/72, 2/24/73, 2/24/74, 2/5/75

Table 13. A comparison of 5 combination herbicides in a panoche clay loam for annual weed control in almonds. (425-78-501-H14-1-73)

Herbicides	lb/A	Average[1] Phyto.	Weed Control
Simazine + Nitralin	1+4	0.0	9.2
Simazine + Oryzalin	1+4	0.0	9.1
Simazine + Napropamide	1+4	0.0	10.0
Oxadiazon + Norflurazon	4+2	0.0	9.6
Oxadiazon + Napropamide	4+4	0.0	9.8
Check	-	0.0	4.1

[1] Average of 20 replications. Based on 0 - 10 scale where 0 = no control and 10 = complete control. Main weeds present: sow thistle and London rocket. Treated 4/18/74; evaluated 11/21/74. Soil O.M. 1.0%, Sand 24%, Silt 36%, and Clay 40%.

Table 14. The effect of 5 herbicides and their combinations on annual weed control in almonds. (CW 22, A-36, H-8, 10, 71-4)

Herbicides	lb/A	Weed Control[1/]
Napropamide	4	8.2
Napropamide	8	7.5
Oxadiazon	2	5.2
Oxadiazon	4	7.5
Norflurazon	2	5.0
Norflurazon	4	5.0
Oryzalin + Terbutryn	2+1	9.5
Oryzalin + Terbutryn	4+2	9.7
Oryzalin + Oxadiazon	2+2	9.0
Napropamide + Simazine	2+½	7.7
Napropamide + Terbutryn	4+1	8.7
Napropamide + Norflurazon	4+1	8.2
Napropamide + Oxadiazon	4+2	9.0
Check	-	0.0

1/ Average of 4 replications. Based on 0 to 10 scale where 0 = no weed control and 10 = complete weed control. Trees planted Spring, 1969. Treated 1/14/71. Retreated 12/31/73. Evaluated 5/3/74. Soil O.M. 1.4%, Sand 54%, Silt 38%, and Clay 8%.

Table 15. Annual weed control in a young almond orchard under continuous complete chemical; i.e. non-tillage. (A36-50-501-H8-1-70)

Herbicides	lb/A	Average Ratings[1/] Grass	Broadleaf	Phytotoxicity
Simazine	2	1.7	8.7	1.0
Simazine + Nitralin	2+4	7.3	9.0	1.0
Napropamide	4	8.0	5.0	0.0
Napropamide	8	10.0	4.7	0.0
Simazine + Napropamide	2+4	8.0	8.0	1.3
Check	-	0.0	0.0	0.0

1/ Average of 3 replications. Based on 0 to 10 scale where 0 = no effect and 10 = complete kill. Trial established 11/13/70. Retreated annually until the Spring of 1976. Soil O.M. 1.9%, Sand 76%, Silt 17%, and Clay 7%.

Table 16. A comparison of residual preemergence herbicides on the control of grass, nutsedge and several broadleaf annuals in a young almond orchard under continuous complete chemical, i.e., non-tillage. (A36-50-501-H8-1-70)

Herbicides	lb/A	Average Control Ratings[1/]			
		Grass	Nutsedge	Broadleaf	Trunk Diameter
Simazine	2	2.3	6.3	8.0	24.8
Napropamide	4	9.0	7.0	6.0	32.8
Napropamide	8	7.8	4.0	6.3	35.2
Simazine + Napropamide	2+4	6.3	5.0	8.8	34.5
Check	-	4.0	5.0	4.8	31.5

1/ Average of 3 replications. Based on 0 to 10 scale where 0 = no effect and 10 = complete control. Evaluated 5/16/74-cheeseweed, mare's tail, flaxleaved fleabane, lambsquarter, mustard staphonmaria, filaree, sow thistle and knotweed. The grass was Hilman's panicum. Treated 11/13/70. Retreated annual to the Spring of 1976. Soil O.M. 1.9%, Sand 76%, Silt 17%, and Clay 7%.

