Growing Chickpea in North Dakota

This publication is intended for growers considering kabuli or desi chickpea as a crop. The text covers basic plant growth habit, crop production, field selection, seedbed preparation, fertilization, inoculation, seeding, weed control, diseases, insects, rotational benefits and harvesting.

Chickpea (Cicer arietinum L.) originated in what is now southeastern Turkey and Syria and was domesticated about 9,000 B.C. It is an annual grain legume or “pulse” crop sold in human-food markets.

Chickpea is classified as kabuli or desi type, based primarily on seed size. Kabuli chickpea, sometimes called garbanzo bean, has a white to cream-colored seed coat and ranges in size from small to large (greater than 100 to less than 50 seeds per ounce). Desi chickpea has a pigmented (tan to black) seed coat and small seeds.

Before selecting a cultivar, contact potential buyers to ensure it is accepted in the market you are targeting. Farm-level chickpea yields in the northern Great Plains typically range from 500 to 1,500 pounds per acre.

Chickpea is a high-value crop that is adapted to deep soils in the semiarid northern Great Plains. However, disease risks are high, and Ascochyta blight can cause devastating financial losses for growers. Thus, this crop is recommended only for producers who are willing to scout diligently and actively manage disease pressure throughout the entire growing season.

Price Uncertainty

Producers of alternative crops such as chickpea face price volatility in addition to production uncertainty. Chickpea is a high-risk/high-input crop with potentially high financial rewards. Price uncertainty is a particular challenge with chickpea because it is a small-acreage crop and acres planted can fluctuate dramatically. Harvested acres in North Dakota from 2010 to 2017 are presented in Figure 1.

Figure 1. Chickpea harvested acres showing large (kabuli) and small-seeded (desi) chickpea varieties planted from 2010 to 2017 in North Dakota.
Markets

It is essential to know where a chickpea crop is going to be sold before you plant it. Because chickpea is a specialty crop, bringing harvested chickpea to the local elevator may not be possible. Therefore, you need to know where to sell and deliver the crop, as well as what the buyer wants.

Things to ask:
- Does the buyer want a specific variety? If yes, buy certified seed because the buyer may require documentation of the seed source, especially if it is a Plant Variety Protected (PVP) variety.
- What are the quality specifications? In the food-grade market, split seeds, cracked seed coats, discoloration and greens (immature seeds) can result in steep discounts. Buyers of kabuli types prefer a light and creamy seed color. For these reasons, food-grade chickpea demands careful harvesting, handling and storage to sell for the highest price.

Researching Buyers

Although many opportunities exist for contracting chickpea production with U.S. and Canadian buyers, producers should be careful to understand all the terms of the contract, particularly quality specifications and dispute resolution. The chickpea market, like markets for other alternative crops, is undergoing significant changes, with many firms entering and leaving the industry every year. Be certain to research the reputation of the firms with which you consider contracting.

Adaptation

Drought Tolerance

Under drought stress conditions, maturity requirements for chickpea are similar to or slightly longer than for spring wheat. However, chickpea has an indeterminate growth habit, which can extend maturity greatly if cool or wet late-summer conditions persist. Chickpea roots deeper than dry pea or lentil and is more drought tolerant when stored subsoil moisture is available.

Temperature

Cool growing-season temperatures and early fall frost can prevent chickpea from fully maturing. Chickpea tolerance to frost is similar to spring cereal grains. Chickpea tolerates high temperatures during flowering, unlike dry pea.

Growing Season

Chickpea matures later than dry pea or lentil and prefers a longer, warmer growing season. Desi chickpea typically flowers one day to one week earlier than kabuli, depending on the variety. Large-seeded kabuli varieties generally mature one to two weeks later than desi types, which have been bred for earlier maturity. Average maturity will depend on the variety and climatic conditions, and ranges from 100 to 130 days.

If seeding chickpea in early May, plan to harvest by mid-September. Under cool, wet late-summer conditions, maturity can be delayed substantially due to chickpea’s indeterminate growth habit, and producers must manage the crop to meet market specifications for green seed content (less than 0.5 percent to receive U.S. No. 1 grade, USA Dry Pea and Lentil Council).

In a year with abundant fall precipitation, chickpea might never fully mature. Under such conditions, a producer should gauge when the crop has fully mature pods from the bottom of the canopy up to the top 25 percent of the canopy, and then swath or desiccate.

Plant Growth Habit

Most chickpea varieties have compound leaves that exhibit a fernlike appearance (Photo 1); however, a few kabuli types have simple leaves (Photo 2). The chickpea plant is erect, with primary and secondary branching resembling a small bush. The plant flowers profusely and has an indeterminate growth habit, continuing to flower and set pods as long as climatic conditions allow.

Most Kabuli and desi chickpea types can be identified by flower color: Kabuli types have white flowers, indicating the absence of pigmentation, while desi types have purple flowers (Photo 3). The pods are oval-shaped, borne singly, and contain one or two seeds. Plant height ranges from 10 to 22 inches, while kabuli types often are slightly taller than desi types.

Growth stages for chickpea are divided between vegetative and reproductive phases (Table 1). However, because the plant is indeterminate, new leaves continue to develop after flowering begins.

