



MUSTARD GREEN MANURES

By
Andrew McGuire, Irrigated Cropping Systems Agronomist,
Washington State University Extension.

Mustard Green Manures

Farmers are using several types of mustard for their ability to build soil quality and to suppress soilborne diseases, nematodes, and weeds. Described below are the practices typically used by farmers for mustard green manure crops in the irrigated Columbia Basin.

Types of Mustard

There are two types of mustard being used in the Columbia Basin: white mustard (*Sinapis alba*, also called *Brassica hirta* or yellow mustard) and oriental mustard (*Brassica juncea*, also called Indian or brown mustard). See Figures 1 and 2.

Commercial varieties are used to produce table mustard, oil, and spices. Blends of the two types of mustard, most with a high proportion of oriental mustard, are often planted for green manuring.



Figure 1. White mustard seed (*Sinapis alba*) on left; Oriental mustard seed (*Brassica juncea*) on right.



Figure 2. White mustard (*Sinapis alba*) on left; Oriental mustard (*Brassica juncea*) on right.

Uses

Farmers are using mustard green manures, mainly before potatoes, to:

Suppress soilborne diseases and nematodes. When used as a green manure, researchers (Larkin and Griffin 2007, Ochiai et al. 2008) have found that mustards can suppress some diseases such as *Verticillium dahliae* and *Aphanomyces euteiches* (common root rot). Mustard green manures have also been found to suppress Columbia root-knot nematodes and may be effective against other types of nematodes (Mojtahedi et al. 1993; Fourie et al. 2016). However, because even low levels of some nematodes puts potato crops at risk of being rejected by processors, mustard cover crops should be used to enhance, not eliminate, chemical control of nematodes. Fall incorporation works best for control of nematodes and soilborne diseases and, oriental mustard may be better for this use than white mustard for disease suppression (Lazzeri and Manici 2001). Research is ongoing.

Suppress weeds. Weed control using mustard green manures has been variable (Haramoto and Gallandt 2004). The level of suppression seems to depend on the combination of mustard type and weed species and on the management of the green manure crop.

Biofumigation. Reductions in the numbers of nematodes, disease problems, and weeds are thought to be due in part to the presence of glucosinolates in mustards (Matthiessen and Kirkegaard 2006).

When the crop is incorporated into the soil, the breakdown of glucosinolates produces other chemicals that act against pests. These chemicals are similar to the active chemical in the commercial fumigant metam sodium.

Improve soil quality. Regular use of mustard green manure crops, with reduced tillage, has been found to increase soil organic matter levels and water infiltration rates and reduce wind erosion (McGuire 2003).

Crop Characteristics and Requirements

Soils

Mustards tolerate saline soils as well as barley and grow in soils with pH 5.5–8.3.

Temperature

Healthy, unstressed mustard plants can withstand temperatures into the low 20s (°F).

Herbicide Sensitivity

Mustards are sensitive to glyphosate as well as to 2,4-D and various other broadleaf herbicides. They may also be affected by carryover from herbicides used on previous crops.

Growth and Biomass

A mustard cover crop, planted in early to mid-August, will generally be in full bloom by the end of September in the Moses Lake area. Cool temperatures in September and October usually prevent it from producing viable seed before it is incorporated or freezes in late October or November. With approximately 100–120 lb available nitrogen and irrigation, mustards will produce up to 9,000 lb of dry matter per acre, depending on management and temperatures during the growing season (McGuire 2012).

Management

Seeding Dates

The optimal seeding time is during the second week of August; otherwise, up to the end of August is appropriate. With current varieties, planting in July is not recommended, as the mustard will mature quickly and require early incorporation to prevent production of viable seed.

Varieties and Sources

Several varieties and blends of both types of mustard are currently available. Plant seed that has been tested and certified not to be infected with the black leg (*Phoma lingam*) and black rot (*Xanthomonas campestris* pv. *campestris*) pathogens to avoid spreading these diseases. Most of Washington State is now protected by a Crucifer Quarantine to avoid introducing these pathogens on seed. If planting seed in an area where these diseases are established, plant only seed treated with fungicides that are effective against black leg or seed treated with hot water.

The mustards that are currently being used do not have hard or dormant seed. Cover crop varieties may not be acceptable for commercial purposes.

Wheat Straw

If possible when following wheat, leave the standing stubble to be incorporated with the mustard. This reduces the volunteer wheat emergence, avoids nitrogen immobilization by the straw and the resulting need for additional nitrogen, and may reduce winter leaching by immobilizing nitrogen released by mustard residues. See Figure 3.

