Selective black nightshade control in tomatoes

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Above: Young tomato plants in pot infested with black nightshade. Below: Two weeks after treatment with acifluorfen, black nightshade has been selectively killed.

Success depends on giving tomatoes a head start

A large portion—450,000 acres—of California's tomato acreage is infested with varying degrees of two nightshade species: hairy nightshade (*Solanum sarrachoides*) and black nightshade (*S. nigrum*). Hairy nightshade, now the lesser of the two, predominated as a considerable problem before the use of pebulate (Tillam). Continuous use of pebulate plus napropamide (Devrinol) and rotation with crops where nightshade was inadequately controlled have led to a rapid increase of *Solanum nigrum* and, to a lesser extent, other black nightshade species. Cropping tomatoes "back-to-back" because of equipment and market considerations has contributed to this increase.

Continuous use of trifluralin (Treflan) and chemically related herbicides in cotton has also helped to promote a large population of the *Solanum* species in the central San Joaquin Valley. A similar buildup of black nightshade has occurred along the coast where herbicides similar to trifluralin have been used in beans.

Rotation to crops where herbicides such as prometryne (Caporal) are used in cotton and celery, EPTC (Eptam) in beans, and EPTC plus safener (Eradicane), alachlor (Lasso), and metolachlor (Dual) in corn has helped to keep black nightshade under control in some fields. In most tomato fields, however, black nightshade has become a severe problem.

Over the past few years, the University of California, the California Tomato Research Institute, and cooperating chemical companies have supported research on control of black nightshade in tomatoes. Partially successful approaches include: (1) soil fumigation with spray-blade applications close to the surface with metham (Vapam) and 1,3-D fumigants; (2) water incorporation of metham; (3) the use of plug planting coupled with application of chlorpropham (Furloe), and (4) metham used experimen-

tally preplant with two unregistered herbicides, metolachlor (Dual) and ethalfluralin (Sonalan) applied postplant. Some of the answers to the nightshade control problem are logistically difficult, and others are expensive. Many other herbicides were also evaluated for weed control in tomatoes, applied preplant incorporated, preemergence, or postemergence, but were not sufficiently selective.

In 1980 a new herbicide, acifluorfen (Blazer or Tackle), for black nightshade control was observed to be selective in tomatoes in the Midwest, where it was being developed for use in soybeans. This chemical has been extensively evaluated in California's processing tomato fields for the past five years and has shown considerable promise for selective control of black nightshade. It is relatively less active on hairy nightshade, on many broadleaf weeds such as lambsquarter and pigweed, and on annual grasses.

Field and greenhouse work has shown that an early postemergence application of acifluorfen at a sublethal dose followed one week later by a higher rate was better tolerated by the tomatoes and gave better control of black nightshade than larger single doses. Timing of the applications was critical: the tomato had to be fairly well established with the first or second true leaf expanded, and it had to be larger and preferably more mature than the cotyledon to two-leaf stage of the black nightshade. When these conditions were met, excellent selective black nightshade control (80 to 100 percent) was obtained in a large number of trials in many locations throughout the state. In 1984 and 1985 field experiments, yields were higher in treated than in untreated control plots in nearly all trials, even though tomatoes at some locations showed some early herbicide phytotoxicity symptoms.

Acifluorfen applied at ½ to 1 ounce per acre in the first or second true-leaf stage of the tomato in good growing conditions followed a week later with 1 to 2 ounces has given excellent selective black nightshade control in most processing tomato varieties. In a wet year, such as 1981-82 and 1982-83, or under sprinkler irrigation with continuous nightshade germination, a third application may be necessary. Although repeated applications increase the cost because of the additional trips across the field, the chemical is relatively low in cost at these low rates.

Successful control depends on the tomato seedling being well ahead of the nightshade seedling in growth. Since there are many times more black nightshade than tomato seedlings in most infested fields, the competition for nutrients and water can be devastating to the young tomato seedlings. A possibly more important reason is that tolerance to acifluorfen appears to be related to the relative development of the crop plant and the weed species. If nightshade development can be slowed by cultural techniques or the use of selective preplant preemergence chemicals, the young tomato will have an immediate and important advantage over the weed.