<table>
<thead>
<tr>
<th>Chickpea Growth Stages</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Vegetative Growth Stages</strong></td>
<td></td>
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<tr>
<td>VE Seedling emergence</td>
<td></td>
</tr>
<tr>
<td>V1 1st multifoliolate leaf fully expanded</td>
<td></td>
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<tr>
<td>V2 2nd multifoliolate leaf fully expanded</td>
<td></td>
</tr>
<tr>
<td>V3 3rd multifoliolate leaf fully expanded</td>
<td></td>
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<tr>
<td>V4 4th multifoliolate leaf fully expanded</td>
<td></td>
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<tr>
<td>Vn nth multifoliolate leaf fully expanded</td>
<td></td>
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<tr>
<td><strong>Reproductive Growth Stages</strong></td>
<td></td>
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<tr>
<td>R1 Early bloom, one open flower</td>
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<tr>
<td>R2 Full bloom, most flowers on the plant open</td>
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<tr>
<td>R3 Early pod, pods visible on lower portions of the plant</td>
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<tr>
<td>R4 Pods have reached their full size but still are flat</td>
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<tr>
<td>R5 Early seed, seed in any single pod fills the pod cavity</td>
<td></td>
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<tr>
<td>R6 Full seed, seeds fill the pod cavity</td>
<td></td>
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<tr>
<td><strong>Physiological Maturity</strong></td>
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<tr>
<td>R7 Leaves start to yellow and 50 percent of the pods are yellow</td>
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<tr>
<td>R8 90 percent of the pods are mature color (gold to brown)</td>
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</table>
Cultural Practices – Crop Production

For optimum yield potential and success in chickpea production, give attention to field selection, seeding, inoculation, disease control, weed management, insect pest management, harvesting and crop rotation. Disease management is critical to success.

Crop Rotation

Chickpea, like other annual legumes in a rotation, offers several cropping advantages for the producer. Cereal crop yields often increase when planted after legumes due to the following:

- Cereal pest life cycles are disrupted.
- Alternative herbicides can be used to clean up grassy weeds.
- The soil nitrogen supply is increased.

However, chickpea has a moderately deep rooting system (similar to spring wheat), which is effective at extracting subsoil moisture, and because little stubble remains after harvest to trap snow and minimize evaporation, available crop water can be limited following chickpea in dry areas.

Fallowing on chickpea stubble presents severe soil erosion risks and should be avoided. If attempted, do so only if sufficient cereal stubble is present from the previous year in a no-till system.

Chickpea stubble is not recommended to be planted to winter wheat because seeding disturbance destroys scarce crop residues and soil moisture often is insufficient to allow good germination of the winter wheat crop.

Field Selection

Chickpea can be planted into small-grain stubble. Chickpea should not be planted in a field that was planted to dry pea or lentil last year, and ideally, has been out of pulse crops for at least two years to minimize the risk of root rot.

Seed size is a critical marketing factor for large kabuli types, and production in low-rainfall areas after a low-water-use crop such as flax can help ensure adequate water supply late in the growing season when seed size is determined.

Little information is available for chickpea production under irrigation in the northern Great Plains, but experience in southern Alberta and central Montana suggests it is a viable practice, provided Ascochyta blight is managed successfully. At Sidney, Montana, the average chickpea yield under irrigation was approximately 2,100 pounds per acre in 2017.

To select appropriate fields for chickpea, consider previous herbicide use, weed spectrum and pressure, interval since chickpea was last grown, and proximity to current and past chickpea fields. These considerations are critical to managing weeds and diseases and to reduce the potential for residual herbicide injury to the crop (see “North Dakota Weed Control Guide,” W253, www.ag.ndsu.edu/weeds/weed-control-guides/nd-weed-control-guide-1).
Avoid fields that have a history of perennial weeds, such as Canada thistle and field bindweed. Many herbicides used in small-grain production can carry over and cause chickpea injury and yield loss. The rotational interval for chickpea depends on how long herbicides remain in the soil.

Factors that affect herbicide persistence include pH, moisture and temperature. Because western North Dakota has a dry climate and short growing season, herbicides generally degrade more slowly there than in warmer, wetter areas. Sulfonylurea herbicides (Ally, Ally Extra, Amber, Finesse, Glean, Peak and Rave) persist longer in high-pH soils. In areas with low rainfall and high soil pH (greater than 7.5), sulfonylurea herbicide residues may remain in the soil much longer than described on the label, and a soil bioassay should be conducted before planting chickpea.

For integrated disease management, start by selecting a field that has not had chickpea for at least three years and is at least three miles from previous year’s fields. However, even with these precautions, any chickpea field should be considered susceptible to Ascochyta blight during wet periods because long-distance spore transmission appears to occur. Fields that are well-drained are preferred because chickpea can be injured by waterlogged soil relatively quickly, compared with other nonlegume broadleaf or cereal crops.

**Inoculation**

Chickpea must be inoculated with a specific Rhizobium strain (Mesorhizobium cicer) to ensure effective nodulation and nitrogen-fixing activity. This species of rhizobium is unique to chickpea. The rhizobium used for field pea and lentil will not result in a symbiotic relationship and N fixation if used on chickpea.

Inoculant is marketed in granular, liquid and powder forms for seed inoculation or in granular form for soil inoculation. The powder and granular formulations usually are clay- or peat-based. Seed-applied inoculant must be applied to the seed immediately prior to planting. Large populations of introduced rhizobia bacteria must survive in the harsh soil environment for two to three weeks to form nodules effectively on the roots of chickpea seedlings. In dryland cropping regions, peat-based granular inoculant is preferred because it is more reliable in dry seeded conditions.

