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SMALL GRAIN PRODUCTION MANUAL
PART 11

# Small Grain Cover Crops

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This publication, *Small Grain Cover Crops,* is the eleventh in a fourteen-part series of University of California Cooperative Extension online publications that comprise the *Small Grain Production Manual*. The other parts cover specific aspects of small grain production practices in California:

- *Part 1: Importance of Small Grain Crops in California Agriculture*, Publication 8164
- *Part 2: Growth and Development*, Publication 8165
- *Part 3: Seedbed Preparation, Sowing, and Residue Management*, Publication 8166
- *Part 4: Fertilization*, Publication 8167
- *Part 5: Irrigation and Water Relations*, Publication 8168
- *Part 6: Pest Management—Diseases*, Publication 8169
- *Part 7: Pest Management—Insects*, Publication 8170
- *Part 8: Pest Management—Vertebrates*, Publication 8171
- *Part 9: Pest Management—Weeds*, Publication 8172
- *Part 10: Small Grain Forages*, Publication 8173
- *Part 12: Small Grains in Crop Rotations*, Publication 8175
- *Part 13: Harvesting and Storage*, Publication 8176
- *Part 14: Troubleshooting Small Grain Production*, Publication 8177

A cover crop is a crop grown to improve the soil, repress weeds, or benefit subsequent crops grown in rotation. It is not intended to be harvested or grazed, although when small grains are used as cover crops a side benefit is that the timing of operations for cover cropping makes possible their use as forage (see Part 10, *Small Grain Forages*). Small grains (including wheat, barley, oat, triticale, and rye) are useful as cover crops in many cropping systems because seed is relatively inexpensive, they produce large amounts of biomass quickly, and they have important soil-preserving properties. Small grains are excellent candidates as cover crops for many situations, including orchard, vineyard, and row crop acreage. Cultural practices (planting rates and dates, tillage, fertilization, and irrigation) for producing small grain cover crops are similar to practices for producing a regular grain or forage crop, except that lower fertilization and irrigation inputs are required and crop termination (through herbicide application or plowing under) is geared to the timing of the subsequent crop. Specific cultural practices vary from region to region of California, as does crop development (see Part 2, *Growth and Development*; Part 3, *Seedbed Preparation, Sowing, and Residue Management*; Part 4, *Fertilization*; and Part 5, *Irrigation and Water Relations*).

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## BENEFITS OF COVER CROPS

Cover crops can increase soil organic matter content and improve soil physical properties, enhance soil fertility and biological activity, provide soil cover and thereby reduce erosion, scavenge nutrients and prevent leaching losses, suppress weeds and diseases, and, in certain cases, enhance biological control of various pests. Keeping the soil surface covered by a cover crop during the off-season is vital in reducing soil losses by both water and wind and may improve air quality due to reduction in airborne particulates. Driving safety may be improved in areas such as California's Central Valley, where blowing dust storms are common during the winter when fields are typically bare.

Cover crops help maintain and improve soil quality in a number of ways. Residues of cover crops that are included in annual cropping systems are typically incorporated before the cover crop reaches maturity (thus the name "green manure"). Because small grains usually contain a low amount of nitrogen (about 1.5%) relative to legume cover crop species, they are not used as cover crops for their nitrogen contribution but for their carbon. Increasing soil carbon content improves several aspects of soil physical quality. Underirrigation, such as is used in California's Central Valley, moist soil and high temperature conditions favor rapid decomposition of soil organic matter, so increases in soil organic matter may be small. Under these conditions cover cropping may increase soil organic matter by only a few tenths of a percent. Such increases, however, still contribute to improvements in soil aggregation, water infiltration rates, reduced soil surface crust strength, and improved tilth.

## NITROGEN INTERACTIONS

Small grain cover crops can serve as "sinks" for scavenging and storing residual nitrogen from fertilizer applied to previous crops. Residual soil nitrate is particularly vulnerable to loss during the winter, when it can be moved by leaching through the soil profile. Nonlegumes are more efficient than legumes at reducing this nitrogen leaching. "Catch" cover crops with deep, dense rooting and high nutrient scavenging capacities, such as small grains and mustards, can be helpful in areas prone to leaching. See Part 2, *Growth and Development*, in this series for a description of the fibrous root system of small grains, which can grow 6 to 7 feet deep (about 2 m) with no competition.

Establishment of small grain cover crops may require nitrogen inputs, depending on residual soil nitrogen, the previous crop, and growing season conditions. However, the rates required are far less (probably less than half) than those recommended for small grain crops grown for grain production (see Part 4, *Fertilization*). Lower inputs are required because of the expected early termination of the cover crop and because it is not necessary to provide adequate nutrition for grain-fill. Nitrogen (residual in soil and/or fertilizer nitrogen), however, is necessary for establishment and vigorous vegetative development of a small grain cover crop in order to attain the full benefits of cover cropping.

## PEST INTERACTIONS

Cover crops may suppress certain plant pathogens, nematodes, and weeds and provide habitat for beneficial insects. Cover crops suppress weeds by smothering or outcompeting them as either living or dried surface mulches. Some cover crop residues contain compounds known as allelochemicals, which suppress the growth of other plants. Rye is an example of an allelopathic cover crop. It may suppress the growth of certain broadleaf weeds, but it also may inhibit germination of small-seeded vegetables such as onions and carrots. The allelopathic effects of a cover crop are difficult to separate from competition effects.

