

WEED CONTROL IN AVOCADO ORCHARDS

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Cultivation in avocado orchards in California is almost a thing of the past. It has been shown that cultivation does not conserve soil moisture, nor does it have advantages in the establishment of a mulch. Since avocados are surface feeders, 'Cultivation injures the trees by the destruction of roots near the soil surface. Cultivation also breaks down soil structure and results in the formation of a plow sole just under the cultivated portion, which retards the penetration of water. Erosion from rainfall and irrigation water is a problem when hillside soils are cultivated. Untilled soils are less subject to erosion. Other than its value for incorporating manures into the soil and preparing irrigation works, cultivation is useful to the orchardist only as a means of controlling weeds. With so few advantages to offset numerous disadvantages, it is understandable that growers have sought means other than tillage for controlling weeds so that cultivation may be eliminated altogether as an orchard practice.

In eliminating cultivation, two methods of non-tillage have emerged in avocado orchards. One program allows the development of a sod of weeds between the trees. Weeds are mowed and no effort is made to eradicate them except around young trees to prevent excessive plant competition. Under a mowing program, regardless of the weed population originally present, bermudagrass eventually crowds out other weed species, resulting in a solid bermudagrass sod.

The second method calls for the complete control of weeds by means of chemical or oil sprays with the formation of a natural leaf mulch. There are advantages to such a program, since even closely mowed weeds are competitive with the trees.

Weeds require the same nutrients as other plants. Weedy species feed aggressively, competing for nutrients needed by the trees. Even more serious is the competition of weeds for water. There is evidence that mowing of a cover crop, such as bermudagrass, does not appreciably reduce its use of water. Water-requirement studies show that it takes about seven hundred pounds of water to produce one pound of dried plant material. Although this varies with plant species, it is known that weedy species are among our most extravagant users of water. A permanent cover crop often uses as much water as the trees.

In situations where water is inexpensive and plentiful, it is understandable that weed control in orchards is frequently neglected. However, faced with today's high cost of water, control of weeds in orchards becomes a problem of compelling importance.

Also, weeds harbor insects and other agricultural pests. Rodents prefer to work where weed cover is present. Rodent control is more difficult where weeds prevent the grower from seeing signs of their activity.

From the point of view of control, weeds may be divided into two groups; annuals and perennials. Annuals are more readily controlled than perennials, most of which are capable of re-growth from resistant roots or rhizomes following cultivation or chemical treatment. Bermuda-grass, johnsongrass, wild morning glory, and nutgrass are among the more serious perennial weeds occurring in avocado orchards.

When the top growth of annuals is killed, re-growth from the roots does not occur; therefore, the basis of a program for the control of annuals is to destroy top growth before seeds are set. The same principle also applies to the control of perennials but with the additional, and more difficult, problem of destroying resistant underground plant parts.

Weed control methods may be classified as mechanical, biological, and chemical. Mowing and cultivation are the mechanical methods most widely used in orchards. Biological methods find little application in avocado culture. Chemical sprays, largely petroleum oils, are used extensively.

Chemical methods for weed control may be divided into two main groups; (1) application of herbicides to plant foliage, and (2) application of chemicals to the soil to be taken up by the roots of the weeds. Use of foliage sprays is common in avocado culture. At the present time, not enough is known about the tolerance of avocados to soil sterilants to recommend use of soil-acting chemicals. However, this approach to weed control in avocado orchards offers the most promise for the future and is now being investigated.

Petroleum oils are widely used for weed control in avocado orchards, therefore, problems related to their use will be discussed in some detail. Weed oils have the advantage that they kill all plant tissues wet by the oil, and have the disadvantage that they are not translocated into under ground parts of perennial species. Annuals are thus killed by one spraying. Perennials produce new top growth after each treatment and may be killed only by exhausting their underground food reserves by repeated sprayings for one or more growing seasons.

Avocado growers should find it helpful to consider some of the basic principles of oil toxicity and the characteristics of oils that affect their efficiency as weed killers. An important characteristic of oil is its unique ability to wet foliage. Plants are covered by a waxy coating which, because of its oil-like nature, is repellent to water sprays and readily wet by oils. When applied to plants, oils form a spreading film which creeps along leaves and stems, penetrating and saturating the growing points of grasses and other plant parts sheltered by surrounding foliage. Oils penetrate the stomata and come into close contact with the living tissue.

Wetting and penetrating action alone is not sufficient to explain the herbicidal properties of oils. Some oils, for example the petroleum fractions used as insecticides, have little toxicity to plants. Toxic materials must be present in the oil, or added to it, in order to make it an effective weed killer. Oils may be refined in such a way as to contain toxic

petroleum fractions as natural components, or they may be made toxic by the addition of oil-soluble additives. Commercial weed oils are special refinery fractions which contain higher proportions of petroleum toxicants than are normally present in oils refined for use as fuel. Little is to be gained by the addition of chemical toxicants to commercial brands of weed oils.