Chickpea can achieve its yield potential on a wide range of soil pH from 5.3 to greater than 7. In acidic soils, use a granular inoculant instead of a liquid or powder formulation. In acidic conditions, the activity of the rhizobia is reduced, but the use of granular inoculant helps overcome this problem.

**Seeding**

Producer experience suggests that both types of chickpea can be seeded as early as other pulse crops (dry pea and lentil). Chickpea seed should be treated for soil- and seed-borne pathogens (See “North Dakota Field Crop Plant Disease Management Guide” PP622, www.ag.ndsu.edu/publications/crops/). Using high-quality seed free of Ascochyta (less than 0.3 percent) also is essential, and seed treatment is recommended as part of an effective plan for integrated Ascochyta blight management.

Air drills and openers often need minor modifications and adjustments to avoid damaging seeds and facilitate metering of large-seeded kabuli varieties.

Chickpea typically is seeded in narrow row spacings of 6 to 12 inches. Target established plant densities for kabuli and desi types are four plants per square foot (about 175,000 plants per acre). This usually requires planting four to five chickpea seeds per square foot. Depending on seed size, this often translates into seeding rates of 125 to 150 pounds per acre for large kabuli types and 80 to 100 pounds per acre for desi types.

Processors of kabuli types prefer large seeds and often pay a premium based on size. Breeders consider the ratios of large (>9mm):medium (8mm):small (<8mm) seeds when making their selections because seed size has a genetic component. However, row spacing, seeding rate and, ultimately, plant population also influence seed size. Producers should be careful not to exceed four established plants per square foot to ensure maximum seed size and enhance the marketability of kabuli-type chickpea.

Seeding depth recommendations are 1 inch below moist soil for small-seeded types and 2 inches below moist soil for large-seeded types. Chickpea can be seeded as deep as 4 inches to utilize available soil moisture for germination. If the field requires rolling, the operation should be completed immediately after seeding or after the plants are well emerged but before the six-leaf stage of growth. Do not roll during plant emergence because it will injure the chickpea.

**Fertilization**


**Nitrogen (N)**

Inoculate chickpea with Mesorhizobium cicer to encourage nodulation. A small amount of starter N increased early vegetative growth in one study and led to slightly earlier maturity. We do not recommend you apply more than 10 pounds of N per acre, usually contained in the P fertilizer source, to chickpea.

However, if the crop does not have nodules and is yellow due to a lack of nitrogen, take a soil test (0 to 12 inches) for nitrate-N, and apply the difference between 100 pounds of N and the soil test N (in pounds) per acre as a rescue treatment by broadcasting the fertilizer prior to rain.

**Phosphate (P)**

Desi-type chickpea has a lower P demand than the kabuli types. Kabuli chickpea growers often receive a premium for larger seed size, which is supported by higher P rates (Table 2). Also, a small amount of P (about 10 pounds of P₂O₅ per acre) increased the height of the lowest pods due to increased early vegetative growth, which might facilitate harvest in fields with exposed rocks. Under all but the driest soil environments, chickpea is relatively tolerant to up to 20 pounds of P₂O₅ per acre.

**Potassium (K)**

Chickpea has a low demand for K, similar to lentil and field pea.
Sulfur (S)
Soil testing for soil sulfur is not diagnostic. In the past 20 years, our soils have become increasingly deficient in sulfur, except for our saline soil areas. Although chickpea has the ability to support production of its own N through its relationship with N-fixing bacteria when inoculated, it has no means to support the production of S. Application of 15 to 20 pounds of S per acre as ammonium sulfate or another sulfate-containing fertilizer supplies enough S for a growing season, provided a heavy rain does not leach S in sandy or light-textured soils.

Micronutrients
No evidence is available to show that any micronutrient deficiencies commonly occur in chickpea in North Dakota.

Soluble Salts
Field pea and lentil generally are more sensitive to soil salts than chickpea. Avoiding seriously saline soils (electrical conductivity [EC] greater than 1.5 millimhos/centimeter) is prudent for pulse crops. Great variation in salt tolerance occurs among chickpea varieties. Generally, desi types are more salt tolerant than kabuli types. However, variation occurs even among varieties within type. More screening needs to be done to provide better grower guidance.

For now, determine soil salt (EC) levels in areas that struggle to produce grain and plan to seed a more salt-tolerant crop there in the future. A comprehensive strategy to address salinity issues within fields helps expand future pulse crop options. For more information on addressing soil salinity, visit the NDSU Soil Health website (www.ndsu.edu/soilhealth/).

Disease Management
Multiple diseases, including root rots, affect chickpea and should not be ignored, but Ascochyta blight is easily the most yield-limiting disease of the crop. We cannot overstate how important active and engaged management of Ascochyta blight on chickpea is to produce a successful crop. In a season favorable for disease development, total crop failure can result if Ascochyta blight is not managed appropriately.

Ascochyta Blight is Different
Ascochyta blight is a disease caused by the fungal pathogen *Ascochyta rabiei*. While the disease “Ascochyta blight” also occurs on field pea and lentil, *Ascochyta rabiei* is specific to chickpea. In other words, Ascochyta blight on chickpea is different from Ascochyta blight on lentil and field pea. It is specific to chickpea and does not infect pea or lentil. It also is very aggressive on chickpea, and most importantly, the pathogen in chickpea has developed resistance to QoI fungicides (FRAC 11, also called strobilurins) and is at risk of developing resistance to other classes of fungicides.

