COVER CROPPING IN WALNUT ORCHARDS

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Once harvest season is completed, there is a short window to plant cover crops. Plans should be made now so that seed and equipment is available to beat significant rainfall and leaf drop.

What is a cover crop?
A cover crop is a non-economic crop grown between orchard rows, usually in the middles between row sprayed strips. Cover crops can be annuals, which germinate and die in one season, or perennials that live for more than one year. Additionally, both winter and summer weeds can be allowed to grow and managed like a cover crop.

Why do growers use cover crops?
The appropriate use of cover crops can result in substantial benefits to the cultivated walnut crop itself and/or can cause potential problems. One hopes the benefits out weigh the problems. Since both the benefits and problems can be site and management specific it is good to review them before planting.

Benefits
The most universal reason for using cover crops is to **reduce soil erosion.** The established plant roots hold the soil against the forces of moving water. Established cover crops have been shown quite effective in controlling erosion on slopes as well as river bottom soils during flooding.

Biomass production or the production of plant tissue both above and belowground can be beneficial in both a nutrient and soil quality perspective. A good stand of planted annual cover crop can produce 5000 pounds per planted acre of aboveground dry matter per season. Add to that the root mass, and the total biomass can be near 7500 pounds/planted acres.

In terms of nutrients**, cover crops extract left over nitrogen** from the orchard; take up mineralized nitrogen from organic matter and in the case of legumes (such as clovers and vetch) extract nitrogen from the atmosphere. Legumes generally produce twice the nitrogen per pound of dry (3%) matter than grasses (1.5%). Therefore a 5000-pounds/acre dry matter cover crop can produce up to 75 – 150 pounds of nitrogen depending on the species mix. In order to utilize all this nitrogen, the cover must be incorporated into the soil usually by disking. In contrast, mowing the cover along with subsequent irrigation will cause some (a lot) of the nitrogen to be lost to the atmosphere. Cover crops, which are not incorporated but mowed, have not been shown to replace the application of fertilizer to meet the nitrogen requirement.

Cover crop living vegetation and biomass derived from cover crops **protect the soil surface** from the damaging effects of raindrops and equipment. With the cover crop drying up soil by using water during the winter and covering the surface, orchard access is enhanced. Ruts from equipment are much less of a problem. As the biomass decomposes into primarily polysaccharides (long chain sugar products), they bind soil particles together **stabilizing the soil aggregates** against the effects of sprinkler and rain droplets and other soil compacting/crusting forces. Aggregate stabilization along with the channels created by roots enhances the soil's **water infiltration characteristics**.

By using moisture from the soil during the rainy season, room for more water to infiltrate the soil is made. So when a rainfall event occurs more of the water infiltrates rather than becoming run off which **can reduce off-site movement of pesticides.**

Cover crops can **reduce undesirable weed species**. In the walnut pest management alliance plots, the cover crop established well and reached maturity at both sites, allowing for reseeding. The number of winter weed species and weight were significantly decreased in the cover crop plot versus the resident vegetation plot. Although the occurrence of spring or summer weeds overall was not significantly different between the plots, certain weeds such as burr buttercup were dramatically reduced where there was a cover crop. Other species such as hairy fleabane were found at low levels only in the unseeded plots and not found in the cover crop blocks.

Potential Problems

As with any cultural practice, there are drawbacks to the use of cover crops. The biggest is the **use of water**. Nearly 300 pounds (36 gal) of water is required to produce one pound of aboveground dry matter. Using this conversion a 5000-pounds/acre cover crop would consume about 6.5 inches of water (180,000 gal). In areas, which receive high rainfall, the cover's use is not usually a determent to the eventual volume stored water. However, in areas of lower winter rainfall, the cover could use a portion of the moisture normally stored in the root zone for later use by the orchard. Hence, more water must be pumped to meet the orchard's seasonal water requirement. Perennial cover crops, which grow year round, compete successfully with the orchard for water. Studies in a mature almond orchard indicate a 10-30% increase in orchard water use when a perennial clover was present when compared to bare soil.

