Plant composition, indicated by species present in each randomly thrown, 8-inch-diameter ring (left), often shifts with changes in cultural practices. In the nontilled orchard at right, mowing of resident vegetation and lack of weed control encouraged an increase in the dandelion population.

Plant composition of orchard floors

Clyde L. Elmore ❑ Wesley K. Asai ❑ Lonnie C. Hendricks
Rachel B. Elkins

Vegetation on orchard floors varies considerably among orchards and growing regions. Weed populations also vary within orchards. The complex of species includes many winter and summer annual plants and often some perennials. Numbers range in any given orchard from a few species (10 to 12) to more than 20.

Changes in orchard cultural practices alter both the number and composition of species. An example is timing a cultivation or mowing to allow certain weeds to seed and remove others that have not yet seeded. Another is frequent mowing, which promotes low-growing annuals or perennials like bermudagrass, *Cynodon dactylon*, over tall weeds. When pre-emergence herbicides remove competition from annual weed species, yellow nutsedge, *Cyperus esculentus*, frequently becomes more prevalent and is very difficult to control.

Introducing competitive or managed species (planted cover crop) or making major changes in management practices often decreases weed species diversity. Introduction of a species may cause major beneficial changes in plant species, make the system easier to manage, reduce pest problems, or increase water penetration. On the other hand, less competitive species may be removed so that fewer but more difficult-to-manage species remain. These changes can increase costs, management time required, or other problems. Shifts to a desirable or an undesirable spectrum of weeds are thus among the factors that must be taken into consideration in selecting a vegetation management system.

Plant composition comparisons

We evaluated the effects of five orchard floor management systems on plant composition as part of the study in the two San Joaquin Valley almond orchards (A and B). We compared the various cover crop and herbicide treatments for their effects on the number of species and plant shifts from the normal resident vegetation.

Plant composition was measured four times a year to determine the spectrum of summer and winter annual, biennial, and perennial species. Within each plot, 25 rings (8-inch diameter) were randomly thrown and the presence of each species in each ring was recorded. From the data we obtained a percent presence figure for each species in each treatment. Plant composition was evaluated over several years for changes under each system. Observation of an important weedy species in the second or third year but not in the first year was also of interest.

Effects on species diversity

The spring plant survey in orchard A showed major changes in species populations under different systems during 1984-88 (table 1). The resident vegetation and the Blando bromegrass systems had a similar number of species. The Blando bromegrass population declined between 1986 and 1988. Salina strawberry clover, which formed a dense, competitive cover, had seven weed species compared with nine in the resident vegetation. In areas where residual herbicides were used, most species were controlled; however, one or two species (nutsedge or prostrate spurge) were present or increased over the 4-year period.

In orchard B, each of the planted cover crops had essentially the same number of species as did resident vegetation (table 1). The perennial strawberry clover was not as competitive in this older, heavily shaded orchard. In the solid herbicide-treated area, no weeds were observed in the spring of 1987 or 1988. When resident vegetation was chemically mowed with glyphosate, the number of species decreased between 1985 and 1988. Similar trends in weed numbers were observed in winter and summer evaluations.

Weed species changes

In orchard A, common sowthistle (*Sonchus arvensis*), an annual weed, was found frequently at first (table 2), but declined during the first year under all systems studied. Common sowthistle does not withstand mowing or herbicide combination treatments. In resident vegetation systems, annual bluegrass (*Poa annua*), hairy fleabane (*Conyza bonariensis*), pineapple weed (*Matricaria matricarioides*), and shepherd's purse (*Capsella bursa-pastoris*), all annuals, decreased over 4 years. Species that increased over the 4-year period included the

perennials dandelion (*Taraxacum officinale*) and strawberry clover, as well as the annuals smooth catsear (*Hypochoeris glabra*) and prostrate spurge (*Euphorbia maculata*). Yellow nutsedge, another perennial, was observed in the resident vegetation in only 1 year of the survey. The same trends occurred in orchard B, except that cudweed (*Gnaphalium*) also increased each year (table 3).