Identifying Ascochyta Blight
Scouting for Ascochyta blight is critical; proactive and preventive disease management is necessary because Ascochyta cannot be controlled once it reaches epidemic levels. The pathogen can infect all above-ground plant parts any time after chickpea emergence.

Ascochyta blight first appears as small gray specs that quickly turn into brown lesions with dark borders (Photo 4). Small, circular black dots (fungal reproductive structures called pycnidia) will appear in lesions (Photos 4-5), frequently arranged in concentric rings resembling a bull’s-eye. The disease often appears first in places close to areas where previous chickpea crops were grown or in areas of higher humidity and longer dew periods, such as along shelterbelts or in low areas.
Disease Cycle
The pathogen causing Ascochyta blight can survive for up to four years in infected residue and seed. If infected seed is planted, the pathogen can grow along with the plant. Even a very low level of infected seed can facilitate an epidemic in a favorable environment.

Ascospores produced on the infected residue (or seed) are dispersed aerially and can travel for miles. Spores that travel through air or from infected seed cause the first infections on leaves, stems or other above-ground tissue. Consequently, a field that never has been planted to chickpea, is not near other chickpea fields, and is planted with clean seed still is not immune from Ascochyta blight and must be scouted.

Ascochyta blight develops most rapidly in cool (59 to 77 F) and wet conditions. The small black pycnidia that appear in lesions produce a second spore type (conidia) that are dispersed easily by rain splash and cause new infections. If multiple infection cycles occur, an epidemic can quickly decimate a chickpea crop. An epidemic can occur particularly fast in a season with frequent rains, heavy dews, and high humidity. Hot and dry conditions will slow or stop disease development, but once favorable conditions return the epidemic will resume.

Managing Ascochyta Blight
Ascochyta blight must be managed with as many strategies as possible. Reliance on fungicides or genetics alone is likely to result in management failure and large economic losses.

No single management strategy can guarantee disease prevention, so use all available strategies to prevent or delay infection. Here are some strategies:

- **Plant clean seed.** This is critical to ensure that high amounts of the pathogen will not be brought into the field at planting. Use seed treatments that are efficacious on Ascochyta.
- **Practice long crop rotations** to help limit the inoculum already present in the field. This is particularly important in minimum and no-till systems.
- **Select resistant chickpea varieties.** While selecting a variety completely resistant to Ascochyta blight is not possible, some varieties are less susceptible than others.

Fungicides can be an effective tool to manage Ascochyta blight, but field scouting, application timing, fungicide selection and fungicide rotation are critical for success (See “North Dakota Field Crop Plant Disease Management Guide,” PP622, www.ag.ndsu.edu/publications/crops/). Multiple fungicide applications likely will be needed to manage the disease in a growing season.

At the time of this printing, QoI fungicides (FRAC 11: also called strobilurins) are **not effective** on Ascochyta blight in North Dakota because the pathogen population has developed resistance to them. This includes products such as Headline and Quadris, which are one of the compounds in many premixed products.

However, at the time of this printing, DMI fungicides (FRAC 3: also called triazoles) and SDHI fungicides (FRAC 7) can be used to manage disease, but the pathogen population could develop resistance to them in the future. Other chemicals, such as chlorothalonil (FRAC M5) are less efficacious but can be useful in some fungicide rotation/mixing strategies and are unlikely to be rendered ineffective by pathogen resistance development.

When preparing to manage Ascochyta blight with fungicides, consulting the most up-to-date information on fungicide timing, efficacy and rotation strategy (www.ag.ndsu.edu/CarringtonREC/plant-pathology/plant-pathology-1) is critical.

Weed Management
Chickpea is a poor competitor with weeds at all stages of growth. Chickpea is a small, short plant, slow to canopy, and the canopy may not fully close. Without good weed control, yield loss can be substantial.

Slow seedling growth, in addition to a relatively sparse optimum plant population of three to four plants per square foot, results in an open crop canopy, which requires season-long weed management. Crop rotation and field selection are cultural methods that should be used as part of an integrated weed management program.

Cultural weed control begins with avoidance. Avoid fields where perennial and annual broadleaf weeds are a major problem, and be sure to control these weeds in the preceding crop. Perennial weeds such as Canada thistle should be controlled in the previous crop year. Glyphosate applied in the fall and again in the spring burndown will help reduce perennial weed densities. Kochia, Russian thistle, wild mustard and wild buckwheat are the most problematic annual weeds in chickpea and can cause major problems for direct harvesting.

Weeds can be managed with stale seedbed techniques, provided the grower is willing to risk yield loss due to delayed seeding. Stale seedbed techniques include delaying seeding and allowing weeds to emerge, then controlling them with tillage or a non-selective herbicide.

Generally, the first flush is the largest, and the earliest emerging weeds are the most competitive. Stale seedbed techniques are not foolproof because weeds will continue to emerge throughout the growing season, and warm-season annual weeds such as green foxtail (pigeon grass) may be favored by delayed seeding.

As of 2018, there are no herbicides registered that can be applied postemergence to control broadleaf weeds in chickpea. Group 1 herbicides such as Select and Assure II can be used to control grass weeds. Controlling emerged weeds with a good burn-down before planting chickpea and using pre-emergent (PRE) herbicides to extend control as long as possible into the growing season are important.

