Weed Management Challenges and Options for Subtropical Crop Orchards in California.

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Introduction

In Southern California, there is a diverse acreage of subtropical tree crops, such as date palms, macadamias, pomegranates, mangos, citrus, avocados, dragon fruit, and cherimoyas to name a few. Many of the growers of these tree crops range from large scale production operations with hundreds of acres to small grower parcels that are only a few acres. In addition there are certified organic growers. Subtropical crop integrated weed management (IWM) programs typically utilize a combination of control practices, like cultural, mechanical, and chemical, to minimize competitive effects of weeds on crop productivity. Weed management can be an expensive part of the total subtropical tree crop production program and resources invested here can provide significant economic returns. However after assessing these high value commodities this past year it looks as if weed management has not been a top priority, or seems as if there is a need for more research, outreach, additional herbicide mode of action (MOA) labels and in general alternative weed management methods that can be suitable for the continuing growth of organic acreage .

Need for Weed Management

Weeds can impact cultural operations, tree growth, and yields by altering the spray pattern of low-volume irrigation systems, intercepting soil-applied chemicals (fertilizer and agricultural chemicals), reducing grove temperatures during freeze events, and interfering with pruning and harvest operations. The presence of weeds in a subtropical grove can also affect insect populations and create an environment for dangerous vertebrate pests such as coyotes and venomous snakes which can be hazards to hand picking crews. For example, in the Coachella Valley, there has been an increase in rattlesnake bites during date harvest season due to the lack of vegetation management in the grove. Weeds growing around tree trunks may also create a favorable environment for pathogens that infect the trunk and roots (Futch and Singh, 2010). Weed species compete with trees in many ways and with varying intensities; management of more competitive weeds such as hairy fleabane, horseweed, johnsongrass, dallisgrass, and vetch should be prioritized. While some weeds (e.g., puncturevine, spiny cocklebur, stinging nettle, bull thistle, and bristly oxtongue) may have low competitive effects on citrus trees, they can also hinder labor operations and may also rank high for active management. In addition, in the southern California mild climate, certain annuals may behave as biennials or short-lived perennials- for example, horseweed, fleabane, and mallow.

Cultural

Preventive programs are often overlooked, but are an important component of cultural practices and are cost-effective. Practices, such as sanitation, spot spraying, and/or hand removal of weed escapes before they produce new seed are examples of prevention. While preventive programs may not stop the spread of all weed species, these practices may slow the spread of undesirable species, thereby reducing long-term weed control costs.

Mechanical

Cultivation or tillage has been used in the past in citrus production. However this practice does not fit all subtropical trees since many have a shallow fibrous root system and tillage increases the risk of root and trunk damage. In addition, some subtropical trees such as avocados are planted on steep mountain sides and bringing in any type tractors or machinery can be a challenge and even dangerous. However when used, tillage is an effective method of controlling annual weeds effectively by severing weed stems and roots. Tillage can be counterproductive for perennial grasses or sedges that can propagate vegetatively. Soil erosion concerns are cited as a reason why tillage use is decreasing as more groves are planted on raised berms. With the use of low-volume irrigation systems and closer in-row planting distances, tillage in both directions is no longer possible in some groves. Mechanical mowing is generally more expensive than tillage and can throw seed under the tree canopy, increasing weed pressure next to the tree trunk.

Chemical

The amount of products that are registered for certain specialty subtropical crops can also be a challenge. Currently there are only 13 preemergent and 13 postemeregnt herbicide registered for a few of the leading subtropical trees, avocados, citrus, pomegranates, and dates and even then there are many restrictions and specific label instructions that must be followed (Table 1.).

Preemergence herbicides are generally applied two to three times per year, so the maximum amount of herbicide is in the upper soil profile (0 to 2 inches) slightly before peak weed emergence. Herbicides applied too early, before weeds emerge, will not provide adequate weed control due to herbicide leaching or degradation on the soil surface or within the soil profile. Preemergence herbicides must be incorporated (mainly by rainfall or irrigation) and are usually broadcast on the entire orchard floor since growers do not know where weeds will emerge and to reduce risk of frost damage. Growers using drip irrigation or micro-sprinkler irrigation have a difficult time adequately incorporating preemergence herbicides, so they usually try to treat prior to predicted rainfall (Rector et al. 1998). Soil type can influence herbicide selection and rate used. Many preemergence herbicides including Goal, Prowl, Surflan, Treflan, and Visor can be used on sandy soils without injuring citrus trees (McCloskey and Wright 1998). However some premergent herbicides that are registered for avocados should still be used with caution due to sandy soils. Tree age is also an important consideration when selecting which herbicide(s) to use. Unfortunately, due to the cost of water, rain becoming less unpredictable, risk of mishandling

and damaging sensitive root systems, and price, preemergents are seen less and less in weed management regimes.

