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SMALL GRAIN PRODUCTION MANUAL
PART 12

Small Grains in Crop Rotations

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This publication, *Small Grains in Crop Rotations,* is the twelfth 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 11: Small Grain Cover Crops*, Publication 8174
- *Part 13: Harvesting and Storage*, Publication 8176
- *Part 14: Troubleshooting Small Grain Production*, Publication 8177

Small grain crops are grown on virtually all cultivated soils and in many different crop rotation systems in California. Rotations differ depending on the relative importance of specific crops in different regions. In low-rainfall areas small grains may be grown in a summer-fallow system with or without tillage or chemical fallow, or they may be cropped annually with minimum tillage. Rainfed production in higher-rainfall areas occurs in rotation with pasture (sometimes with 3 or more years of pasture). Under irrigation, small grains are rotated with a wide assortment of crops, including cotton, tomato, potato, sugar beet, rice, safflower, sunflower, melons, lettuce, onions, and alfalfa. Small grains can be double-cropped with a summer crop of corn, grain sorghum, or beans.

Small grain rotations can help reduce pest problems in other crops and provide agronomic benefits that improve the long-term stability and performance of agricultural systems. Weeds, pathogens, and nematodes are the pests most commonly affected by small grain rotations. Small grains help improve soil structure, aid water penetration and retention, and reduce erosion on sloping land. They may also help retain residual soil nitrogen in the root zone by decreasing the potential for leaching losses of nitrogen during the rainy season.

Barley can be grown in some cases to reduce salt levels in saline soils so that other crops less tolerant of salt can be grown. This is an important part of a reclama-

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tion program for saline and sodic soils. If irrigation water is not high in salts, irrigation can leach excess salt from the upper portion of the soil profile, and a few seasons of barley production to leach salts from the soil may be sufficient to allow other crops to be grown. When water penetration is a problem because of poor water quality, incorporating barley straw into the soil improves water penetration. An amount of residue equal to 10 to 30 percent by volume of the upper 6 inches (15 cm) of soils is recommended.

The deep, fibrous root system of small grains helps build soil structure, improve water penetration, and control soil erosion. Straw residue and roots left after harvest decompose slowly, which is important for erosion control and for improving soil physical characteristics. Incorporating the residue increases soil organic matter, improving soil tilth. Residue cover on the soil surface also slows runoff and improves water retention, which is particularly important on sloping land. Water penetration to deeper soil layers is improved by the root penetration of small grains and the biological activity associated with decomposition of crop residue. Small grain crops may mobilize potassium and phosphorus from deeper in the soil, making it available to the following crops in the rotation.

Crop rotation helps make weed management easier by changing growing conditions that favor the buildup of specific weeds and by allowing the use of different herbicides according to crop labels. The improvement of soil tilth by the small grain crop allows the rotation crop to grow more vigorously and compete more effectively with weeds. Small grain crops are especially useful for helping control broadleaf weeds that emerge during the small grain crop and perennials that emerge prior to grain harvest. Small grain crops are highly competitive with weeds, and most broadleaf weeds are easily controlled with selective herbicides that can be applied to the small grain (see Part 9, *Pest Management—Weeds*). This helps reduce the populations of weeds that are difficult to control in winter broadleaf crops such as cole crops, lettuce, and sugar beets. Sunflower family weeds such as cudweed, common groundsel, mayweed chamomile, prickly lettuce, and sowthistle are common problems in all broadleaf crops. Available herbicides control these weeds in small grains. Mustard family weeds such as London rocket, kaber mustard, black mustard, shepherd's-purse, and wild radish are common problems throughout California but are easy to control in small grains with available herbicides. Small grains also help reduce infestations of field bindweed, curly dock, Canada thistle, bermudagrass, johnsongrass, and nutsedges.

Crop rotation is an important tool for managing some diseases. If a pathogen does not survive for more than a few years in the absence of a host plant or host plant residue, rotation to a nonhost crop is effective in reducing disease. Rotating small grain crops with other crops can help reduce diseases of small grain crops such as Septoria tritici blotch of wheat, Fusarium crown and root rot, barley scald, and barley net blotch (see Part 6, *Pest Management—Diseases*). Small grain rotations are useful for managing a number of diseases of vegetable crops and broadleaf field crops such as alfalfa, beans, cotton, and sugar beets, and they also can help reduce inoculum of some diseases of tree and vine crops (table 1).

Small grain crops in a rotation can also reduce populations of several nematode species that can be harmful to trees, vines, or broadleaf crops (table 2).

Table 1. Disease control by small grain rotations for selected crops

Crop	Disease	Scientific name	Reduce inoculum below damaging levels	Reduce inoculum and/or keep inoculum levels from building up
beans	anthracnose	*Colletotrichum lindemuthianum*	x	
	Fusarium root rot	*Fusarium solani* f.sp. *phaseoli*	x	
beets	leaf spot	*Cercospora beticola*	x	
carrots	foliar blight	*Alternaria dauci*	x	
	leaf spot	*Cercospora carotae*	x	
celery	late blight	*Septoria apicola*	x	
cole crops	bacterial diseases	*Pseudomonas syringae* pv. *maculicola; Xanthomonas* spp.	x	
	black leg	*Phoma lingam*	x	
cotton	Verticillium wilt	*Verticillium dahliae*	x	
lettuce	anthracnose	*Marssoninia panattoniniana*	x	
melons	damping off, fruit and stem rot, and sudden wilt	*Pythium* spp.		x
	Fusarium root rot	*Fusarium solani* f.sp. *cucurbitae*	x	
peas	Aschochyta blight	*Aschochyta* spp.	x	
potato	ring rot, bacterial wilt	*Corynebacterium sepedonicum*		x
	scab	*Streptomyces scabies*		x
	stem rot	*Sclerotium rolfsii*		x
sweet potato	scab	*Monilochaetes infuscans*	x	
tomato	corky root	*Pyrenochaeta lycopersici*		x
	Phytophthora root rot, fruit and seedling blight	*Phytophthora* spp.		x
trees, vines, and caneberries	crown gall	*Agrobacterium tumefaciens*		x
	southern blight	*Sclerotium rolfsii*		x
vegetable crops	stem rot, white mold, and lettuce drop	*Sclerotinia minor; S. sclerotiorum*	x	
	southern blight	*Sclerotium rolfsii*		x
	Verticillium wilt	*Verticillium dahliae*		x

Table 2. Nematode control by small grain rotations for selected crops

Crop	Nematode	Scientific name	Reduce nematode populations
beets	sugar beet cyst nematode	*Heterodera schachtii*	X
chard	sugar beet cyst nematode	*Heterodera schachtii*	X
cole crops	sugar beet cyst nematode	*Heterodera schachtii*	X
	cabbage cyst nematode	*Heterodera cruciferae*	X
spinach	sugar beet cyst nematode	*Heterodera schachtii*	X
sugar beets	sugar beet cyst nematode	*Heterodera schachtii*	X
various broadleaf vegetable and field crops	root knot nematodes	*Meloidogyne* spp.	X
	root knot nematodes, warm-climate species	*Meloidogyne incognita, M. javanica, M. arenaria*	X
	Northern root-knot nematode	*Meloidogyne hapla*	X
various tree and vine crops	root-knot nematodes	*Meloidogyne* spp.	X
	lesion nematode	*Pratylenchus vulnus*	X
	ring nematode	*Criconemella xenoplax*	X

REFERENCE

Strand, L. L. 1990. Integrated pest management for small grains. Oakland: University of California Division of Agriculture and Natural Resources Publication 3333.

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