Several soil-applied herbicides are labeled for managing weeds in chickpea (Table 3). Troublesome broadleaf weeds like kochia and Russian thistle can be controlled in no-till chickpea with sulfentrazone (Spartan Charge, Spartan Elite, and BroadAxe XC) applied in the fall before chickpea is planted or as an early pre-plant application. NDSU research has shown that spring-applied sulfentrazone provided better season-long control compared to fall-applied. Other research has shown that higher rates of sulfentrazone may be required to control wild buckwheat. Sulfentrazone can be applied from up to 30 days prior to planting.
Table 3. Chickpea herbicides for North Dakota.

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Product/A (ai/A)</th>
<th>Weeds</th>
<th>When to Apply</th>
<th>Remarks and Paragraphs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil-applied Herbicides</strong></td>
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</tr>
<tr>
<td>Far-Go (triallate)</td>
<td>1.25 qt. EC (1.25 lb.)</td>
<td>Wild oat</td>
<td>PPI</td>
<td>PPI immediately after application. A two-pass incorporation improves weed control.</td>
</tr>
<tr>
<td>Prowl H2O (pendimethalin)</td>
<td>1.75 to 3.6 pt. 3.3EC (0.72 to 1.5 lb.)</td>
<td>Grass and some broadleaf weeds</td>
<td>PPI</td>
<td>Adjust rate for soil type. Apply in fall when soil temperature is less than 45 F to reduce fall herbicide degradation.</td>
</tr>
<tr>
<td>Treflan/generic trifluralin</td>
<td>1 to 1.5 pt. EC (0.5 to 0.75 lb.)</td>
<td>Poor wild oat and no wild mustard control</td>
<td>PPI Fall or spring</td>
<td>Refer to label for additional information.</td>
</tr>
<tr>
<td>Sonalan (ethalfluralin)</td>
<td>1.5 to 2 pt. EC (0.55 to 0.75 lb.)</td>
<td></td>
<td>Fall or spring</td>
<td>Incorporate once using minimum soil disturbance with a rotary hoe or heavy harrow. Refer to label.</td>
</tr>
<tr>
<td>Dual/II/Magnum (S/metolachlor)</td>
<td>1 to 2 pt. EC (0.95 to 1.9 lb.)</td>
<td></td>
<td>Shallow PPI or PRE</td>
<td>Shallow PPI improves consistency of weed control. PRE requires precipitation to activate herbicide. Adjust rate for soil type and OM. Refer to label for tank-mix options.</td>
</tr>
<tr>
<td>Outlook / generic dimethenamid</td>
<td>16 to 21 fl. oz. EC (0.75 to 1 lb.)</td>
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<tr>
<td>BroadAxe XC Spartan Elite (s-metolachlor and sulfentrazone)</td>
<td>20 to 32 fl. oz. EC (0.98 to 1.58 lb. and 1.75 to 2.8 oz.)</td>
<td>Annual grass and small-seeded broadleaf weeds</td>
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<tr>
<td>Spartan Charge (carfentrazone and sulfentrazone)</td>
<td>3.75 to 7.75 fl. oz. SE (0.16 to 0.34 oz. and 1.48 to 3.05 oz.)</td>
<td>Small-seeded broadleaf weeds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pursuit (imazethapyr)</td>
<td>2 fl. oz. SL (0.5 oz.)</td>
<td>Small broadleaf weeds. No control of ALS-resistant weeds.</td>
<td>Fall, EPP, shallow PPI and PRE</td>
<td>PRE requires precipitation to activate herbicide. Provides burn-down control of small-emerged broadleaf weeds. Refer to label for tank-mix options.</td>
</tr>
<tr>
<td>Sharpen (saflufenacil)</td>
<td>1 to 2 fl. oz. SC (0.36 to 0.72 oz.)</td>
<td>Small broadleaf weeds including winter-annual species</td>
<td></td>
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</tr>
<tr>
<td><strong>POST-Applied Grass Herbicides</strong></td>
<td></td>
<td></td>
<td>POST Crop: Refer to PHI</td>
<td>Add oil adjuvant at 1 gal./100 gal. water but not less than 1.25 pt./A. Refer to label for tank-mix options</td>
</tr>
<tr>
<td>Assure II (quizalofop)</td>
<td>7 to 12 fl. oz. EC (0.77 to 1.32 oz.)</td>
<td>Annual grasses and quackgrass</td>
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<tr>
<td>Targa</td>
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<td>POST Crop: Refer to PHI</td>
<td></td>
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<tr>
<td>Poast (sethoxydim)</td>
<td>0.5 to 1.5 pt. EC (0.1 to 0.3 lb.)</td>
<td>Annual grasses</td>
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<tr>
<td>Select Max 1EC Shadow 3EC (clethodim)</td>
<td>9 to 16 fl. oz. EC (1 to 2 oz.)</td>
<td>Annual grasses and quackgrass</td>
<td></td>
<td></td>
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<tr>
<td>Shadows Max 2EC Shadow 3EC (clethodim)</td>
<td>4 to 8 fl. oz. EC (2.7 to 5.3 fl. oz. EC)</td>
<td>Annual grasses and quackgrass</td>
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</tbody>
</table>