Postemergence herbicides are used to control weeds that escape control by preemergence herbicides or mechanical cultivation. These herbicides are effective on small annual weeds and usually only suppress growth of perennials. It should be noted that the majority of organic herbicides are contact herbicides. Currently, glyphosate seems to be the herbicide of choice for these tree crops. Growers appreciate the convenience of the broad label and wide-ranging spectrum of weeds that it can eradicate. It's inexpensive, readily available and can be used in just about any stage of the tree's development. Though continuous use over time will likely lead to the development of resistant populations in some weed species. To help reduce likelihood of herbicide resistance development, it should be rotated and/or mixed with herbicides having different modes-of-action. While it is well known that horseweed and fleabane have been confirmed resistant to glyphosate in the central and northern parts of California, verifying if these biotypes have developed south of the grapevine is still in question. Nevertheless, I have received several calls from growers that weeds in their groves are not being controlled by their favorite choice of herbicides and these problems are starting to become more frequent in subtropical tree crops.

Cover crop benefits and complications

Vegetated orchard floors can accentuate frost hazard, often experiencing 3-5°F cooler ambient temperatures than do bare orchard floors, depending on vegetation height and atmospheric conditions (Steinmaus 2014). Alternatively, ground cover in the row middles can reduce soil erosion, reduce sand blasting during windy conditions and help retain nutrients. Ground covers can also be beneficial if they are less competitive than other weeds potentially present in the grove, and for erosion-prone situations such as on steep slopes or poorly structured soil. Cover crops may require additional management steps such as rotation to a different species or species mixture every few years to avoid pathogen buildup. Currently, there are no cover crops that will fit all situations and provide all possible benefits (Steinmaus 2014). Water requirements for vegetation regrowth after mowing can impact water availability within the grove, with grasses typically using more water than broadleaves post-mowing. This form of weed control is mostly seen in the organic production side.

Organic Tree Production

Organic groves are probably the biggest challenge when it comes to weed management, as they lack available herbicide chemistries. Most organic operations are usually the smaller scale growers that cannot simply afford weed management.

Summary and Conclusions

Weed control options are limited in some cases by economic, environmental, or practical limitations. Additionally, there are relatively few herbicide mode of actions registered in these specialty tree crops. Our challenge is to start thinking about IWM strategies and revisit basic

principles such as using pre- and post- emergent herbicides in combos and rotating MOA's. Alternative tools for weed management need to be evaluated.

Table 1. Herbicide Registration on CA Subtropical Crops (*Updated October 2015- UC Weed Sciences)*

	Herbicide-Common Name *(example trade name)*	Site of Action Group[1]	Avocado	Citrus	Date	Fig	Kiwi	Pomegranate
Preemergence	dichlobenil *(Casoron)*	L / 20	N	N	N	N	N	N
	diuron *(Karmex,Diurex)*	C2 / 7	N	R	N	N	N	N
	EPTC *(Eptam)*	N / 8	N	R	N	N	N	N
	flazasulfuron *(Mission)*	B / 2	N	N	N	N	N	N
	flumioxazin *(Chateau)*	E / 14	NB	NB	N	NB	N	R
	indaziflam *(Alion)*	L / 29	N	R	N	N	N	N
	isoxaben *(Trellis)*	L / 21	NB	NB	N	NB	NB	NB
	napropamide *(Devrinol)*	K3 / 15	N	N	N	N	R	N
	norflurazon *(Solicam)*	F1 / 12	R	R	N	N	N	N
	oryzalin *(Surflan)*	K1 / 3	R	R	N	R	R	R
	oxyfluorfen *(Goal, GoalTender)*	E / 14	R	NB	R	R	R	R
	pendimethalin *(Prowl H2O)*	K1 / 3	N	R	N	N	N	R
	penoxsulam *(Pindar GT)*	B / 2	N	N	N	N	N	N
	pronamide *(Kerb)*	K1 / 3	N	N	N	N	N	N
	rimsulfuron *(Matrix)*	B / 2	N	R	N	N	N	N
	sulfentrazone *(Zeus)*	E / 14	N	R	N	N	N	N
	simazine *(Princep,Caliber 90)*	C1 / 5	R	R	N	N	N	N
Postemergence	carfentrazone *(Shark)*	E / 14	R	R	R	R	R	R
	clethodim *(SelectMax)*	A / 1	N	R	N	N	N	N
	clove oil *(Matratec)*	NC[3]	R	R	R	R	R	R
	2,4-D *(Clean-crop, Orchard Master)*	O / 4	N	N	N	N	N	N
	diquat *(Diquat)*	D / 22	NB	NB	NB	NB	NB	NB
	d-limonene *(GreenMatch)*	NC[3]	N	R	N	R	R	N
	fluazifop-p-butyl *(Fusilade)*	A / 1	NB	R	NB	NB	N	NB
	glyphosate *(Roundup)*	G / 9	R	R	R	R	R	R
	glufosinate *(Rely 280)*	H / 10	N	R	N	N	N	N
	halosulfuron *(Sandea)*	B / 2	N	N	N	N	N	N
	paraquat *(Gramoxone)*	D / 22	R	R	N	R	R	R
	pelargonic acid *(Scythe)*	NC[3]	R	R	R	R	R	N
	pyraflufen *(Venue)*	E / 14	N	N	R	R	R	R
	saflufenacil *(Treevix)*	E / 14	N	R	N	N	N	N
	sethoxydim *(Poast)*	A / 1	NB	R	NB	NB	N	NB

Notes: R = Registered, N = Not registered, NB = nonbearing. This chart is intended as a general guide only. Always consult a current label before using any herbicide as labels change frequently and often contain special restrictions regarding use of a company's product.

References

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