Mustard (Brassica spp.), a native to temperate regions of Europe, was one of the first domesticated crops. This crop's economic value resulted in its wide dispersal and it has been grown as a herb in Asia, North Africa, and Europe for thousands of years. Ancient Greeks and Romans enjoyed mustard (sinapis) seed as a paste and powder. In about 1300, the name "mustard" was given to the condiment made by mixing mustum, which is the Latin word for unfermented grape juice, with ground mustard seeds. Mustard has been a major specialty crop in North America since supplies from western Europe were interrupted by World War II. California and Montana were the major production areas until the early 1950s. Production of mustard in the Upper Midwest began in the early 1960s.

Mustard is currently grown on approximately 250,000 acres annually in the United States. North Dakota has the largest share of domestic production. Canadian mustard production increased for twenty years until it peaked in the mid-1980s. Alberta, Manitoba, and Saskatchewan currently grow a large share of the world's mustard crop. The French people are the largest consumers of mustard (1.5 lbs/person/year), and buy approximately 70% of the annual Canadian production.

Three types of mustard, yellow, brown, and oriental, are grown in North America. Yellow mustard (Brassica hirta) comprises about 90% of the crop in Montana. In Europe, yellow mustard is also known as white mustard (Sinapis alba - an older botanical name).
Brown and oriental mustards (Brassica juncea) are grown on limited acres. This crop is commonly produced in a rotation with small grains.

**Mustard Production Figures for Montana Varieties**

**Uses:**
More than 700 million lbs of mustard are consumed worldwide each year. Yellow mustard is usually used for prepared or table mustard, a condiment, and as dry mustard. Dry mustard is frequently used as a seasoning in mayonnaise, salad dressings, and sauces. Flour made from yellow mustard is an excellent emulsifying agent and stabilizer, and consequently, it is used in sausage preparation. Brown and oriental mustards are also used as oilseed crops. However, the strong flavor of this high-protein oilseed has made it unpopular in the livestock feed and vegetable oil markets of North America. As a result, mustard produced in North America is used primarily as a spice or condiment.

**Growth Habit:**
Mustard is an annual herb with seedlings that emerge rapidly, but then usually grow slowly. Plants cover the ground in 4 to 5 weeks with favorable moisture and temperature conditions. The tap roots will grow 5 ft into the soil under dry conditions, which allows for efficient use of stored soil moisture. Plant height at maturity varies from 30 to 45 in. depending on type, variety, and environmental conditions.

Flower buds are visible about five weeks after emergence. The crop will appear to be rather uneven at this stage of development. Yellow flowers begin to appear 7 to 10 days later and continue blooming for a longer period with an adequate water supply. The stand will then appear more even. A longer flowering period increases the yield potential. About half of the flowers produce dark, reddish-brown seeds that are retained in pods of 0.5 to 0.75 in. in length. Flowers pollinated during the first 15 days of the flowering period produce most of the seed. Just like canola, this crop will blast flowers if temperatures are too hot during the bloom.

Small grain crops following mustard in rotations will usually yield better than following small grains. Crops that can be sprayed with 2,4-D or MCPA should follow mustard so that any volunteer plants can be controlled. Crops such as sunflower, canola, safflower, crambe, dry bean and soybean are not recommended in close rotation with mustard, as they are all susceptible to sclerotinia (white mold).

**Environment Requirements:**

- **Climate:** Mustard is a cool season crop that can be grown in a short growing season. Varieties of yellow mustard usually mature in 80 to 85 days whereas brown and oriental types require 90 to 95 days. Seedlings are usually somewhat tolerant to mild frosts after emergence, but severe frosts can destroy the crop. Mustard, especially the brown and oriental types, has a partial drought tolerance between that of wheat and rapeseed. Moisture stress caused by hot, dry conditions during the flowering period frequently causes lower yields.

- **Soil:** Mustard can be raised on variable soil types with good drainage, but is best adapted to fertile, well-drained, loamy soils. Soils prone to crusting prior to seedling emergence can cause problems. This crop will not tolerate waterlogged soils since growth will be stunted. Dry sand and dry, sandy loam soils should also be avoided.

