

WEED CONTROL IN AVOCADO ORCHARDS

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Efficient weed control in avocado orchards is a challenging undertaking in most climates, but it is particularly difficult in warm, humid areas where the annual rainfall is 1,000 mm or more. Seed germination and the subsequent growth of most weeds increase with higher temperature and humidity and conversely decrease in cooler and drier weather. The most troublesome weeds in lowland, tropical climates and in South Florida are annual and perennial grasses, some vines and woody plants, because they are prolific seed producers or have deep rhizomes or underground storage organs. Good examples of the latter are johnsongrass (*Sorghum halepense* (L.) Pers.) and nutsedge (*Cyperus rotundus* L. and *C. esculentus* L.) which have a world-wide distribution and are very difficult to kill with chemicals. These and similar species cause untold expense to avocado and other fruit growers.

Weed Control During the First 2 Years

The most important time to control weeds in the orchard is when the trees are young and too small to effectively compete with weeds for light, space, water and nutrients. Unfortunately, young avocado trees are more sensitive to chemicals used for weed control.

Complete weed suppression is highly desirable but is seldom attained in tropical climates. The goal should be to minimize the problem as much as possible. Mulches of various types are effective for suppressing weeds around young trees and should be used according to their local cost and availability. Organisms which decompose organic matter also compete with the trees for nitrogen which means additional applications of this element may be necessary to avoid deficiencies. Organic mulches can be a source of weed seeds and, in dry areas with saline soils, some natural mulches, composts and even manures can contain toxic concentrations of chlorides and sodium.

Black plastic and other synthetic mulches should be tested locally to determine their cost efficiency. In large orchard situations where mechanical installation is possible, plastic mulches have been tested with variable results. Their success depends on careful placement of the plastic so as to prevent weed growth in the area near the trunk of the tree where weed control is so important for young trees.

A certain amount of hand hoeing and weed pulling may be unavoidable, even if the cost of labor is expensive. Hand labor should be the last resource but its use will depend on ultimate cost and availability. Chemicals, particularly of the preemergent type, are generally injurious to young avocado trees and should not be used at least during the first year after planting.

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Contact herbicides such as paraquat (Gramoxone®; 1,1-dimethyl-4,4'-bipyridylum dichloride) which only affect green tissue and have a short residual life in the soil are practical and useful if hand-applied around small trees with some protection to avoid leaf injury due to drift. Paraquat is rapidly absorbed and rain 20-30 minutes after spraying does not interfere with its effect. Care should be exercised to use it according to instructions. An experimental post-emergent herbicide showing much promise is Roundup® [glyphosate: N-(phosphonomethyl) glycine], a relatively new product which has demonstrated a nonselective, systemic effect on most weeds. Roundup® has low mammalian toxicity and appears to break down quickly in the soil into nontoxic products. It kills the underground storage organs of perennial weeds because it translocates deep into most tissues. It does not appear to injure young avocado trees when properly used.

There is much practical value in alternating the use of herbicides since none of them are completely nonselective or uniformly effective on all weeds. Continuous use of one will tend to encourage growth of the more tolerant species by reducing competition. Such is the case with lantana (*Lantana camara* L.) which has shown resistance to paraquat and has become predominant in orchards where this chemical was the only postemergent herbicide used for a period of years.

Bearing Orchards

Mature orchards should be maintained as free of weeds as possible. This can be accomplished adequately in drier, cooler areas with the proper technology, equipment and chemicals. However, weed control becomes increasingly more difficult and expensive in warm, humid areas and the timing of the operation is crucial. Delayed action allows weeds to grow beyond the point where they can be killed economically and effectively.

There are 3 general methods of weed control in orchards. 1) Soil cultivation with disc harrows or rotary hoes is not practiced in most areas due to the above-ground damage to branches and fruit and to root destruction in shallow soils. 2) Selective mowing discourages tall-growing weeds and ultimately converts the orchard to permanent sod. Mowing is useful in rainy and hilly areas to prevent erosion, to minimize the oxidation of soil organic matter and protect the structure of the soil. 3) Chemical control is the most efficient method of suppressing weeds, particularly in cool, dry areas where the ultimate goal should be clean cultivation. This is a rather expensive undertaking initially, but is more economical and convenient in the long run. A combination of chemical control and mowing appears to be the most practical approach in south Florida, where the average rainfall is 1,625 mm, but may approach 2,500mm in some years. Herbicides are usually applied in a band along the rows of trees and the middles are kept in sod by frequent mowing.