Lower spring temperatures on cover cropped orchards may increase the **risk of frost**, especially with early varieties. A dense cover crop will reduce the temperature at the surface level in comparison with bare ground. Close mowing of the cover before the frost hazard will reduce the possibility of damage from radiation type frosts.

Cover crop biomass production and orchard sanitation practices used to control navel orangeworm (NOW) can be in conflict. **Orchard sanitation** is the most important element in a NOW control program. It requires the mower to be adjusted low enough to shred the nuts before insect emergence. This practice can decrease biomass production and be detrimental to some species.

Another problem that may result from cover cropping is the buildup of **pocket gophers and voles**. Gophers are particularly attracted to annual and perennial clovers.

Winter annuals that die off in early summer can be allowed to stand and compete (for light) with germinating summer weeds or be mowed. Repeated mowing helps decompose the cover crop residue. Legume residue decomposes very fast where as grasses are slower. Full coverage irrigation systems (flood and sprinkler) speeds decomposition whereas microirrigation (drip and microsprinklers) leave more residues in the non-wetted areas. This **cover crop trash can cause a slower harvest** and in wet years, can increase the incidence of mold if nuts are left on the ground.

Choosing a Species

When choosing a cover crop species or mix of species, growers should first determine the benefits desired and potential drawbacks addressed in this article in conjunction with specific orchard conditions, cultural practices, and lastly, costs. Table 1 contains a number of popular species, growth habits, physiology and common seeding rates.

Costs

There is no doubt the use of cover crops results in increased costs. Annual and perennial cover crops require seedbed preparation, planting and further attention to controlling potential drawbacks as previously mentioned. Annual crops, which are good re-seeders and are not mowed or disked until seed maturity has been reached, may last for 2 – 4 years. Seed costs alone can range from $15 - $50/acre with $35 being typical. Add soil preparation and planting costs and the cost is typically $45 - $65/acre. If using a reseeding annual or perennial the one time costs can be average over the time of the crop (average 3 years) to get an annual cost. Don't forget to consider additional rodent control and water in the yearly costs.

Getting Started

Cover crops in walnut are most successful when planted soon after harvest, before leaves fall and when rainfall or irrigation water is available to provide for germination and good seedling growth. Covers can be broadcast into lightly worked orchard middles followed by a springtooth harrow. Broadcasting lightweight non-aerodynamic grass seed can lead to uneven distribution. Coated legume seeds broadcast well. Brillion type seeders work well with legumes and some grasses but can plug easily with some multi species mixes. Seed drills can be adapted for most of species but can also have difficulties with multi species mixes. No-till drills which drill directly into the orchard floor with out any other seedbed preparation are faster and usually cheaper than the methods requiring soil preparation and seed covering practices. Be sure to consult your seed dealer as to their experiences with seed and seeder experiences.

Additional Sources of Information:

Covercrops for Agriculture, University of California DANR Publication 21471
Cover Croppping in Vineyards, University of California DANR Publication 3338

