# Pre-emergence Herbicides for Weed Control in Walnuts

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WALNUTS ARE CALIFORNIA'S leading deciduous tree crop. Walnut orchardists spend over one million dollars annually for weed control on an estimated 140,000 acres. In addition, losses due to weeds in the orchards were recently estimated at $2,720,000 annually.

Current methods of weed control include repeated disking, some oil spraying, and, to a limited extent, dormant-season application of soil-residual herbicides. This report summarizes the results of a general study, including greenhouse and field experiments, designed to evaluate the effectiveness of a number of herbicides for use in walnut orchards. Following preliminary greenhouse tests, simazine and diuron were tested in mature orchards in the major walnut-producing districts of California. Effects of the herbicidal treatments were evaluated for residues in the nuts, leaf symptoms, and for the degree of weed control obtained.

The possibility that walnut trees might be resistant to the urea and triazine herbicides was first recognized when walnut seedlings were observed growing as "weeds" in citrus orchards that had been treated with those materials. Preliminary tests were made in the greenhouse at Riverside with seedlings of Paradox hybrid and northern California black walnut growing in soil in 4-gallon cans. The tests indicated that both types of walnut were tolerant of four herbicides in the increasing order: monuron, diuron, atrazine, and simazine. Later greenhouse tests at Davis substantiated the earlier tests, and have shown a number of other herbicides such as the uracils to be considerably less safe on walnuts than are the triazines or substituted ureas.

On the basis of their relative safety and excellent weed control characteristics, diuron and simazine were selected for field testing in California's major walnut-producing districts from the Sacramento Valley, through the Brentwood and San Joaquin Valley to the southern coastal areas and the Moreno Valley.

Fifteen sets of field tests were designed to evaluate tree tolerance and weed control, and to provide residue information. Generally, simazine and diuron were each applied at rates of 2, 4, and 8 lbs (2.5, 5 and 10 lbs of the 80% wettable powder) per acre in the fall, followed by second applications of the 2- and 4-lb rates in the spring. Plots at some locations received only the fall treatment, at other locations only the spring treatment, and still others received both fall and spring applications: Tests were continued at three locations for two years and at one

Pre-emergence control of annual weeds in walnuts with simazine in test plot to left, as compared with check (untreated) plot to right.

location for three years. In the latter, an accumulated total of 24 lbs of herbicides was applied to the plots treated with 4 lbs semiannually or 8 lbs annually. The plots were rated for weed control (see table), and the trees were examined for phytotoxic symptoms periodically through the growing season. Where standing weeds were present, a knock-down herbicide was applied with simazine and diuron.

Field plot trials showed that simazine and diuron in the range of 2 to 4 lbs per acre, each, resulted in greater than 90% weed control (see table). Control of winter annual weeds was generally better than of summer annuals. Excellent control of winter weeds in the Davis test was achieved using the low application rates of both simazine and diuron, but control of summer weeds by diuron was poor. In the plots at the Chase Ranch in San Joaquin County, both diuron and simazine were limited in effectiveness on both winter and summer weeds the first year. Better control, particularly with diuron, was obtained in the two subsequent years. Both herbicides were generally more effective in southern California and in the lower San Joaquin Valley than in the northern growing areas.

The experiments show that diuron and simazine are generally equal in effectiveness for control of annual weeds under these orchard conditions (see graph). In some instances one herbicide is markedly more effective than the other. This difference in response is dependent on soil type, organic matter, amount of rainfall and weed species. One of the plot area photos shows excellent annual weed control. Amitrole, used experimentally in combination with simazine or diuron, was effective in all cases in providing

HERBICIDE TREATMENT SCHEDULE AND PER CENT WEED CONTROL FROM THIRTEEN FIELD PLOTS IN WALNUT ORCHARDS IN FOUR PRODUCTION AREAS OF CALIFORNIA