Herbicides can be used to control weeds in chickpea fields. For best results, growers should consult the label or a product representative to determine the optimum rates for their fields. Growing Chickpea in North Dakota can be challenging due to the presence of various weed species. To control weeds effectively, growers can use a combination of pre-emergence and post-emergence herbicides. Some recommended herbicides include trifluralin (Treflan), ethalfluralin (Sonalan), and pendimethalin (Prowl) for pre-emergence control. These herbicides are effective against a wide range of weed species, including grasses and broadleaf weeds. For post-emergence control, growers can use selective herbicides such as imazethapyr (Pursuit) and saflufenacil (Sharpen) to control broadleaf weeds in chickpea fields. Always follow the label instructions for proper use and application rates. In conventional tillage systems, trifluralin (Treflan), ethalfluralin (Sonalan) and pendimethalin (Prowl) incorporated preplant will control certain broadleaf weeds, plus foxtail and barnyard grass, but not wild oat or quackgrass. Imazethapyr (Pursuit) can be incorporated preplant or pre-emergence to control certain broadleaf and grass weeds. However, imazethapyr will not control ALS-resistant kochia. Pyridate (Tough) is expected to be registered sometime in 2019. Pyridate can be applied postemergence to control broadleaf weeds such as kochia, lambsquarters, pigweed, and others. Pyridate is most effective in sunny, warm conditions. The label will likely require 15-20 gallons per acre spray volume and an oil adjuvant. Always read and follow herbicide labels.
Chickpea have few economic insect pests since the stems, leaves and seedpods are covered with small hairlike glandular structures that secret malic and oxalic acids, which deter insect pests. Researchers have observed that some grasshopper species are reluctant to feed on chickpea. Two soil insect pests, cutworms and wireworms, occasionally damage chickpeastands early in the season. Researchers also have noted that chickpea fields infested with mustard will suffer some cabbage looper feeding injury on chickpea plants adjacent to mustard plants.

**SEEDLING AND ROOT FEEDERS**

### Cutworms (Lepidoptera: Noctuidae)

#### Life Cycle

Several species of cutworms, such as dingy cutworm (Photo 6 and 7), army cutworm, red-backed cutworm and pale western cutworm, feed on chickpea in the northern Great Plains. Adult cutworms are a moth. They have dark wing colors (brown to gray) with markings and about 1½-inch-long wings (Photo 6). Cutworms have one generation per year. They overwinter as eggs or young larvae, depending on the species. Eggs hatch in April or early May, and young larvae (or caterpillars) feed at night on weeds and crops as they emerge. Larvae molt six times and grow larger with each instar. A mature cutworm larva is about 1½ inches long and the size of a pencil in width (Photo 7).

Cutworms are most noticeable in chickpea from late May through mid-June. After cutworms complete their development in late June, they burrow deep into the soil and make a small pupal chamber. Adult moths emerge from August through early September. Adults mate and females lay eggs on or just below the surface of loose, dry soil, weedy stubble or fallow fields, depending on the species.

#### Damage

Cutworm damage first appears on hilltops or south-facing slopes, or in areas of light soil, which warm earlier in the spring. Larvae will cut young plants in the seedling to six- to eight-leaf stages. Cut plants can be found drying and lying on the soil surface. As damage continues, fields will have areas of bare soil where chickpea has disappeared. In a severe infestation, the entire field can be destroyed.

#### Pest Management

Scout fields by looking for freshly damaged (cut off) plants. Dig down 3 or more inches around the cut-off plant and search for cutworm larvae. When disturbed, cutworms curl up or hide under soil debris.

Chickpea is more susceptible to cutworm damage than small grains because cut plants do not grow back (grains compensate by tillering). **Two to three cutworms per square yard justifies an insecticide treatment.** Cutworm larvae feed actively at night, so an evening insecticide application is best. As a cultural control technique, weed-free fields and crusted summer fallow fields are less attractive to egg-laying adults in late summer.

### Wireworms (Coleoptera: Elateridae)

#### Life Cycle

Wireworm larvae are hard, smooth, slender, wirelike worms from 1 to 2 inches long when mature (Photo 8). They are yellowish white, with three pairs of small, thin legs behind the head. The last abdominal body segment is forked or notched.

Adult wireworms are bullet-shaped, hard-shelled beetles that are brown to black and about an inch long (Photo 9). The common name “click beetle” is derived from the clicking sound the insect makes when attempting to right itself after landing on its back.

Wireworms usually take three to four years to develop from the egg to an adult beetle. Most of this time is spent as a larva in the soil. Generations overlap, so larvae of all ages may be in the soil at the same time. Wireworm larvae and adults overwinter at least 9 to 24 inches deep in the soil. When soil temperatures reach 50 to 55 F during the spring, larvae and adults move nearer the soil surface.
Adult females emerge from the soil, attract males to mate, then burrow back into the soil to lay eggs. Females can re-emerge and move to other sites, where they burrow in and lay more eggs. This behavior results in spotty infestations throughout a field. Some wireworms prefer loose, light and well-drained soils; others prefer low spots in fields where higher moisture and heavier clay soils are present. Larvae move up and down in the soil profile in response to temperature and moisture. After soil temperatures warm to 50 F, larvae feed within 6 inches of the soil surface. When soil temperatures become too hot (greater than 80 F) or dry, larvae will move deeper into the soil to seek more favorable conditions. Wireworms pupate, and the adult stage is spent in cells in the soil during the summer or fall of their final year. The adults remain in the soil until the following spring.

