

A Four Year Study of Almond Orchard Floor Vegetation Management Options

*J.H. Connell, F. Colbert, W. Krueger, S. Dallman, T. Bettner, R. Gast, D. Cudney
Farm Advisor UCCE, Butte Co., Project Consultant Colbert Enterprises, Farm Advisor UCCE
Glenn Co., PCA Helena Chemical Co., Sales Representative Dow AgroSciences, Research
Station Manager Dow AgroSciences, and Weed Specialist UCCE UC Riverside*

Over ninety percent of California almond orchards are farmed using non-tilled orchard floor management. Strip weed control down the tree rows combined with non-tillage is an efficient system requiring cultural operations in only one direction. Less dust and improved orchard access throughout the year are important benefits of non-tillage.

A smooth, firm, weed free surface facilitates nut drying when nuts are shaken to the ground at harvest. Clean firm middles also provide for an efficient nut pick up operation. Avoiding tree water stress, desirable for flower bud development, is also important during harvest. To avoid tree stress, growers may irrigate between variety harvests which can start a new weed flush. Various methods of orchard middles management are used by growers to achieve desired harvest conditions. Each management system can lead to shifts in orchard weed species composition. Project objectives included evaluating cost effective management programs for difficult to control summer weed species such as common purslane (*Portulaca oleracea* L.) and determining the effect of these selected long term programs on populations of desirable winter annual orchard floor vegetation. This study compared three methods of orchard floor vegetation management over a four-year period.

Materials and Methods

A management team comprised of farm advisors, a project consultant, a pest control advisor, chemical company representatives, an extension weed specialist, and the grower and his foreman was assembled to determine and modify the selected vegetation management programs as needed. The three selected management programs included: 1) mechanical mowing with a supplemental preharvest Roundup 4S or Ultra² application at 1-2qt/Ac, 2) chemical mowing applying Roundup 4S or Ultra at 1pt.-1qt./Ac through the spring supplemented with mechanical mowing, and 3) a low rate residual program applying Surflan 4AS³ at 1qt plus Roundup 4S or Ultra at 1qt/Ac timed just prior to common purslane emergence in the spring supplemented with mechanical mowing. Management programs were arranged in a randomized complete block design employing five replications of approximately one acre per plot.

All herbicides were applied using the growers boom sprayer towed by an all terrain vehicle. The sprayer was equipped with flat fan TeeJet nozzles calibrated to deliver 10 gallons per acre. Summer vegetation counts of common purslane were made annually in each plot. The percentage bareground for each program was estimated before harvest to evaluate the ease of

² Roundup and Roundup Ultra are trademarks for glyphosate manufactured by Monsanto Company.

³ Surflan 4AS is a trademark for oryzalin manufactured by Dow AgroSciences.

harvest operations and the overall program success. Winter vegetation counts of all species were made annually to evaluate a management programs effect on the composition of winter annual vegetation. Cultural practices and actual costs for each management program were tracked and compared.

Results

Summer vegetation management was improved with both chemical programs compared to the standard mechanical mowing. The low rate residual herbicide program most effectively reduced the number of common purslane plants per nine square feet.

Average number of common purslane plants per 9 square feet in June*

Treatment	1995	1996	1997	1998	Average
Mechanical mowing	8.6	99.6	24.2	11.7	36.0
Chemical mowing	6.9	11.4	1.4	6.6	6.6
Low rate residual	1.5	2.2	0.2	0.3	1.0

* Average of 5 replicates with 6 sub-samples per replicate.

Bareground ratings in July prior to preharvest Roundup applications indicated that the low rate residual program provided better summer weed control and reduced the number of mowings required compared to other treatments.

Percent bareground* in July prior to preharvest Roundup application

Treatment	1995	1996	1997	1998	Average
Mechanical mowing	58	84	58	71	68
Chemical mowing	73	98	86	77	84
Low rate residual	82	99	98	97	94

* Average of 5 replicates with 3 visual sub-observations per replicate.

By harvest time in August there was less difference in percent bareground among the three orchard floor management programs. A preharvest Roundup application applied where required as a clean up spray before the August rating readied all vegetation management programs for a clean harvest operation.

Percent bareground* in August after a preharvest Roundup application

Treatment	1995	1996	1997	1998	Average
Mechanical mowing	91	85	96	72	86
Chemical mowing	81	96	96	79	88
Low rate residual	86	99	100	94	95

* Average of 5 replicates with 3 visual sub-observations per replicate.