| County and cooperator | Herbicide | Rate* | Number of treatments | | Accumulated treatment* | Average weed control | |
|---|---|---|---|---|---|---|---|
| | | | Fall | Spring | | Winter | Summer |
| | | lb/A | | | lb/A | % | % |
| Riverside (Corwin, 1) | Diuron | 2.5[a] | 1 | .. | 2.5 | 95 | 10 |
| | | 10[a] | 1 | .. | 10 | 98 | 30 |
| | Simazine | 2.5[a] | 1 | .. | 2.5 | 95 | 10 |
| | | 10 | 1 | .. | 10 | 95 | 20 |
| Riverside (Corwin, 2) | Diuron** | 2.5 | 1 | 1 | 5 | 90 | 90 |
| | | 5 | 1 | 1 | 10 | 90 | 98 |
| | Simazine** | 2.5 | 1 | 1 | 5 | 95 | 99 |
| | | 5 | 1 | 1 | 10 | 95 | 100 |
| Santa Barbara (Rowe) | Diuron** | 2.5[ab] | 1 | 1 | 5 | 100 | 99 |
| | | 10[a] | 1 | .. | 10 | 100 | 100 |
| | Simazine** | 2.5[ab] | 1 | 1 | 5 | 100 | 100 |
| | | 10[a] | 1 | .. | 10 | 100 | 100 |
| Ventura (Barrett) | Diuron | 2.5[a] | 1 | 1 | 5 | 95 | 100 |
| | | 10[a] | 1 | .. | 10 | 100 | 100 |
| | Simazine | 2.5[a] | 1 | 1 | 5 | 90 | 100 |
| | | 10[a] | 1 | .. | 10 | 98 | 100 |
| Tulare (Newman) | Diuron** | 2.5[a] | 2 | 2 | 10 | 98 | 93 |
| | | 10[a] | 2 | .. | 20 | 100 | 98 |
| | Simazine** | 2.5[a] | 2 | 2 | 10 | 80 | 90 |
| | | 10[a] | 2 | .. | 20 | 93 | 95 |
| Stanislaus (Wilson) | Diuron | 2.5 | 1 | 1 | 5 | 100 | 100 |
| | | 5 | 1 | 1 | 10 | 100 | 100 |
| | | 7.5 | 1 | 1 | 15 | 100 | 100 |
| | Simazine | 2.5 | 1 | 1 | 5 | 100 | 98 |
| | | 5 | 1 | 1 | 10 | 100 | 100 |
| | | 7.5 | 1 | 1 | 15 | 100 | 100 |
| San Joaquin (Chase) | Diuron** | 2.5[ab] | 3 | 3 | 15 | 75 | 80 |
| | | 5 | 3 | 3 | 30 | 85 | 90 |
| | | 10[a] | 3 | .. | 30 | 93 | 93 |
| | Simazine** | 2.5[ab] | 3 | 3 | 15 | 75 | 55 |
| | | 5 | 3 | 3 | 30 | 85 | 65 |
| | | 10[a] | 3 | .. | 30 | 93 | 65 |
| San Joaquin (Stewart) | Diuron** | 2.5[a] | 1 | 1 | 5 | 50 | .. |
| | | 5 | 1 | 1 | 10 | 60 | .. |
| | | 10[a] | 1 | .. | 10 | 80 | |
| | Simazine** | 2.5[a] | 1 | 1 | 5 | 98 | .. |
| | | 5 | 1 | 1 | 10 | 98 | .. |
| | | 10[a] | 1 | .. | 10 | 100 | .. |
| Yolo (UC Davis) | Diuron** | 2.5[a] | 1 | 1 | 5 | 100 | .. |
| | | 5 | 1 | 1 | 10 | 100 | 60 |
| | | 10[a] | 1 | .. | 10 | 100 | 70 |
| | Simazine** | 2.5 | 1 | 1 | 5 | 99 | 85 |
| | | 5 | 1 | 1 | 10 | 99 | 95 |
| | | 10 | 1 | .. | 10 | 100 | 98 |
| Sutter (Blazer) | Diuron** | 2.5 | 1 | 1 | 5 | 100 | 95 |
| | | 5 | 1 | 1 | 10 | 100 | 98 |
| | Simazine** | 2.5 | 1 | 1 | 5 | 100 | 90 |
| | | 5 | 1 | 1 | 10 | 100 | 98 |
| Butte (Corcoran) | Diuron** | 2.5[a] | 2 | 2 | 10 | 95 | 100 |
| | | 5 | 2 | 2 | 20 | 95 | 100 |
| | | 10[a] | 1 | .. | 10 | 90 | 100 |
| | Simazine** | 2.5 | 2 | 2 | 10 | 98 | 85 |
| | | 5 | 2 | 2 | 20 | 98 | 90 |
| | | 10 | 1 | .. | 10 | 98 | 80 |
| Contra Costa (Bunn) | Diuron** | 2.5[ab] | 1 | 1† | 5 | 100 | .. |
| | | 5[a] | 1 | 1† | 7.5 | 100 | .. |
| | | 10[a] | 1 | 1† | 12.5 | 100 | .. |
| | Simazine** | 2.5[ab] | 1 | 1† | 5 | 100 | .. |
| | | 5 | 1 | 1† | 7.5 | 100 | .. |
| | | 10[a] | 1 | 1† | 12.5 | 100 | .. |
| Lake (Smith) | Diuron** | 2.5[a] | 1 | 1 | 5 | 85 | 100 |
| | | 5[a] | 1 | 1 | 10 | 85 | 100 |
| | | 10[a] | 1 | .. | 10 | 98 | 100 |
| | Simazine** | 2.5[a] | 1 | 1 | 5 | 80 | 100 |
| | | 5[a] | 1 | 1 | 10 | 90 | 100 |
| | | 10[a] | 1 | .. | 10 | 95 | 100 |
| Sutter (Hansen) | Diuron** | 2.5 | .. | 1 | 2.5 | .. | 85 |
| | | 5 | .. | 1 | 5 | .. | 100 |
| | | 10 | .. | 1 | 10 | .. | 100 |
| | Simazine** | 2.5 | .. | 1 | 2.5 | .. | 95 |
| | | 5 | .. | 1 | 5 | .. | 100 |
| | | 10 | .. | 1 | 10 | .. | 100 |
| Butte | Diuron** | 1.2 | .. | 1 | .25 | .. | 40 |
| | | 2.5 | .. | 1 | 2.5 | 1 | 70 |
| | | 5.0 | .. | 1 | 5.0 | .. | 70 |
| | Simazine** | 1.2 | .. | 1 | .25 | .. | 70 |
| | | 2.5 | .. | 1 | 2.5 | .. | 70 |
| | | 5.0 | .. | 1 | 5.0 | .. | 80 |

