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 location for three years.
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 in all cases in providing excellent annual weed control. In the lower San Joaquin Valley than in the northern growing areas. 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 excellent annual weed control.

**Table 1:** 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 in All Cases in Providing Excellent Annual Weed Control. In the Lower San Joaquin Valley Than in the Northern Growing Areas. 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 Excellent Annual Weed Control.
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 walnut orchards). 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, the tree rows, or in small strips down the tree rows, or in small areas around the base of trees. Regardless of the method used, accurate application 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 2.5 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.

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.

![Diagram showing weed control in walnuts]