**Damage**

Wireworm infestations are more likely to develop when pulse crops follow grasses, including grain crops, perennial grass (Conservation Reserve Program) or pastures. Wireworms (larvae) inflict most of their damage in the early spring, when they are near the soil surface. Wireworms damage crops by feeding and tunneling on the germinating seed or the young seedling. Damaged plants soon wilt and die, resulting in thin stands. In a severe infestation, large bare spots occur in the field and reseeding is necessary.

**Pest Management**

Producers have no easy way to estimate wireworm infestations, so field history often is used because the same field will have a wireworm problem for several years due to its long life cycle. Two methods are used for monitoring wireworms:

- **Soil sampling:** Sample 20, well-spaced, 1-square-foot sites to a depth of 4 to 6 inches for every 40 acres being planted. If an average of one wireworm per square foot is found, treatment would be justified.

- **Solar baiting:** In the spring or fall, place bait stations randomly through the field but representing all areas of the field. You should have 10 to 12 stations per 40-acre field. For each station, soak 1 cup of wheat and 1 cup of shelled corn overnight and then place the wheat and corn into a 4- to 6-inch-deep hole. Cover the grain with soil and then an 18-inch-square piece of clear plastic. After two to three weeks, dig up the grain and count wireworms. If an average of one or more wireworm larvae is found per station, treatment would be justified.

Several insecticides are approved for use as seed treatments to protect seeds from wireworms and other soil insect pests. Insecticides applied to the seed just before planting time is an inexpensive means of reducing wireworm damage. For maximum benefits, treat shortly before seeding; prolonged storage after treatment may reduce germination.

If using on-farm treaters, be sure they are calibrated properly to apply the recommended dosages.

Soil-applied insecticides also are used as a preventive measure because rescue treatments are ineffective against wireworms.

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**FOLIAGE, FLOWER AND POD FEEDERS**

**Grasshoppers (Orthoptera: Acrididae)**

**Life Cycle**

Grasshoppers (Photo 10) are generalists and feed on a wide range of agricultural crops, including chickpea. Grasshoppers overwinter as eggs, and nymphs start to emerge in late April to early May, with peak egg hatch in mid-June. Nymphs (young grasshoppers, Photo 11) will go through five molts before transforming into adults. The complete life cycle is 40 to 60 days. Adults are most numerous in mid-July, with egg laying usually beginning in late summer and continuing into the fall. Eggs are deposited in a variety of noncrop areas, including ditches, shelterbelts and weedy fall fields.

**Damage**

Adults and nymphs feed on green plant material, creating holes in leaves or pods. The greatest risk from grasshopper feeding injury is in the bud stage through early pod development. Grasshoppers consume flower buds and especially small pods, causing yield loss and a delay in maturity (due to delayed pod set).
**Pest Management**

Grasshopper populations often increase during several years of low rainfall or drought. In contrast, grasshopper populations decrease when cool, wet weather favors diseases that infect and kill them.

Scout chickpea for feeding injury from nymphs during the seedling stage through early vegetative stages, and for adults during the early bud stage through pod development. Grasshopper thresholds are based on the number of grasshoppers per square yard. Four 180-degree sweeps with a 15-inch sweep net equal 1 square yard. The infestation ratings are listed in Table 4.

**Table 4.** A “threatening” rating would indicate a need to treat with an insecticide.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Nymphs per square yard</th>
<th>Adults per square yard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Margin</td>
<td>Field</td>
</tr>
<tr>
<td>Light</td>
<td>25-35</td>
<td>15-23</td>
</tr>
<tr>
<td>Threatening*</td>
<td>50-75</td>
<td>30-45</td>
</tr>
<tr>
<td>Severe</td>
<td>100-150</td>
<td>60-90</td>
</tr>
<tr>
<td>Very severe</td>
<td>200+</td>
<td>120</td>
</tr>
</tbody>
</table>

*Action threshold.


**Varieties**

Variety evaluations for North Dakota (Photo 12) appear in Table 5. Chickpea yields range widely in North Dakota. Although some varieties possess some level of Ascochyta tolerance, recent experience has shown that the unifoliate varieties have very low levels of tolerance in the northern Great Plains.

Even though the desi chickpea market price typically is less than that for large kabuli types, the increased yield potential and lower production costs might result in equal or greater net returns.

**Harvesting**

Most chickpea is sold as a high-quality human food product. While seed size is a major factor in economic returns for the kabuli type, seed color is the single most important factor in determining marketability of the crop. If the seed coats are dark or discolored, the crop will not be accepted by food processors.

Harvesting decisions such as timing and harvesting methods are the major factors determining if you will harvest seeds with the light yellow to cream color demanded by processors. Delayed harvest can result in weathered seed that is not marketable.

Chickpea seed has a thin seed coat that is very susceptible to cracking, which can reduce germination. Combine cylinder speeds should be as low as possible to avoid cracking the seed coat.

**Factors That Affect Ripening**

Chickpea has an indeterminate growth habit, which means the growth cycle extends as long as moisture is available. This growth pattern can be problematic in fields with uneven topography, where soil water varies throughout the field, or where seeding problems caused uneven emergence.
Herbicide injury, disease and predation by deer also commonly affect maturity and can result in uneven field ripening, sometimes causing green pods to persist until the first fall frost.