* Treatment Rate—Commerical product basis containing 80 per cent active ingredient.

** Retreatments include amitrole—one pound per acre (active ingredient basis). NOTE: Amitrole is not registered for use in walnuts.

† II plots re-treated at 2.5 pounds per acre rate.

[a] Nut samples analyzed for diuron or simazine residues.

[b] Nut samples analyzed for amitrole.


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initial control of standing vegetation (amitrole is *not* as yet registered for use in walnut orchards).

No symptoms of injury were observed in trees in the tested areas with the exception of leaf symptoms appearing in late June in the Chambers plot, Butte County, on a sandy river bottom soil that had been treated in April at the rate of 4 lbs per acre. Symptoms in young trees consisted of marginal and interveinal chlorosis, recognized as characteristic of triazine symptoms in walnuts.

A method for simazine analysis was developed which gave an average 80% recovery with average deviation of ± 42%. No residue was found in the meats of walnuts from samples of 10 orchards. Samples from the same field tests were also analyzed for diuron by the E. I. du Pont de Nemours Chemical Company and found to be free of chemical residue.

### Weed control program

Annual weeds in walnut orchards can be controlled under several programs, including applications of a 50:50 mixture of weed oil and water at 40 to 100 gallons per acre, depending upon the height and density of weed growth. The lower rates are sufficient for young weeds in the 1- to 2-inch stage, whereas older weeds will require closer to 100 gallons per acre. It is therefore desirable to control weeds with weed oil in the earliest stage after the maximum amount of germination. In using weed oil for annual weed control in walnut orchards, one must exercise care in using directed sprays to keep oil off the trunks, particularly of young trees, as severe damage may result from applying weed oil to the foliage or trunks of young trees.

Annual weeds can also be controlled by application of 2 lbs of diuron (i.e., 2.5 lbs of Karmex) in 40 to 60 gallons of water, applied after harvest and prior to fall rains. In areas of heavy soils and high rainfall, a second application in the spring is often desirable. Weeds can be controlled over the entire orchard floor, in strips down the tree rows, or in small areas around the base of trees. Regardless of the method used, accurate application on the basis of the area of soil sprayed must be employed. Diuron should be used only on well-established walnut trees one year or older. It should never be used in desert valleys nor on some sandy soils. Diuron can also be used in a single application after harvest and prior to weed germination at the rate of 2.4 to 4 lbs of diuron (3 to 5 lbs of Karmex) in 40 to 60 gallons of water per acre. The lower rate of 2.4 lbs has usually been adequate in light soils whereas in heavy soils with high organic matter content, 4 lbs has given better weed control, with sufficient safety, to well-established walnut trees, one year or older.