Mowing may not be necessary in older orchards where shading has reduced weed growth and this would prevent much damage to branches and fruit. Efficient chemical weed control with knapsack spray pumps may be entirely feasible and economic in this situation and where mowing is prohibited by steep terrain.

Most commonly used chemicals in avocado orchards are preemergent and postemergent herbicides. Preemergents such as Karmex® [diuron; 3-(3,4-dichlorophenyl)-1,1-di-methylurea] and Princep® [simazine; 2-chloro-4,6-bis(ethylamino)-s-triazine] are most useful when applied in programs where the 2 are alternated. Karmex® tends to have better activity against grasses than Princep® but the latter has a longer residual life in the soil. Both are most effective when applied to clean ground after the weeds have been killed by a postemergent such as paraquat or Roundup®.

Preemergents are applied in south Florida in a 2.5-3.0 m band along the tree rows commencing in late May or early June just before the rainy season. The intent is to use the anticipated rains to move the herbicide below the soil surface where it will be more effective and will escape the rapid degradation which takes place if exposed to ultraviolet light. Since annual grasses grow vigorously following the onset of the rainy season, Karmex® is preferred as a starter for the summer. A postemergent is usually applied to kill existing weeds. Then an application of Karmex®, followed by Princep® 2-3 months later will give adequate weed control throughout the critical summer months and the fall and winter periods as well. A third application may not be required in January or February, depending on how carefully these applications were timed and carried out. However, Princep® may be used then, if necessary, to control broad-leaved weeds which are the predominant weeds during the period from January to May. This program also includes frequent mowing of the middles, always striving to cut the weeds before they flower and produce seed.

Recent experimental work conducted in Homestead indicated that good weed control can be obtained with 2 annual applications of Roundup® followed by Princep® in June and in October. It is encouraging that Roundup appears very useful for avocado orchards, especially since the 2 most effective pre-emergent herbicides for annual grasses [Sinbar® (terbacil; 5-chloro-3-tertiary-butyl-6-methyluracil) and Hyvar-X® (bromacil; 5-bromo-3-secbutyl-6-methyluracil)] have proven injurious to avocado trees in the low organic soils of Florida. Their detrimental effects last for months and even years in some cultivars and they should not be used in avocado orchards, regardless of soil type.

Prospects for the Future

Very few herbicides have been developed specifically for the tropics. The development of herbicides is an expensive undertaking so chemical companies have aimed their efforts at crops which are grown on a large scale in the vast warm-summer areas of the U.S. and Canada. Consequently, herbicides registered for use on fruit crops have usually appeared as by-products of the research directed toward agronomic crops. Fruit crops are not considered a high priority for herbicide development because of their comparatively small hectareage and avocado orchards comprise only a small fraction of the total hectareage.

A chemical which is found acceptable and nontoxic to a particular crop must satisfy innumerable bureaucratic requirements before a label can be obtained from the

U.S. Environmental Protection Agency (EPA) allowing the manufacturer to market it. The steps involved in complying with EPA regulations are so costly that chemical companies do not consider it economical to seek a label for such minor crops as the avocado.

Avocados are grown in warm climates where grasses predominate, so we need long-lasting preemergent herbicides which are specifically effective against grasses and which are not toxic to avocados or animals.

Words of Caution

It is well to understand that we cannot rely on chemicals alone for satisfactory weed control. The human element is just as important, so we need to educate the applicator to the intricacies of weed control. The proper timing and manner in which chemicals are applied can make the difference between success or failure. Instructions must be followed and operators should be constantly aware of such seemingly self-evident practices as avoiding overdosing by slowing spray rigs, overlapping and turning. Continuous agitation of chemicals is necessary to maintain a uniform concentration. Finally, it is also well to remember that there are legal limitations that should be observed in the use of herbicides, such as proper disposal of empty containers and adequate operator protection equipment.

There is an increasing desirability for using herbicides in avocado orchards. We expect to see a greater use of chemicals in tropical areas in conjunction with programs of manual and mechanical methods of weed control as labor costs increase and more effective products become available.

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