Seeding Rates and Methods

The following seeding rates are the minimum recommended rates for white mustard green manures. Seeding rates for oriental mustard, which has smaller seed, may be reduced by one third. Some producers are experimenting with higher seeding rates which will produce smaller stems and roots that decompose more quickly when incorporated.



Figure 3. Mustard green manure growing in standing wheat straw.

Drilled. Drill 8–10 lb seed per acre through wheat straw using a minimum or no-till drill, or a drill with offset, double-disk openers.

Aerial seeding. Fly on the day before wheat harvest at 10–15 lb per acre. Keep surface wet until crop has emerged after 5–10 days. Rolling or packing the field before irrigation will result in better stands.

Broadcast. Same rate as aerial seeding. This can be done in combination with fertilizer application, followed by a pass of a noninversion undercutter V-sweep implement which also kills existing weeds (Figure 4). Alternatively, use a packer to press seed into soil or, if wheat straw is absent, a light cultivation.

Seeding Depth

For quick emergence, which improves weed control, a depth of 1/8–1/4 inches is recommended for center-pivot irrigated fields, or down to one inch where overhead irrigation is not available.



Figure 4. An undercutter like this can be used to incorporate broadcast mustard seed while also killing weeds.

Seed Cost

Cost of seed is \$2.00–2.40 per lb as of 2015. Commercial condiment varieties may be less expensive but may also be less suited for use as green manures. Ask your seed dealer.

Fertilization

Test soil to determine residual soil nitrate available to crop. For optimum growth, 120 lb available nitrogen per acre total (100–140 range) is needed over the season, with sulfur at 6:1 nitrogen-to-sulfur ratio. Early applied nitrogen will help the mustard compete with weeds and volunteer wheat.

Irrigation

To attain maximum benefits, maintain adequate soil moisture throughout growing season. This is critical to keep the mustard plants vegetative as long as possible for maximum biomass production. Stress will initiate flowering and limit biomass production.

Weed Control

Because mustard does not compete well early on, weed control may be needed. For best mustard growth, control the volunteer wheat and other grassy weeds with selective herbicides. Broadleaf weeds, such as pigweed, that emerge at the same time as the mustard are difficult to control, although the mustard often outgrows the weeds. In addition, large weeds that may be left after wheat harvest should be controlled before mustard emergence (see the broadcast seeding method in the Seeding Rates and Methods section). Check to see which herbicides are currently labeled for use with mustard.

Incorporation

Irrigation water shut-off, or fall practices such as fumigation, can dictate the timing of incorporation. For maximum biomass production, wait until late October to early November in the upper Columbia Basin, or three to six weeks before spring planting. Flail chopping followed immediately by disking to incorporate into top six inches of soil is recommended for maximum biofumigation effects (Figure 5).

One of the effects of a green manure is to bind soil particles together, enhancing resistance to erosion. However, this is a short-term effect. Therefore, leave sufficient residue—mustard, straw, or both—where wind erosion may be a problem. Do not let soil dry out in the fall because this will inhibit breakdown of the incorporated cover crop.



Figure 5. Chopping and disking of a mustard green manure crop.

Growers of mustards have a responsibility to either incorporate or otherwise kill plants which survive in fields or field borders to prevent potential cross-pollination with seed crops. Compared with spring-incorporated cover crops, fall-incorporated mustards will scavenge less soil nitrogen and therefore may result in nitrate leaching in some conditions. Incorporating the green manure with wheat straw may reduce this risk.

Possible Problems

Insects. There is the potential for increased soil insect populations after incorporation. Incorporate in fall or four to six weeks before planting spring crops to avoid these problems. In very mild winters, when the mustard does not winterkill, green peach aphids may overwinter on mustards. To avoid this, kill cover crop before spring warm-up. Various aphids and loopers can attack mustard, but damage is generally limited in late summer- or fall-planted mustard.

Effects. The effects of mustard green manures may vary due to differences in soil texture, organic matter levels, and quality; crop rotation; mustard variety and growth; initial pest levels; and other biological factors.

Other Resources

[Mustard Green Manures](#), WSU Center for Sustaining Agriculture and Natural Resources

[Using Green Manures in Potato Cropping Systems](#)

This is a revision of EB1952E, written by Andrew McGuire and published by WSU Extension in 2003.

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Use pesticides with care. Apply them only to plants, animals, or sites as listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

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