Cover cropping also may suppress plant parasitic nematodes. In certain cases, the cover crop acts as a nonhost, preventing nematodes from reproducing. In other instances, the roots of cover crops may emit compounds that stimulate nematode activity, but in the absence of a suitable host, the nematodes die.

## WATER REQUIREMENT

Because the inclusion of a small grain cover crop in a crop rotation affects numerous aspects of the management, biology, and economics of a production system, the potential advantages must be carefully weighed against the disadvantages. Water use by a cover crop is a major factor that must be considered, particularly in California's Central Valley (see Part 2, *Growth and Development*, and Part 5, *Irrigation and Water Relations*). Although water use by fall-sown small grain cover crops is relatively small because evapotranspiration during the winter is generally low, rainfall may be insufficient or too erratic to establish and support a winter cover crop and provide optimal early-winter growth. Supplemental irrigation may be necessary if it is available and if the expected benefits of cover cropping warrant the investment in irrigation water. Many areas of California receive adequate winter rainfall for the growth of small grain cover crops. Although depletion of stored water under small grains grown during the winter as cover crops is relatively small, it may impact preirrigation needs and the growth and productivity of subsequent crops. Thus, long-term water budgeting at a cropping systems level is essential to successfully integrate cover crops into crop rotations, especially in arid and semiarid areas.

## AGRONOMIC FACTORS

Small grains used as cover crops are typically sown from mid-October through November in most California cropping systems, prior to the onset of winter rains (see Part 2, *Seedbed Preparation, Sowing, and Residue Management*), and are terminated (harvested) at a time determined by the field preparation requirements for the subsequent crop. Small grain cover crops are generally easily established and tend to produce more biomass during a typical winter cover crop "window" (the time from the fall sowing of the cover crop to termination in the spring before the sowing of the subsequent crop) than most other crops grown during this period. Seeding rates tend to be similar to those used when small grains are sown for grain production: 1.2 to 1.5 million seeds per acre (3.0 to 3.7 million/ha) for irrigated crops, 1.0 million seeds per acre (2.5 million/ha) for rainfed crops. These rates should yield the plant density needed to exploit the cover crop benefits, including reduction of erosion risk by providing rapid soil cover, scavenging nutrients and preventing leaching losses, and suppressing weeds. The seeding rate required to achieve the desired plant density averages about 120 pounds per acre (135 kg/ha) for wheat and triticale, 100 pounds per acre (112 kg/ha) for oat, 90 pounds per acre (101 kg/ha) for barley, and 60 pounds per acre (67 kg/ha) for rye; the rate varies from cultivar to cultivar, however, because cultivars vary widely in seed size. When sown in mixtures with legumes (such as vetch) or other crops (such as mustard, canola, or bell beans) reduce the seeding rates depending on the relative competitive ability of each crop in the mixture in order to achieve the desired mixture composition and biomass. The performance of a particular small grain cultivar as a pure cover crop or as a component of a mixture is difficult to predict because a variety of factors, including soil properties, sowing date, seeding rate, and growing season conditions, interact to influence the growth of each crop.

## SELECTION OF A SMALL GRAIN CULTIVAR FOR USE AS A COVER CROP

Mid-October-sown small grain cover crops that are terminated in mid-March typically produce between 9,000 and 11,000 pounds per acre (10,100 to 12,300 kg/ha) of dry matter. Among current small grain cultivars, triticale cultivars produce the most biomass. Biomass production varies widely and is highly influenced by growing season conditions, soil properties, inputs of irrigation and fertilization, and growing region. Reports documenting the productivity of current California small grain cultivars are published annually in the series *UC Davis Agronomy Progress Reports: Regional Barley, Common and Durum Wheat, Triticale, and Oat Performance Tests in California,* available online at the UC Agronomy Research and Information Center Small Grain Workgroup Web site, http://agric.ucdavis.edu/crops/cereals/cereal.htm.

No one small grain cultivar is the best choice to use for all cover cropping situations in all regions of the state, since individual cultivars are adapted to different growing regions. Rapid establishment of ground cover through tillering, appropriate maturity class for the area, disease resistance, and biomass production potential are important selection criteria. Characteristics of current California small grain cultivars (updated annually) are given in *UC IPM Pest Management Guidelines: Small Grains*, available online at the UC IPM Web site, http://www.ipm.ucdavis.edu/PMG/selectnewpest.small-grains.html.

## CONCLUSIONS

Whether to use a small grain cover crop depends on

- the specific objectives for growing the cover crop (soil quality improvement, organic matter input, scavenging residual nitrogen and reducing nitrate leaching, suppressing weeds and other pests)
- the timing of planting and other crop management practices that must be altered
- the effect that integrating the cover crop in a rotation may have on weeds, diseases, and pests
- the investments in equipment and inputs that may be required

Small grain cover crops must be compatible with the scheduling and management requirements of a given cropping system in order to provide long-term benefits. A great deal remains to be learned about how best to select and manage small grain cultivars as cover crops in specific rotations and environments. Farmers interested in cover cropping small grains should start by experimenting on a relatively small scale at first and by working with other farmers, University of California advisors and specialists, and other people with experience using small grain cover crops.

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