

# Dodder control in alfalfa

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**Extended dodder control was achieved with pre-emergence applications of dinitroaniline herbicides, in either a single 4-pound application or a split application of 2 + 2 pounds. Of the herbicides studied, prodiamine was the most persistent.**

Dodder is a parasitic weed that causes serious problems in California forage and seed alfalfa fields. Parasitized alfalfa plants grow less vigorously, often becoming so weakened that they die. Because dodder is succulent, heavily infested alfalfa may require at least an extra day to cure. A severe dodder infestation can thus reduce stand, cause improper curing of hay, and lower forage and seed yields. As a result, hay prices may be discounted, often by more than \$10 a ton.

A survey of California's major alfalfa-producing areas in 1985 revealed that dodder was present in 25 of the 29 counties studied. The survey, conducted by the University of California Cooperative Extension, showed a trend toward greater infestations in the warmer regions of the state. The highest infestation level was in the high desert areas of Los Angeles and San Bernardino counties, where 90% to 95% of the alfalfa fields were infested.

## Dodder biology

Three species of dodder have been found in alfalfa: largeseed dodder (*Cuscuta indecora*), field dodder (*C. campestris*), and smallseed dodder (*C. planiflora*). Field samples indicated that smallseed and field dodder are most prevalent in northern California; largeseed and field dodder predominate in the Sacramento and San Joaquin valleys; and largeseed is the only dodder species in the high desert region.

Most dodder seeds are hard, with only a small percentage of the seed present in an alfalfa field germinating in any one year. As a result, once an alfalfa field is infested with dodder, it can be expected to be a problem for several years.

Field observations have shown that dodder first emerges in late winter to early spring, depending on the location. Initial emergence occurs in late May in the northern intermountain alfalfa production re-

gion, late February to early March in the Sacramento and San Joaquin valleys, and March in the high desert. Emergence then continues throughout the season but at a significantly lower level.

Dodder emerges as a rootless, leafless stem, dependent on the food reserve stored in the seed for its immediate survival. A suitable host, such as alfalfa or certain weeds, must be found within a few days or the dodder seedling will die. Once the dodder twines around the host, it embeds suckerlike structures (haustoria) into the stem. Its contact with the soil is then severed and it lives at the expense of the host plant. New shoots are initiated at the point of attachment and become attached to other stems on the same plant or adjacent plants.

Dodder can form dense mats greater than 10 to 15 feet in diameter, which often coalesce, turning large areas of the field an orange color. During the summer, numerous clusters of small white flowers are produced near the alfalfa stem. Seed production is prolific, with each flower capable of producing up to four seeds.

Dodder has been an extremely difficult weed to control. Previously available pre-emergence herbicides provided only erratic, short-lived control. Growers have relied on nonselective contact herbicides and on flaming with propane-fueled burners to combat this tenacious pest after it has become attached to the alfalfa. These methods of dodder control are time-consuming, costly, injurious to the alfalfa, and largely ineffective.

## Field studies

Dodder control was observed in preliminary studies in 1985 using a new granular formulation of trifluralin (Treflan TR-10). This prompted a series of field research trials.

During 1985-87, we conducted herbicide trials in the high desert (Lancaster and Lucerne Valley), Central Valley (Madera and Tracy), and northeastern mountain region (Janesville). A total of nine trials were conducted in commercial alfalfa fields with a history of severe dodder infestation.

Trifluralin was evaluated at 2 and 4 pounds active ingredient per acre and a split application of 2 plus 2 pounds. Herbicide applications were made with granular applicators before dodder emergence and

incorporated with rainfall or irrigation water within 3 days. The second application of the split treatment was made after the first alfalfa harvest.

Four additional experiments were conducted in Lancaster and Madera in 1986-87 to evaluate the effectiveness of other dinitroaniline herbicides. Trifluralin, pendimethalin (Prowl), and prodiamine (Endurance) were applied at 2 and 4 pounds active ingredient per acre and a split application of 2 plus 2 pounds. Both pendimethalin and prodiamine were applied with a constant-pressure, carbon dioxide backpack sprayer, and trifluralin with granular applicators. The herbicides were applied before dodder emergence and incorporated with rainfall or sprinkler irrigation. The second application of the split treatments was made after the first alfalfa harvest.

Dodder control was evaluated throughout the season. Percent control was calculated based on counts of dodder colonies. A randomized complete block experimental design with four replications was used in all studies.

## Results and discussion

The results obtained in Lancaster in 1986 are typical of the trifluralin experiments (fig. 1). Dodder control 3 and 4 months after application was 90% or greater at all application rates. Control diminished significantly 149 days after treatment, particularly at the 2-pound application rate. The split application of 2 + 2 pounds was the most effective treatment 6 months after applica-

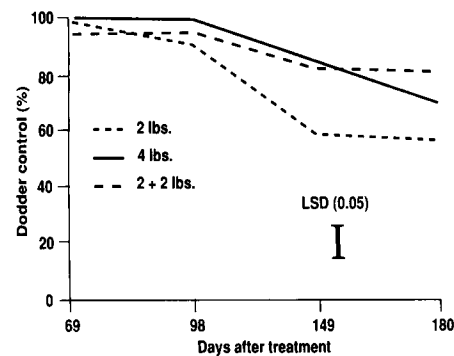


Fig. 1. Early-season dodder control was above 90% at all three rates of trifluralin. Control then declined, particularly at 2 pounds. Lancaster 1986 results shown are typical of the experimental data.

tion. There was a highly significant interaction between treatment and evaluation date, indicating that dodder control diminished as the season progressed, but the decline was most rapid at the 2 pound rate.