Table 17. Comparative effects of 4 herbicides in combination on weed control and the effects on young almonds. (A36-50-501-H8-2-73)

Herbicides	lb/A	Average Ratings 1/ Weed Control	Phytotoxicity
Simazine + Oryzalin	1+4	10.0	0.1
Simazine + Napropamide	1+4	10.0	0.5
Norflurazon + Oxadiazon	1+4	10.0	0.0
Check	-	0.0	0.0

1/ Average of 11 replications. Based on 0 to 10 scale where 0 = no effect and 10 = complete weed control or death of crop. Treated 1/11/73. Evaluated 5/31/73. Soil O.M. 0.6%, Sand 79%, Silt 14%, and Clay 7%.

Table 18. The effect of 5 postemergence herbicides applied dormant to young almond trees and preemergence to weeds.

Herbicides	lb/A	Average Ratings[1] Broadleaf Control 5/20/74	Cupgrass Control 7/29/74	General W/C 10/29/74	Overall Phytotoxicity 5/20/74	7/29/74	[2] Diameter 12/18/74	12/19/75
Simazine (80%)	2	10.0	7.0	2.7	1.6	2.3	31.3	55.3
Simazine (4F)	2	10.0	3.7	2.3	2.6	2.7	30.7	54.7
2,4-D (OSA)	2	7.6	2.3	0.7	1.6	0.6	26.7	45.0
2,4-D (OSA)	8	9.3	5.0	3.0	2.0	1.0	31.0	64.3
MBR-12325	½	1.6	0.6	0.7	2.0	4.0	21.3	39.7
MBR-12325	2	2.3	3.0	0.0	1.6	3.0	21.3	38.0
Glyphosate	2	10.0	1.3	3.3	1.0	0.0	33.7	60.3
Glyphosate[3]	8	10.0	1.7	3.0	1.3	0.0	30.7	45.3
Glyphosate[3]	8	9.0	1.0	2.0	1.3	0.3	27.3	58.3
DPX-3674	2	9.6	9.3	2.3	5.6	10.0	Dead	Dead
DPX-3674	8	10.0	10.0	0.0	6.0	10.0	Dead	Dead
MBR-11464	2	4.3	4.3	0.0	2.0	4.3	23.7	33.3
MBR-11464	8	5.6	4.0	0.0	3.6	6.0	18.7	29.7
Check	-	5.6	2.0	0.0	1.4	2.3	22.0	36.7

1/ Average of 3 replications. Based on 0 to 10 scale where 0 - no effect and 10 = complete weed control or kill of almonds. Treated 3/7/74 or 4/11/74. O.M. 0.75%, Sand 59%, Silt 33% and Clay 8%.

2/ Average diameter measured at just above the graft union. Average measured in mm.

3/ Soil only, trunk shielded.

Table 19. The effect of postemergence herbicides applied dormant to young almond trees and preemergence to the weeds.

Herbicides	lb/A	Average Ratings[1] Broadleaf[2] 5/10/75	Grass Control 4/24/75	Grass Control 9/22/75	Phyto 8/25/75	Diameter[3] 12/19/75
Simazine	2	10.0	9.0	6.4	4.0	34.3
Glyphosate + Simazine + Napropamide	4 1 4	10.0	9.7	8.0	1.0	32.0
Glyphosate + Simazine + Oryzalin	4 1 4	10.0	10.0	10.0	2.3	36.3
Cyperquat	4	4.0	3.0	1.7	0.7	27.3
Cyperquat	16	0.0	7.0	3.7	4.0	18.3
DPX-1108	8	7.6	4.7	2.7	0.0	27.0
DPX-1108	32	1.6	7.0	2.3	5.0	17.7
MBR-16302	2	9.0	2.0	1.7	6.3	19.0
MBR-16302	8	10.0	3.3	1.0	6.7	17.3
MBR-15802	2	8.3	2.7	1.3	5.0	18.3
MBR-15802	8	10.0	1.7	0.3	9.0	5.0
Check-partially weeded	-	2.6	4.7	1.0	0.0	17.3

1/ Average of 3 replications. Based on 0 to 10 scale where 0 = no effect and 10 = complete weed control or kill of almond trees. Treated 3/27/75. Soil OM 0.75%, Sand 59%, Silt 33%, Clay 8%.