In the orchard A Blando bromegrass plantings, common sowthistle, annual bluegrass, common chickweed, shepherd's purse, and cudweed declined while populations of prostrate spurge, purslane, and

TABLE 1. Species diversity in each vegetation management system, spring survey

Treatment	Number of species*				
	1984	1985	1986	1987	1988
Orchard A:					
Resident vegetation	3	9	8	7	9
Blando bromegrass	4	9	7	7	13
Strawberry clover	2	6	7	3	7
Residual herbicide	0	1	2	0	2
Orchard B:					
Resident vegetation		8	9	10	13
Blando bromegrass		8	9	11	13
Strawberry clover		6	9	10	12
Residual herbicide		3	◊	0	0
Chemical mow		8	◊	1	2

* Diversity indicated by number of weed species present in more than 5% of the rings
◊ Not surveyed due to recent herbicide treatment of these plots rendering weed species unidentifiable.

TABLE 2. Weed species presence by vegetation management system and year, spring survey (April), orchard A

Weed species	Resident vegetation					Bromegrass					Clover					Residual herbicide				
	84	85	86	87	88	84	85	86	87	88	84	85	86	87	88	84	85	86	87	88
	%																			
Annual grasses																				
Annual bluegrass	1	70	3	2	2	—	38	1	1	4	<1	15	8	1	15	—	—	—	—	—
Bromegrass	—	1	6	15	—	—	97	78	—	2	—	—	14	5	3	—	—	—	—	—
Crabgrass	—	—	—	—	11	—	—	—	—	31	—	—	—	—	11	—	—	—	—	—
Annual broadleaves																				
Chickweed	1	32	74	9	48	—	15	46	5	40	—	6	71	1	54	—	1	—	—	—
Cudweed	3	71	2	—	4	4	71	7	2	10	3	10	2	—	2	—	1	—	—	—
Filaree	1	41	88	22	73	—	40	86	25	1	1	10	23	8	52	—	1	—	—	1
Fleabane	2	80	40	26	13	7	55	58	43	8	4	6	6	5	4	<1	—	3	—	—
Pineapple weed	13	60	45	3	—	15	41	26	—	—	39	4	<1	—	—	—	—	—	—	—
Purslane	—	—	<1	28	2	—	—	<1	16	6	—	—	—	2	3	—	—	1	—	—
Shepard's purse	15	61	5	3	7	6	50	5	2	10	4	15	6	—	7	—	—	1	—	3
Sowthistle	34	15	8	—	<1	64	16	6	2	—	45	—	8	—	—	2	—	—	—	—
Smooth catsear	—	—	6	—	15	—	—	4	—	20	—	—	—	—	—	—	—	—	—	—
Spurge	—	—	—	42	—	—	—	—	40	58	—	—	—	2	16	—	—	—	11	32
Perennials																				
Clover	1	15	48	33	50	1	10	18	30	42	—	100	100	100	90	—	—	<1	—	—
Dandelion	—	—	2	11	44	—	1	1	8	24	1	<1	<1	1	7	—	—	1	—	4
Nutsedge	—	—	—	—	1	—	—	—	—	<1	—	—	—	—	—	—	5	10	—	8

NOTES: Species presence—percent of rings where species was recorded—is presented for each plant found in more than 5% of the rings. Dash (—) indicates no plants present of the species.

TABLE 3. Weed species presence by vegetation management system and year, spring survey (April), orchard B

Weed species	Resident vegetation				Bromegrass				Clover				Residual herbicide				Chemical mow			
	85	86	87	88	85	86	87	88	85	86	87	88	85	86*	87	88	85	86*	87	88
	%																			
Annual grasses																				
Annual bluegrass	100	99	78	77	99	96	48	47	100	99	86	82	6		—	—	99		—	—
Bromegrass	—	83	33	84	100	100	90	96	—	53	37	91	—		—	—	1		—	—
Crabgrass	—	—	—	11	—	—	—	13	—	—	—	11	—		—	—	—		—	2
Annual broadleaves																				
Brass buttons	69	45	81	73	36	25	66	76	47	43	83	80	—		—	—	40		—	1
Chickweed	97	80	61	23	88	81	31	13	98	77	52	13	7		—	—	94		—	—
Cudweed	3	13	22	33	2	9	21	16	1	15	15	40	—		—	—	1		—	—
Filaree	19	19	39	10	21	23	33	13	24	29	20	9	—		—	—	29		—	3
Knotweed	61	3	37	19	45	5	14	24	50	5	33	26	1		—	—	61		—	7
Shepherd's purse	3	7	19	8	5	10	8	6	4	12	6	2	—		—	—	9		—	—
Spurge	—	4	43	25	—	—	56	34	—	<1	17	20	—		—	—	—		21	54
Perennials																				
Clover	13	26	42	54	9	16	51	65	—	47	99	89	2		—	—	19		—	3
Dandelion	—	<1	—	11	—	1	4	15	—	<1	—	14	—		—	—	—		—	—
Nutsedge	—	—	—	—	—	—	4	1	—	—	—	—	9		3	—	—		5	4

NOTE: See table 2 NOTES.
* Not surveyed due to recent treatment of these plots rendering weed species unidentifiable.

dandelion increased. In orchard B, a similar decline of winter annuals occurred in the heavy bromegrass stand, but crabgrass and dandelion increased.