In our tests, the use of soil fumigants or nonselective, short-lived contact herbicides (such as metham) to reduce the number of healthy nightshade seedlings has been very effective in giving tomato seedlings a small but significant head start. Tomatoes and nightshade have very similar soil temperature and other environmental requirements, and they tend to germinate together. If beds were prepared well in advance, black nightshade was often well started before tomatoes were seeded, making it difficult or impossible to obtain a good margin of selectivity. When metham was used at a low rate to kill or retard the black nightshade seeds ready to germinate, selectivity with acifluorfen was excellent.

Although acifluorfen showed the most selectivity when applied postemergence, it was also active through the soil with a degree of selectivity for black nightshade control in tomatoes. Recent trials have included preplant as well as preemergence applications with direct-seeded tomatoes, which were then followed by repeated postemergence application of low rates of the herbicide. Initial preemergence application of low rates appeared to slow nightshade growth and thereby weaken the weed so that subsequent applications eliminated the competition to tomatoes.

Acifluorfen is not registered for use in tomatoes in California, but its selectivity in soybeans makes it more likely to be registered and manufactured for tomatoes through the national IR-4 pesticide registration program in which California has an active part. A large number of field trials have been conducted to support registration of this selective preemergence and postemergence herbicide for weed control in California tomatoes.

TABLE 1. Comparison of actifluorfen and untreated control plots of 15 tomato varieties, Sacramento and San Joaquin counties

Varieties	Average yield	
	Acifluorfen	Control
	------ *tons/acre* ------	
UC204C	32.0	20.2
E-6203	29.4	24.5
PSX 33790	37.5	32.8
Castlejay	27.8	28.8
FM 785	34.7	30.7
GSX-1	27.0	25.5
AUX 5131	32.8	28.7
UC82B	34.2	29.3
H-1916	27.1	21.4
49er Hybrid	34.4	27.6
PETO 9889	30.1	24.4
UC204B	23.4	26.1
Castlejay 1518B	39.5	31.0
Castle Royal	27.7	23.4
Joaquin	27.6	34.1

Note: Increased yields from acifluorfen are from enhanced weed control. Decreased yields are from herbicide injury. The relation of tomato variety to herbicide could be important when (and if) this herbicide is registered; however, statistical analysis of 1984-85 data indicated no apparent interaction between variety and acifluorfen treatment.

TABLE 2. Effect of sequential postemergence applications of acifluorfen on black nightshade control in tomatoes

Acifluorfen rates on application dates	Stage of tomato growth*	Average weights†	
5/19+5/26+6/3		Black nightshade‡	Tomato§
.... *lb/acre*		*kg*	*kg*
1/2 + 2	1 leaf	0.9	24.8
1 + 2	1 leaf	0.4	19.1
2 + 2	1 leaf	0.3	16.6
1 + 4	2-4 leaf	0.6	15.5
2 + 4	2-4 leaf	0.3	15.2
4 + 4	2-4 leaf	0.5	18.8
2	4-6 leaf	1.1	11.5
4	4-6 leaf	1.3	14.8
8	4-6 leaf	1.0	12.7
Untreated check	—	2.2	8.1

* Stage of tomato seedling at the time of first application.
† Average of three replications.
‡ Entire black nightshade plant was weighed. Weights taken in kilograms per plot.
§ Whole tomato plants and fruits were weighed. Weights taken in pounds and converted to kilograms. Treatment dates indicated at top of table. Evaluated 7/23/82.

TABLE 3. Effect of applying acifluorfen to young tomatoes in the 1-2 true leaf

Herbicide	Oz/acre*	Average tomato vigor†‡		
		Exp.3	Exp.4	Exp.5
Acifluorfen	1/2(+2)	9.2	7.5	9.2
Acifluorfen	1(+2)	8.5	9.5	9.0
Acifluorfen	2(+2)	7.8	8.5	9.2
Untreated check	—	7.2	7.8	9.2

Note: The poor growth in the untreated check indicates the effect of black nightshade and hand weeding by commercial crews whereas the treated plots had fewer weeds to hoe and therefore less damage.
* The rate in parentheses was applied 5/18/83. The initial rate was applied 5/11/83.
† Average of four replications where 0 = no tomatoes and 10 = best growth. Evaluated 6/7/83.
‡ Exp. 1 and 2 gave the same result, but slightly different rates were used.

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