Simazine is also recommended for annual weed control in walnut orchards and should be applied at the rate of 2½ to 5 lbs of 80W simazine in 40–60 gallons of water after harvest, i.e., before annual weeds germinate in the fall. More latitude on timing can be used when under sprinkler irrigation. However, under furrow irrigation it is essential to apply both simazine and diuron prior to the annual rainfall so that these herbicides may be activated by being leached into the root zone of germinating weed seeds.

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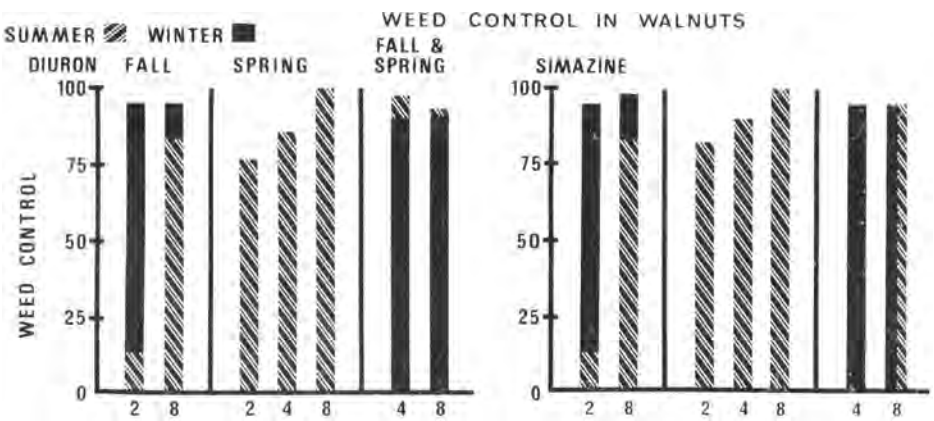
**Summary of average percentage weed control from 15 field trials where applications were made in the fall, spring, and in both spring and fall, at rates of 2, 4 and 8 lb per acre. Evaluations for weed control were made in summer and again in the winter.**




H. T. HARTMANN

THE OLIVE TREE (*Olea europaea* L.) has very desirable characteristics for use as an ornamental. It has attractive, gray-green foliage, and develops a picturesque, gnarled trunk and branch system as the tree grows older. It is an evergreen with a willowy-type of shoot growth which makes a very pleasing appearance. The great disadvantage of the olive as a street, lawn, or patio tree is the production of fruits which drop over a long period of time during the winter and early spring months. These, of course, become a great nuisance, discoloring concrete walks, adhering to pedestrians' shoes, and attracting birds which consume some of the olives and further contribute to the litter.

Aware of the potential value of a fruitless olive as an ornamental, horticulturists of the University of California have long been on the lookout for an olive tree which does not produce fruits. Occasionally, it appeared that one had been located, but invariably it originated in an area having warm winters and, when grown in regions having greater amounts of winter chilling, such trees would fruit. It is known from the climatic adaptation of olives for commercial fruit production, as well as from experimental studies, that the olive tree requires a period of several months with substantial chilling temperatures (about 2000 hours below 45°F) for flower and fruit production. Trees grown in regions having little or no such chilling produce few blooms or fruit because they have received insufficient winter chilling. Unlike many deciduous tree-fruit species, the olive does not require winter chilling in order to have satisfactory vegetative growth in the spring.

### Australian tree

During a sabbatic leave, in Australia in 1960–61, the author discussed the desirability of a fruitless olive tree with horticultural officers of the Victoria Department of Agriculture. They mentioned the existance of a single olive tree which had been planted approximately 30 years previously near a farm house close to the town of Swan Hill in Northern Victoria. This tree had never been known to produce fruits. Other olive trees of the same age planted around the farmhouse fruited normally. This place was visited in November, 1960, just at the time the olive trees were coming into full bloom. The "fruitless" tree was in bloom, but examination proved that the flowers were