The heavy stand of perennial strawberry clover in orchard A led to a dramatic decrease in all winter annual weed species. Although three species were present (over 5% presence) none was significant in number. In the older orchard with heavy shade and a thinner stand of clover, the winter annual species (annual bluegrass, chickweed, brass buttons [*Cotula* spp.], and cudweed) persisted. The summer annuals spurge and crabgrass increased in this system, as did dandelion, indicating the shade susceptibility of clover and its decreasing competitiveness in older orchards.

The complete herbicide treatments did not allow any single species to increase to high populations after treatment. Spurge and nutsedge, however, were present in low numbers at both locations. Summer glyphosate treatments were used to reduce weed populations, but these two species persisted. If the glyphosate treatments had not been used, these difficult-to-control weeds would have become major species (data not shown from summer survey).

In the area chemically mowed with glyphosate at orchard B, prostrate spurge, knotweed, nutsedge, filaree, and escaped strawberry clover were present. All of these species except prostrate spurge are somewhat tolerant of low glyphosate rates. Prostrate spurge probably increased because it germinates throughout the summer at shallow depths and has a rapid germination-to-seeding cycle. It thus can seed before treatment. If prostrate spurge could be used as a cover, it could be easily grown in the summer.

Conclusions

It is unclear which is the "best" system. Both complete herbicide and chemical-mow systems decreased the number of weed species and shifted the composition to prostrate spurge, nutsedge, knotweed, and dandelion. These species are often more difficult to control. This result may not be of concern if timing of applications, changing rates of glyphosate, the use of other herbicides, or cultivation will control the problem weeds. Both systems would dramatically reduce competition to the trees, especially from the spring and summer weeds. In the study locations, the herbicide-treated strip was wide enough to prevent competition that would affect yield or tree growth.

The greatest diversity of species and smallest change in number of species and in population size occurred in the resident, or weedy, vegetation. Because several species were growing and competing into the summer, nutsedge did not appear as a weed; however, dandelion increased. Nutsedge probably was present but could not withstand the competition from annual weeds.

Salina strawberry clover was very competitive when it formed a dense stand (orchard A), and it reduced the diversity and populations of weed species. Where the clover was thin (orchard B), however, the same species found in the resident vegetation were present. Because of its competitiveness in a young orchard, clover should not be allowed around the trees.

A dense Blando bromegrass stand in orchard B competed well with winter annual weeds but allowed summer annuals such as prostrate spurge and the perennial dandelion and clover to increase. Perennial clover would not normally be a problem weed if it had not been planted in the orchard. Blando bromegrass was not a strong competitor as a cover crop and did not maintain a dense population in the young, open orchard A. Blando bromegrass was managed by allowing it to grow until mid-January or February and then mowing it. Regrowth occurred until seed maturity before mowing again late in April or May. This mowing produced a residue mulch, which reduced summer annual germination.

As a means simply of managing vegetation, any one of the systems evaluated could be maintained. Blando bromegrass did not maintain itself well in the sunny, open orchard, and strawberry clover did not develop a heavy stand in the mature, shady orchard. Weed species shifts occurred in all systems, with the greatest shifts in the complete herbicide and chemical mowing treatments. The fewest weed shifts occurred in the resident vegetation and Blando bromegrass, followed by strawberry clover. The effects of the two planted cover crops varied between the two orchards because of the amount of sunlight; bromegrass was persistent in the shaded orchard, and clover in the sunny orchard.

Selection of a vegetation management system depends on orchard conditions, including desirability of a soil cover because of slope. Initial and potential weed species and the options such as herbicides available to handle changes in species would affect the choice. Other considerations include effects on soil, irrigation and water penetration, insect pests, and economics.

Clyde L. Elmore is Extension Weed Scientist, Department of Botany, University of California, Davis; Wesley K. Asai, Lonnie C. Hendricks, and Rachel B. Elkins are Farm Advisors in Stanislaus, Merced, and Lake counties, respectively.