Table 1 summarizes all the trifluralin trials throughout California. Early-season dodder control was excellent, ranging from 91% to 98% approximately 3 months after application. About 4 to 5 months after application, control with the 2-pound rate declined to 78.1% but was still at about 90% in the 4- and 2 + 2-pound treatments. Dodder control after that was no longer commercially acceptable in five out of nine of the trials. No alfalfa injury was observed in any of the treatments.

There are two possible reasons for the low level of dodder control and variability

at the end of the season. First, the concentration of trifluralin remaining in the soil most likely had declined to a level that was no longer lethal to the dodder seedlings. Second, dodder plants not controlled during the season are apt to be extremely large by mid- to late-summer. Although a high percentage of individual plants may have been controlled, the rapid growth rate of dodder makes it impossible to determine if an extensive mat developed from numerous plants or from an individual seedling. The wide range in the percentage of control at the last evaluation date could be due to different dodder infestation levels at the test sites. Percent control of individual dodder plants was probably similar but, by late season in fields with a heavy infestation, the control appeared to be less because the

dodder plants that escaped had expanded and coalesced.

In areas with relatively short growing season, such as Janesville (110 frost-free days), a single application of 2 pounds per acre appears to be sufficient. At the end of the season, that trifluralin treatment was still providing 95% control.

In other areas, split applications of trifluralin extended the period of dodder control. A split application of 2 + 2 pounds was significantly superior to the single 2-pound application. Control with a split application was similar to that at a single 4-pound rate until the end of the season, when the split application was slightly more effective.

All of the dinitroaniline herbicides tested provided outstanding early-season dodder control—at least 93% (table 2). However, they differed in the length of control provided. By late-summer, control with all rates of trifluralin and pendimethalin declined substantially. Pendimethalin at the 4- and 2 + 2-pound rates was slightly more effective than trifluralin. Prodiamine was the most persistent of the dinitroaniline herbicides tested, giving 78%, 87%, and 94% control at the 2-pound, 4-pound, and 2 + 2-pound rates, respectively.

## Conclusions

These trials indicate that dinitroaniline herbicides provide pre-emergence dodder control without injury to alfalfa. Early-season dodder control was excellent with all herbicides at the rates tested. Control diminished as the season progressed. A single application of 4 pounds per acre or a split application of 2 + 2 pounds extended the control period. Prodiamine was the most persistent, providing nearly season-long control. At present, trifluralin (Treflan TR-10) at the 2 or 2 + 2-pound rate is the only herbicide registered for this use in alfalfa in California.

For complete dodder control, the use of a pre-emergence dinitroaniline herbicide must be integrated with other control measures. Dodder that escapes the dinitroaniline treatment should be controlled by burning or flail-mowing before it has set seed. Dodder patches can then be burned at the end of the season to destroy seeds and reduce dodder emergence the following season. With a conscientious effort and perseverance, dodder can be eliminated by this combination of control measures.

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**TABLE 1. Summary of dodder control results with trifluralin, 1985, 1986 and 1987**

Herbicide and rate	Percent control* Days after treatment		
	90-109	120-150	169-197
lb/acre	%		
Trifluralin			
2	91.2 (81-99)	78.1 (58-99)	58.5 (30-99)
4	98.2 (94-100)	90.6 (80-99)	66.7 (30-100)
2 + 2	96.0 (86-100)	88.3 (77-100)	72.2 (22-99)

NOTES: Average of six to nine trials.

Individual trials were analyzed separately; statistically significant differences (95% confidence level) were found in each trial for herbicide treatment compared to untreated control plots.

\* Values in parentheses indicate the range.

**TABLE 2. Summary of dodder control with preemergence dinitroaniline herbicides**

Herbicide and rate	Percent control* Days after treatment		
	45-75	95-105	140-180
lb/acre	%		
Trifluralin			
2	93 (90-95)	85 (76-98)	46 (30-72)
4	99 (99)	97 (94-99)	58 (30-80)
2 + 2	94 (90-96)	95 (86-100)	56 (45-77)
Pendimethalin			
2	94 (85-100)	85 (70-100)	49 (22-77)
4	99 (97-100)	90 (73-100)	72 (55-93)
2 + 2	95 (90-100)	98 (96-100)	76 (65-86)
Prodiamine			
2	97 (99-100)	91 (92-100)	78 (79-94)
4	99 (99-100)	97 (92-100)	87 (79-94)
2 + 2	94 (87-100)	99 (98-100)	94 (94-95)

NOTES: Average of three to four trials.

Individual trials were analyzed separately; statistically significant differences (95% confidence level) were found in each trial for herbicide treatment compared with untreated control plots.

\* Values in parentheses indicate the range.





A dodder seedling emerges as a rootless, leafless, arched stem (above), then straightens and rotates in search of any elongated object (right). To survive, the parasitic weed must find a suitable host plant within a few days.



Dodder twines counterclockwise around a host plant (above). If the plant is a suitable host, such as alfalfa, dodder embeds suckerlike structures or haustoria in the stem (right) and contact with the soil is severed. It then lives at the alfalfa plant's expense.



New dodder shoots develop rapidly, becoming attached to other stems and suppressing or killing the alfalfa plants. Dense mats of dodder often coalesce, turning large areas of the field orange. Dodder has been found in 25 of 29 alfalfa-producing counties in California.