**Seed Germination:** Seed will germinate at a soil temperature as low as 40°F.

**Cultural Practices:** A small grain crop following mustard in the rotation will usually yield more than when following continuous small grain. Mustard has several of the same diseases and insect pests as flax, oilseed rape (canola), sweet clover, soybeans, field peas, lentils, and sunflowers. Therefore, crops from this group should be avoided in the same rotation as mustard. Cereal grains are not very susceptible to the pest and disease problems of mustard.

**Seedbed Preparation:** The seedbed should be firm, fairly level, and free of weeds and previous crop residue. Soil is firm
enough for seeding when only a shallow depression of a heel is made when someone stands on the soil. Shallow tillage, just deep enough to kill weeds, should keep soil moisture close to the surface and leave a firm seedbed. If necessary, the seedbed should be packed before planting to obtain a firm seedbed. Firm seedbeds with adequate moisture allow shallow planting and encourage rapid, uniform seed germination and emergence of seedlings. A number of growers in North Dakota have also successfully planted mustard in standing small-grain stubble and minimum-tilled stubble.

Seeding Date: In Montana, mustard is normally planted on recrop acres, usually small grain stubble, from April 15 to May 5. The crop will begin to bloom approximately 35 days after planting, and will continue to bloom for three to four weeks as long as conditions remain cool.

Planting should occur as early in the season as the environmental conditions allow. The soil temperature should be at least 40 to 45°F at a depth of 1 in. If seedlings are damaged by frost after emergence, 4 or 5 days may pass before the full extent of the damage is known. Plants should recover if the growing points are not destroyed. An earlier seeding date allows plants to benefit from the spring moisture in establishing a good canopy before weeds emerge, and to avoid heat stress during summer that causes flower or pod abortion. Early seeding also reduces the risk of damage from fall frosts that can reduce crop yields and quality. The recommended seeding date in northern Minnesota and Wisconsin is May 1 to 25. Seeding later than May 15 frequently results in lower yields.

Method and Rate of Seeding: Yellow mustard, which has approximately 100,000 seeds/lb, is solid seeded with a grain drill at a rate of 8 to 14 lbs/acre. The higher rate should be used on heavy, fertile soils or on those where emergence is difficult. Brown and oriental mustards have 200,000 seeds/lb and should be solid seeded at a rate of 5 to 7 lbs/acre. Seed is small and must be planted shallow at a 1/2 to 1 in. depth. If very dry soil conditions exist seeding depth should be increased to 1 1/2 in. If mustard stands are poor, quick decisions for reworking and reseeding should be made.

Fertility Requirements: Mustard generally responds to nutrient additions in a similar way as does rapeseed or canola. Soil tests should be used to determine nutrient need. Optimal (medium) soil test levels are about 15 to 20 ppm Bray P, and 80 to 100 ppm K. At these levels fertilizer should be applied at a rate of about 45 lbs/acre P2O5 and 80 lb/acre K2O. When fertilizer is banded, the bands should be placed below and to the side of the seed furrow. Mustard responds well to nitrogen additions with optimum yields occurring at about 100 to 120 lb/acre N. Where mustard follows legumes or manure additions, appropriate credits should be taken. Work in the western U.S. shows that mustard responds well to sulfur(s) on low S-supplying soils. Sulfur fertil-sandy soils in northwestern Wisconsin and northern Minnesota which have not been manured in the past two years. On soils deficient in boron (testing at less than 0.5 ppm B), apply 0.5 to 1 lb/acre in a uniform broadcast application. Never band B near the seed. Soils with a pH near neutral (7.0) are desired for this crop. Nevertheless, an alkaline pH and slightly saline soils are tolerated. Mustard has a tolerance to soil salinity that is similar to barley. Mustard responds to nitrogen and phosphate fertilizer in a manner similar to small grains. Avoid using more than 10 pounds per acre actual N with the seed as germination injury can occur. Some growers mix low rates of phosphorus fertilizer (20 pounds P2O5) with mustard seed and plant them together. Potash is rarely needed to increase mustard yields.