2/ Redmaids, sow thistle, filaree, fiddleneck. The grass was mainly cupgrass.

3/ Measured in mm.

Table 20. The effect of disking in high rates of trifluralin and spraying glyphosate on the control of bermudagrass in almonds. (A36-10-502-H8-1-73)

Herbicides	lb/A	Ave. Weed Control[1/] Tree Row	Centers
Trifluralin	4 (disked in)	3.0	7.0
Trifluralin + Glyphosate	4+2	8.0	9.3
Glyphosate	2	8.0	8.3
Check	-	1.0	2.5

1/ Average of 4 replications. Based on 0 to 10 scale where 0 = no weed control and 10 = complete weed control. Treated 4/13/73. Evaluated 5/19/73.

Table 21. The effect of basal trunk sprays of glyphosate on young newly planted almond trees. (425-50-502-H8-1-74)

Herbicides	lb/A	SPRAYED:	Average Ratings[1] Vigor 3/6/74[2]	Vigor 5/7/74[3]	Circumference 3/6/74	Circumference 5/7/74
Glyphosate	1		7.5	7.3	12.1	12.3
Glyphosate	2		7.3	7.5	13.0	13.0
Glyphosate	4		7.5	7.7	12.3	13.0
2,4-D	1		6.8	7.3	12.3	12.0
2,4-D	2		6.0	6.5	12.0	12.0
2,4-D	4		7.8	7.0	13.0	12.0
Check	-		7.3	8.0	12.1	13.1

1/ Average of 4 replications. Based on 0 to 10 scale where 0 = no growth and 10 = most vigorous growth. The circumference measured in mm. Trees planted 2/22/74. Established 3/6/74.
2/ Sprayed basal 6"
3/ Sprayed basal 6" after removing suckers.

Table 22. The effect of two growth regulators on the activity of glyphosate as measured by bindweed control in young almond trees. (A36-50-502-H8-1-75)

Herbicides	lb/A	Average Ratings[1/] Weed Control 9/20/75	Weed Control 5/16/76	Phyto 5/16/76
Glyphosate	4	7.0	4.8	0.0
Glyphosate + Chloroflurenol	4+1	7.7	4.8	0.0
Glyphosate + Chloroflurenol	4+2	8.3	7.77	0.0
Glyphosate + MBR-12325	4+2	8.7	5.2	0.0
Glyphosate + MBR-12325	4+4	8.3	5.5	0.0
Check	-	0.7	0.0	0.0

1/ Average of 3 replications. Based on 0 to 10 scale where 0 = no effect and 10 = complete weed control or complete kill, i. e., no regrowth. Treated 6/25/75.

Table 23. Comparative effects of glyphosate applications to trunk diameters of almonds and peaches: soil application vs. trunk applications. (A36-73-501-H14-1-74)

		Trunk Diameter[1/]			
		Almonds		Peach	
Herbicides	lb/A	6/19/74	12/19/75	6/19/74	12/19/75
Glyphosate	2	21.0	60.3	14.7	38.0
Glyphosate	8	15.6	45.3	6.7	0.0
Glyphosate	8[2/]	20.3	58.3	12.3	33.7

1/ Average of 3 replications. Diameter of trunk @ 10 cm above ground level. Measured in mm. Soil O.M. 0.75%, Sand 59%, Silt 33%, and Clay 8%.

OBSERVATIONS ON WEED CONTROL IN ALMONDS

by

A. H. Lange

Annual Weeds

Cheeseweed -- Devrinol has given good control of this weed during germination when applied prior to a 1/4 inch (or more) rain or when incorporated with sprinkler irrigation. Two new herbicides are even better. They are Ronstar and Oxyfluorfen. Both have experimental use permits this year, but no EPA label.