In petroleum oils, plant toxicity is largely associated with the un-saturated and, more particularly, the aromatic fractions. The content of aromatic compounds in an oil is an excellent index of its efficiency as a weed killer, and the specifications of commercial weed oils usually state the percent of aromatics in the formulation. Diesel oils and other fuels deficient in aromatics can be made as toxic as desired by fortifying with such materials as oil-soluble dinitro (dinitro general herbicide) and pentachlorophenol.

For maximum economy, oils should be sufficiently toxic to be effective when applied to weed growth as a very light film. Drenching sprays should not be necessary, although heavier applications are required on perennial grasses, such as johnsongrass and bermudagrass.

High toxic oils are usually effective at lower rates than they can conveniently be applied and may be better utilized by application as emulsions with water. The additional volume gained by emulsifying with water permits better visual control of application, and the larger droplet size of spray reduces drift and provides driving force to carry the spray into dense vegetation.

Emulsions are made by adding a small amount of emulsifying agent to the oil and mixing it with one to three volumes of water in a spray rig equipped with an agitator. Some weed oils have the emulsifier added by the supplier, or have an effective emulsifying agent as a natural component of the oil. If agitation in the spray tank is sufficiently vigorous, emulsifying agents are not needed.

It is important to remember that the sole purpose of emulsifying weed oil with water is to aid distribution. Nothing is to be gained by making emulsions of oils of moderate and low toxicity, as they already have enough volume to spread their toxic action to the maximum.

Growers who use small quantities of weed oil often find it more convenient to use diesel fuel or orchard heater fuel as a herbicide. It is usually advantageous to increase the toxicity of these oils by fortifying with dinitro general or pentachlorophenol. As the amount of fortifying agent added to the oil is increased, the resulting concentrates may be emulsified with increasing amounts of water and the saving in cost of oil used, up to a point, will more than compensate for the cost of the fortifying material. Although fortified oil emulsions containing as little as 5 percent oil may be used successfully to control young weeds provided sufficient fortifier is added, mixed annual and perennial growth is best controlled with emulsions containing upwards of 30 percent oil.

Translocated herbicides, so-called because they are absorbed by the foliage and translocated within the plant, can be used in controlling wild morning glory and certain other broadleaved perennials. Examples of this type of herbicide are 2, 4-D, 2, 4, 5-T and amino triazole. In using 2, 4-D and 2, 4, 5-T, precautions should be taken to avoid drift which could cause serious damage to avocado trees. Low-volatile esters of 2, 4-D

and 2, 4, 5-T herbicides are now on the market. These formulations reduce, but do not entirely eliminate, the dangers of volatilization and drift of herbicidal vapors to the trees. Volatility is not a major hazard when the amine salt and emulsifiable acid formulations of 2,4-D are used; however, 2,4-D at heavy rates (2 pounds per acre and up) can cause soil sterility resulting in the uptake of injurious quantities of the herbicide by the roots of trees. Normally, use of 2,4-D near avocado trees should be limited to spot treatment of small areas using the amine salt or emulsifiable acid formulations, taking maximum precaution to prevent spray drift.

Another approach to orchard weed control, which has proven successful in citrus culture, is selective sterilization of the soil with CMU (3-(p-chlorophenyl)-1; 1-dimethylurea). Application of this material to the soil at the rate of 2 pounds per acre provides seasonal prevention of weed growth by killing the weed seedlings as they germinate. Established perennials and mature annuals are not controlled by CMU.

Citrus is not injured by treatments at this rate, and tests are now in progress to determine whether or not CMU can be safely used under avocados. Preliminary results indicate that avocados are, less tolerant than citrus. At the present stage of experimentation, it appears probable that CMU, or one of the chemicals related to CMU, will prove to be usable in avocado orchards, as in citrus, but with a lower margin of safety for errors in application. CMU is not recommended for use in avocado orchards at the present time.

Dalapon (dichloropropionic acid) is a new herbicide that has proven to be particularly useful in controlling perennial grasses. Perennial grasses can be controlled by wetting the foliage with solutions of Dalapon containing 10 to 20 pounds of the formulation per 100 gallons of water. Two or more applications may be required. Although Dalapon is systemic, in that it is absorbed by the foliage and translocated into the roots and rhizomes of grasses, it also has a sterilizing effect on the soil and is taken up by the roots of trees causing injury. The amount required to kill perennial grasses is injurious to avocados when applied in the root zone of the trees and, therefore, should not be used in orchards. Dalapon has been used to good advantage for spot treatment in eliminating bermudagrass around headstands and along irrigation ditches outside the root zone of the trees.

Amino triazole, also a systemic herbicide, appears to be less toxic to trees. It is a promising material for control of general vegetation, including perennial grasses and is now being tested for use under avocados and other tree crops.

The use of these and other newer chemicals, while not proven safe for use in avocado orchards, should not be overlooked by the grower for the control of weeds in irrigation canals and along the edges of his property. Programs for the elimination of seed sources should proceed abreast of control programs within orchards. Weed control should extend into roadside ditches, along fences, boundary lines, rights-of-way, and all other areas near the orchard where weeds mature and go to seed. Such a program is a matter of community cooperation, and, as such, is one from which the community as a whole — farmer, home owner and industrial land user — benefit. Weeds are equally the problem of all land users, and thus their control deserves the concerted effort of everyone.