Harvesting: Mustard grown in Montana is approximately an 85-90 day crop, and is usually straight cut, not swathed. Wind, rain and normal drying generally does not cause mustard to shatter before cutting. But, the actual harvesting operations can cause severe shattering losses when the crop is overripe or extremely dry. Yellow mustard can be straight combined if the field is not weedy and the crop is uniformly ripe. When direct combining, wait until the crop is mature and dry. The reel may cause shattering when straight combining but it can be removed or lifted above the crop if the stand is good. Mustard should be reduced in speed and half the bats removed. Many growers of yellow mustard prefer to straight combine while the crop is still tough (12-15 percent moisture) and then artificially dry. This results in seed of uniform quality. Brown and oriental mustard varieties are generally more susceptible to shattering than the yellow types and should be swathed. Yellow mustard should be swathed if the crop is weedy or uneven in maturity. Mustard should be swathed following general leaf drop when overall field color changes from green to yellow/brown and early enough to avoid shattering.

Pods selected from the middle of the racemes of several plants in areas representing the average maturity of the field should
be examined for physiological maturity of the seeds. Most varieties are at the optimum maturity for swathing when upper pods have turned and seeds are brown or yellow. The remaining 25 percent green seeds will mature in the swath prior to harvest.

Swathing in early morning hours will aid in reducing shattering losses from ripe pods. The windrow is inclined to be bulky and easily scattered by the wind. To help prevent this, many growers pull steel drums over the top of the windrow to help push it into the stubble. Swathing at a high stubble level will reduce the size of the windrow and will provide stubble in which it can lie.

The combine should be adjusted so that the seeds are completely threshed while using the lowest possible cylinder speed. Cylinder speed should be set at approximately 600 RPM. Careful adjustment of the cylinder speed and cylinder opening is important to avoid cracking. When the crop is very dry, every other cylinder bar may have to be removed. To test for cracking, run your hand into the threshed seed. If cracked mustard is present, it will adhere to the hair on the back of your hand, indicating the need for further combine adjustment. Cracked seed is considered dockage and a loss to the producer. Cylinder speed may need to be varied during the day as crop moisture content varies. Fan speed should be reduced to limit seed loss with the straw, yet maintain sufficient air to ensure a clean sample.

Yield:
Average yield are in the 800 to 1200 pound range, with a value of 9 to 13 cents per pound. I have seen yellow mustard reach as high as 35 cents per pound, so definitely is a finicky specialty crop. Current value is around 10 cents per pound.

Storage:
Mustard seed can be stored safely when the moisture content reaches 9 percent or less. Care should be taken to avoid cracking the seed while moving the crop in and out of storage. Cracked seed ends up as dockage and a loss to the producer. When drying, it is essential not to exceed air temperatures of 150°F or seed temperatures of 120°F. Tight bins and truck boxes free of cracks or holes, are essential for transfer and storage of mustard.

Weeds

Primary weed problems in all mustards, as well as all rotational broadleaf crops (canola, flax, lentils, chickpeas, etc.) are grassy weeds. In Northeast Montana, that would include volunteer cereals, wild oats and green foxtail. Broadleaf weed problems include kochia, Russian thistle and wild buckwheat.

Mustard crops are poor competitors with weeds in the early seedling stage and weeds can greatly reduce mustard yields. Weed seeds, which are difficult to remove, can cause high losses during seed cleaning and lower market grades. Good weed control is based on preparation of a clean field and shallow seeding to encourage quick, uniform emergence. Control small weeds by harrowing before crop emergence until 3 to 5 days after mustard germination. Harrowing after emergence is not recommended. Young mustard seedlings do not compete well with weeds and the early establishment of a uniform, vigorous crop helps control annual weeds. The crop cannot be cultivated after emergence.

Mustard, especially the oriental and brown types, should be grown on land with as little wild mustard as possible to avoid costs of removal and loss of tame mustard seeds. Wild mustard seed can be mechanically separated from the larger-seeded yellow type, but separation is not possible with the smaller-seeded brown and oriental types. Wild mustard seed often reduces the crop quality to the sample grade. Production of rapeseed and mustard on the same fields is also not recommended since seed mixtures can occur easily and degrade both crops.