Annual grasses -- Devrinol properly incorporated has given season long grass control at 4 lb a.i./A (8 lb. of the 50 WP). Surflan has generally been better than Devrinol on some species such as watergrass. Surflan also lasts on the surface longer without incorporation and, consequently, often looks better on annual grasses in late summer.

Pigweed -- Most species of pigweed are controlled by most herbicides. Prostrate and tumbling pigweed are sometimes resistant to Princep (simazine) at low rates and Devrinol partially incorporated. Surflan is more effective but currently only labelled on non-bearing almonds.

Purslane -- Controlled by all labelled herbicides. Sometimes Devrinol "runs out" because of improper incorporation or continuously moist soil, as in the furrow. Surflan is better on purslane than Devrinol. Eptam applied to dry soil and sprinkled in or applied through the sprinkler will control purslane preemergence, as well as most other broadleaf and grassy weeds for 4-6 weeks before harvest.

Puncturevine -- Control has been better with Surflan than with Devrinol. If the puncturevine seed is close to the surface, it is quite easily controlled

by a number of herbicides, but if germinating from some depth, as occurs during mid-summer, puncturevine is difficult to control with shallow pre-emergence herbicides. Incorporation of Treflan is quite effective against puncturevine, however, incorporation is usually to be avoided in clay soils because of clods; also, growers do not wish to till permanent berms. Most contact sprays are very effective on puncturevine, particularly when small. Even simazine, although reported to be weak on puncturevine, kills a large number of the shallow germinating puncturevine seedlings. Those that germinate below the simazine survive.

Lambsquarter -- is controlled by most preemergence herbicides. Surflan is usually more effective on lambsquarter than Devrinol.

Spurge -- Devrinol is rather poor on spurge. Surflan is very effective on spurge.

Sowthistle -- It is easily controlled by low rates of simazine and/or Devrinol. Early germinating sowthistle is often controlled by Surflan, but is not generally as effective as Devrinol.

Wild or Volunteer Grain -- Devrinol is much superior to Surflan, although Surflan will generally control or severely stunt shallow germinating barley.

Perennial Weeds

Bermudagrass and Johnsongrass -- These weeds have been controlled by repeated small applications of Dalapon, however, it does not have a Federal label for use in almonds. On the other hand, Roundup is outstandingly effective. Application for a Federal label for Roundup, the most effective herbicide yet developed for weed control in almonds has been submitted by Monsanto to the EPA. An experimental use permit was anticipated for March 1977, but recent difficulties in the EPA may delay this months or years. Preparations are being made to submit Roundup under "special local need", a provision for state

registration (24C) which if successful, could result in a Federal label for California (only) in a relatively short time.

The control of both Bermudagrass and Johnsongrass profit from the incorporation of Treflan at high rates in infested soil. This herbicide is very active on the roots of all grasses and consequently, prevents normal root development in treated soil. When incorporated at rates of 2 lbs/A or more, Treflan will remain active for over a year in most soils. Treflan is, therefore, present in the soil continuously inhibiting the growth of the roots of Johnsongrass and Bermudagrass. Continuous incorporation of Treflan or a number of related herbicides has greatly reduced perennial grass problems.

Bindweed -- Is also controlled by incorporated Treflan. Preemergence application of Surflan and Ronstar (not yet registered) also gives a degree of control. Treflan works best when applied in a thin layer of herbicide four to six inches below the soil surface where it stops short growth, preventing the emergence of bindweed shoots. Thin layering Treflan at 1-2" will also give a degree of control on raised berms down the tree row.

Nutsedge -- Is not affect by Treflan, but is controlled with repeated sprays of Roundup. Purple nutsedge is controlled better by Roundup than yellow. On the other hand, yellow is controlled better with MSMA than purple. MSMA has a label on non-bearing almond trees.

In fine textured soils, Casoron has also been effective on nutsedge with sufficient safety on almonds. On some sandy soils, symptoms have occurred.

Eptam is also effective on nutsedge when incorporated 4-5 inches deep but the control lasts for only 4-6 weeks at labelled rates.

Solicam (experimental use permit) applied preemergence to incorporated will control both yellow and purple nutsedge. It is more effective on yellow than purple.