12/01

Table 1. Selected Characteristics of Important Cover Crops For California*

Common name	Growth Habit	Maximum Height (inches)	Flowering Period	Maturity Period	Tolerates Close Mowing in Winter	Reliably Self-Reseeding	Seeding Rate (lbs/ac)	Comments
Legumes			**WINTER ANNUALS**					
Bur medic (burclover)	Prostrate to erect	6-15	Feb-Apr	Apr-May	Yes	Yes	15-20	Neutral to alkaline soils; 'Santiago' has no burs
Field pea	Viny	18-30	Mar-May	May-Jun	No	No	70-120	'Magnus' & 'Miranda' are especially vigorous
Clovers								
Berseem	Erect	18-30	May-Jun	Jun-Jul	Yes	No	15-20	Needs multiple cuttings for best results
Crimson	Erect	12-20	Apr-May	May-Jun	Yes	Yes	20-25	Fast winter growth
Rose	Semi erect	8-15	Mar-Apr	May-Jun	Yes	Usually	15-20	'Hykon' is an early & well-adapted variety
Subterranean	Prostrate to semi erect	6-15	Mar-May	Apr-Jun	Yes	Yes	20-25	Many varieties bury seedhead; most prefer neutral to acid soils; 'Koala' & 'Clare' tolerate alkalinity
Vetches								
Bell (fava) bean	Erect	36-84	Mar-May	May-Jun	No	No	120-150	Host for bean aphid
Common	Viny	18-24	Apr-May	May-Jun	High	Yes	40-80	Winter hardy; has extrafloral nectanes
Hairy	Viny	18-24	Apr-May	May-Jun	High	Yes	35-50	Very winter hardy; adapted to sandy soils
'Lana' woolypod	Viny	18-24	Mar-May	Apr-Jun	High	Yes	40-60	Produces some hard seed; popular in California
Purple	Viny	18-24	Apr-May	May-Jun	High	Yes	40-60	Least winter hardy vetch; popular in California
Nonlegumes - Grasses								
Annual ryegrass	Erect	36-60	Apr-May	Jun-Sep	Yes	Yes	20-35	Rapid growth; high biomass; late maturity may lead to competition with trees & vines
Soft chess ('Blando' brome)	Semi erect	12-30	Mar-Apr	Apr-May	Yes	Yes	12-15	Reliable; reseeds well; good for erosion control, grazing
Foxtail fescue ('Zorro')	Erect	12-24	Mar-Apr	Apr	Yes	Yes	8-12	Tolerates poor soils; good for erosion control
Cereals								
Barley	Erect	24-36	Apr-May	May-Jun	Yes	Yes	80-120	Heat, drought, & salinity tolerant
Cereal rye	Erect	36-72	Apr-May	May-Jun	Yes	Yes	60-120	'Merced' is drought tolerant; many varieties tolerate waterlogged soils
Oat	Erect	24-60	Apr-May	May-Jun	Yes	Yes	100-120	Relatively drought intolerant; tolerates wet soils

Common name	Growth Habit	Maximum Height (inches)	Flowering Period	Maturity Period	Tolerates Close Mowing in Winter	Reliably Self-Reseeding	Seeding Rate (lbs/ac)	Comments
Others								
Mustards	Erect	24-72	Mar-May	Apr-Jun	No	Yes	10-15	Rapid growth; may host brassica crop pathogens
Tansy phacelia	Semi erect	12-36	Mar-May	May-Jun	No	Yes	10-15	Grows rapidly; residues decompose readily
Legumes			**PERENNIALS**					
Birdsfoot trefoil	Semi erect	12-24	Jun-Sep	Jul-Oct	Yes	No	10-15	Slow establishment
Strawberry clover	Prostrate	8-12	May-Jun	Jun-Jul	Yes	Yes	10-15	Vigorous; invasive; heat & drought tolerant
White clover	Prostrate	8-12	May-Jul	Jul-Aug	Yes	Yes	10-15	Vigorous; invasive; shade tolerant
Nonlegumes								
Perennial ryegrass	Semi erect to erect	8-36	May-Sep	Jun-Oct	Yes	Yes	25-35	Vigorous; competitive
			SUMMER ANNUALS					
Legumes			**Time of First Flowering (Days After Seed)**					
Cowpea (blackeyed pea)	Erect, viny	18-36	40-80				35-40	Performs well with minimal irrigation; may attract lygus bugs
Hemp sesbania	Erect	48-120	60-85				20-25	Drought intolerant; may attract bean aphid
Hyacinth bean (lablab)	Viny	18-36	60-85				40-45	Performs very well with minimal irrigation
Sunnhemp	Erect	48-120	60-85				20-25	Drought tolerant; rapid growth
Nonlegumes								
Buckwheat	Erect	12-24	25-30				20-30	Drought intolerant; flowers attract beneficial insects, as well as lygus bugs
Sorghum & sudangrass	Erect	36-120	60-80				25-35	Rapid growth; performs well with minimum irrigation

NOTES:
Optimum seeding rates may vary based on local conditions and planting dates. Check with seed supplier for the most appropriate rates.
Listed rates are for monocultures only. Use reduced rates for species mixtures.
*Some characteristics listed apply to the most common varieties used in California. Characteristics may vary greatly by location.
Source: Ingles, C et. al., Selecting the right cover crop gives multiple benefits California Agriculture Sept-Oct 1994