Maintenance of winter annual vegetation is an important goal for all programs since a vegetation-covered surface affords needed access to the orchard year around. Annual bluegrass (*Poa annua*) is a major component of the winter ground cover that is desired. Over the course of this study all programs preserved the annual bluegrass population. The low rate residual program using Surflan resulted in an annual bluegrass reduction in the dry 1997 spring but good recovery was seen in 1998.

Average number of annual bluegrass plants per 9 square feet*

Treatment	1995**	1996	1997	1998	Average
Mechanical mowing	246	275	214	347	270
Chemical mowing	246	239	286	260	258
Low rate residual	246	284	98	373	250

*Average of 5 replicates with 6 sub-samples per replicate. Counts in February 1995-97 and March 1998.

** Initial vegetation count, average across the entire trial area.

Other common winter annuals potentially affected by orchard floor management programs include chickweed (*Stellaria media*(L.)Cyr.), shepherd's purse (*Capsella Bursa-pastoris* (L.) Medic.), and filaree (*Erodium* spp.). Of these, the filaree population was relatively unaffected by the selected management programs. The chickweed population experienced a general decline under all three vegetation management programs in this study. Over the course of the study, the low rate residual program resulted in a sharper decline in the chickweed population than did the other programs. Shepherd's purse populations increased under the low rate residual program when the annual bluegrass population was suppressed. In general, the shepherd's purse population increased over the course of the study for all vegetation management programs.

Average number of chickweed plants per 9 square feet*

Treatment	1995**	1996	1997	1998	Average
Mechanical mowing	103	59	21	8	48
Chemical mowing	103	19	29	8	40
Low rate residual	103	19	4	3	32

Average number of shepherd's purse plants per 9 square feet*

Treatment	1995**	1996	1997	1998	Average
Mechanical mowing	1	5	29	27	16
Chemical mowing	1	21	15	14	13
Low rate residual	1	25	31	14	18

* Average of 5 replicates with 6 sub-samples per replicate. Counts in February 1995-97 and March 1998.

** Initial vegetation count, average across the entire trial area.

Total accumulated four-year orchard floor vegetation management costs were somewhat similar among the three selected management programs. Mechanical mowing was the least expensive program followed by the low rate residual program at an intermediate cost. The chemical mowing program was the most expensive of the three management systems. The total number of operations required (trips through the orchard) is the major difference among the three management systems.

**Accumulated costs for orchard floor management
January 1995 through August 1998**

Treatment	Chemical Cost	Application Cost	Mowing Cost	Total Cost/Acre
Mechanical Mowing + preharvest Roundup	\$84 (5)*	\$25 (5)	\$149(28)	\$258 (33)
Chemical Mowing w/Roundup, mechanical mowing, and preharvest Roundup	\$136 (11)	\$55 (11)	\$91 (17)	\$281 (28)
Low rate residual w/Surflan + Roundup, mechanical mowing, and preharvest Roundup spot treatment.	\$144 (9)	\$45 (9)	\$75 (14)	\$264 (23)

* (x) = the total number of times the applications or operations were conducted.

Conclusions

The low rate residual program most consistently managed common purslane, a difficult to control weed. When Surflan 4AS at 1 quart plus Roundup Ultra at 1 quart per acre was applied prior to germination of common purslane, excellent weed control was provided through the harvest season. Common purslane germination must be anticipated so that chemical application can occur shortly before weed emergence. Application timing is therefore critical to program success. A mid to late April spray timing is optimum in the northern Sacramento Valley. Low rate residual program benefits include reductions in the number of mowings and reductions in Roundup use since only spot treatments are needed for preharvest cleanup.

Following the preharvest Roundup treatment, clean, firm ground for harvest was provided by all three management programs. No harvest efficiency differences were noted among the treatments since good nut pickup occurred in all plots.

All three programs also provided good winter annual vegetation management. The low rate residual program could result in shifts away from desirable annual grassy weeds if rate and timing of application is not carefully managed. Adjustment of rates may be needed under some conditions in order to preserve the winter cover. The mechanical mowing and chemical mowing programs provided the least variation in the annual bluegrass population.

Ultimately, all programs resulted in comparable costs averaging about \$65 to \$70 per acre per year. Of major benefit was a reduction in the total number of applications plus operations (trips through the orchard) that were required by both chemical programs compared to the mechanical mowing. Significant time and labor savings resulted since chemical mowing saved five trips through the orchard over a four year period and the low rate residual program saved ten trips through the orchard during the same period. After two years, our grower cooperators adopted the low rate residual program for their almond orchard floor management. They stated that the main reason for adoption was the reduced requirement for mechanical operations.

References

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