The following herbicides are labeled for use in Montana:
![Company Herbicide | Weeds | Notes](image)

<table>
<thead>
<tr>
<th>Company</th>
<th>Herbicide</th>
<th>Weeds</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASF</td>
<td>Poast sethoxydim</td>
<td>annual grasses, quackgrass suppression</td>
<td>Poast must be applied 60 days or more before harvest.</td>
</tr>
<tr>
<td>Dow Agrosciences</td>
<td>Treflan HFP trifluralin</td>
<td>grasses, broadleaf weeds</td>
<td>Trifluralin must be applied before seeding and incorporated thoroughly in the soil for maximum effectiveness.</td>
</tr>
<tr>
<td>Dow Agrosciences</td>
<td>Treflan TR-10 trifluralin</td>
<td>grasses, broadleaf weeds</td>
<td>Trifluralin must be applied before seeding and incorporated thoroughly in the soil for maximum effectiveness.</td>
</tr>
<tr>
<td>Aventis CS</td>
<td>Sedagri Trifluralin 480 trifluralin</td>
<td>grasses, broadleaf weeds</td>
<td>Trifluralin must be applied before seeding and incorporated thoroughly in the soil for maximum effectiveness.</td>
</tr>
<tr>
<td>Griffin</td>
<td>Trilin trifluralin</td>
<td>grasses, broadleaf weeds</td>
<td>Trifluralin must be applied before seeding and incorporated thoroughly in the soil for maximum effectiveness.</td>
</tr>
<tr>
<td>Griffin</td>
<td>Trilin 10G trifluralin</td>
<td>grasses, broadleaf weeds</td>
<td>Trifluralin must be applied before seeding and incorporated thoroughly in the soil for maximum effectiveness.</td>
</tr>
</tbody>
</table>

**NOTE:** Mustard is sensitive to the broadleaf herbicides used on cereal crops, such as 2,4-D and MCPA, and spray drift from adjacent fields must be avoided. Crops that can be sprayed with 2,4-D or MCPA should follow mustard in the rotation so volunteer plants can be controlled.

**Diseases**

This crop is vulnerable to several diseases, among which the most serious are Sclerotinia stalk rot (white mold), downy mildew, white rust, leaf spots, and mosaic virus. Good cultural practices are the most effective control measures for diseases. These practices should include keeping records of disease occurrence, compliance with the proper crop rotation, control of host plants for diseases in fallow fields and non-crop areas, and use of seed treatments.

Sunflower, rapeseed, canola, safflower, soybeans, crambe, and drybeans should not be grown in rotation with mustard since they have similar disease problems. If these crops are produced in rotation with mustard, damage from these diseases can increase to economic levels. Numerous broadleaf weeds can also serve as hosts or sources of infection for these diseases. Wild mustard, pigweed, field pennycress, and shepherd's purse are examples of predominant hosts. One of the best methods to avoid serious disease problems in mustard (and leaf diseases of small grains) is to produce this crop in a small grain rotation. Mustard should be spaced four or more years apart in the crop rotation to avoid problems with soil-borne diseases. After potato or flax crops, one year should pass before mustard is raised on the same field due to the presence of root rot or damping-off pathogens.

**Insect Pests**

Insects can cause serious yield losses and growers should monitor fields closely for potential problems. Flea beetles and diamondback moth caterpillars have been the most troublesome insects. Serious damage to mustard plants can be caused by the early season feeding of overwintered flea beetles on newly emerged seedlings. The adult beetles feed on the cotyledons...
and first true leaves, causing the typical shot-holed appearance. Severely damaged seedlings may die, while less seriously damaged plants often suffer a reduction in vigor and stamina. Hot, sunny weather is conducive to feeding activity, while cool, damp weather slows feeding and favors crop growth. Hot and dry weather may cause damaged seedlings to wilt and die, and partial to complete crop loss can result. In some instances the infestation of a field can occur as a creeping movement from plant to plant across a field; in other instances the entire field may become quickly and evenly infested. Once the crop advances beyond the seedling stage, serious damage usually does not occur, since vigorously growing mustard can outgrow the beetle defoliation. No major effects on plant vigor have been noted from the feeding of the larvae on plant roots. Cultural methods can help reduce plant losses caused by flea beetles. A firm seedbed that is well tilled and adequately fertilized will help plants outgrow beetle damage during the susceptible early season stages. A few flea beetles or scattered shot-holing are not necessarily cause for alarm. However, if flea beetles are numerous on plants and feeding holes are present in most cotyledons, immediate control will likely be required. Flea beetles are shiny black, jumping beetles about 1 inch long. Diamondback moth caterpillars attain a length of ½ inch and are light yellowish-green to green. The larvae eat leaves, flowers and green pods and are extremely active when touched.

References

3. Tame Mustard Production - http://www.ext.nodak.edu/extpubs/plantsci/crops/a935w.htm