Green pods that are frozen or desiccated will remain green and become an important downgrading factor. Less than ½ percent of green seeds are allowed for the top U.S. commercial grade. Growers should cut around portions of the field with high green seed counts to avoid ruining the whole lot. To maintain a timely harvest for seed quality, some producers have combined different parts of the same kabuli chickpea field on three different dates.

Plants are physiologically mature when seeds begin to change color inside the uppermost pods. Producers have the option to direct combine or swath the crop when the pods are straw yellow.

**Harvest Methods**

Chickpea normally has low shattering potential, although pod drop has occurred in some instances when harvesting was delayed. Pod shattering can occur with unusually hot late August and early September temperatures.

The lowest pods typically are 4 inches off the ground, making direct harvesting possible but requiring an experienced combine operator. In some regions, swathing and combining are advantageous due to the fact that delayed harvests can result in darkening of the seed coat.

Most growers desiccate chickpea prior to harvest to facilitate even dry-down. Many varieties are indeterminate and will keep growing as long as they can. In some cases, mature seed is at risk of shattering at the bottom of the plant, while green plant tissue with immature pods persists at the top. Therefore, the decision about when to desiccate needs to balance harvestable yield and quality with the risk of shattering.

Several chemical desiccants are labeled for chickpea in North Dakota (Table 6). If producers prefer desiccation to swathing, they should be aware that a crop intended for seed should not be desiccated with glyphosate or Sharpen because germination can be affected negatively.

Monitoring seed color is very important to determine proper harvest timing and management. Chickpea can be harvested at 18 percent moisture but requires that the crop ripens uniformly, which is rare.

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**Table 5. Chickpea seed yield, days to flower, days to mature and test weight, North Dakota, 2016-2017.**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Leaf Type</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hettinger</td>
<td>Minot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>yield in pounds per acre</td>
<td>yield in pounds per acre</td>
</tr>
<tr>
<td>Kabuli</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-90</td>
<td>C</td>
<td>1,867</td>
<td>1,667</td>
</tr>
<tr>
<td>CDC Frontier</td>
<td>C</td>
<td>2,119</td>
<td>1,422</td>
</tr>
<tr>
<td>CDC Luna</td>
<td>C</td>
<td>2,054</td>
<td>1,014</td>
</tr>
<tr>
<td>CDC Orion</td>
<td>C</td>
<td>—</td>
<td>2,315</td>
</tr>
<tr>
<td>Sawyer</td>
<td>S</td>
<td>1,387</td>
<td>965</td>
</tr>
<tr>
<td>Sierra</td>
<td>S</td>
<td>879</td>
<td>—</td>
</tr>
<tr>
<td>Desi</td>
<td>C</td>
<td>2,136</td>
<td>1,011</td>
</tr>
<tr>
<td>CDC Anna</td>
<td>C</td>
<td>1,740</td>
<td>1,399</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>268</td>
<td>604</td>
</tr>
<tr>
<td>LSD 0.10</td>
<td></td>
<td>87</td>
<td>304</td>
</tr>
</tbody>
</table>

1 C = compound, S = simple.
2 Averaged across 2016 locations.
3 Data from Carrington only.
Minimizing Seed Damage

Combine speeds, cylinders, sieves and air must be adjusted to prevent seed breakage. Chickpea seeds have a characteristic, protruding beak-like structure that must not be damaged. Seed damage can be minimized by use of conveyor belts or by keeping augers as full as possible and operating at slower speeds.

Storage

Chickpea can be stored at 15 percent moisture. Minimizing the number of times chickpea is handled reduces the number of cracked or damaged seeds, which are significant dockage factors.

Table 6. Preharvest herbicides for chickpea in North Dakota.

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Product/SA (ai/A)</th>
<th>Weeds</th>
<th>When to Apply</th>
<th>Remarks and Paragraphs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glyphosate</td>
<td>Up to 2.25 lb. ae</td>
<td>Emerged grass and broadleaf weeds</td>
<td>Harvest aid and desiccant</td>
<td>PHI: 7 days Use only registered formulations. Apply with AMS at 8.5 lb./100 gal.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Do not apply to crop grown for seed because reduced germination/vigor may occur.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For spot treatment, use a 2 percent solution for perennial broadleaf weeds at or beyond the bud stage. Crop will be killed in treated areas.</td>
</tr>
<tr>
<td>Paraquat + NIS RUP</td>
<td>1.2 to 2 pt. 2SL</td>
<td>Chickpea and weed desiccant</td>
<td>Prior to harvest Greater than 80 percent yellow/brown pods and less than 40 percent green chickpea leaves</td>
<td>Contact herbicides require greater than 15 gpa and full sunlight. Apply at greater than 10 gpa for ground and greater than 5 gpa for aerial application. Apply Sharpen with AMS at 8.5 to 17 lb./100 gal. water or UAN at 2.5 gal./100 gal. water and with Glyphosate or Paraquat for weed desiccation. Glyphosate improves weed control from Sharpen and Valor but antagonism may occur on biennial and perennial weeds. Do not graze or hay treated plants.</td>
</tr>
<tr>
<td>Sharpen + MSO adjuvant</td>
<td>1 to 2 fl. oz. SC +</td>
<td></td>
<td>PHI: Sharpen = 2 days</td>
<td>Do not apply Sharpen to crop grown for seed because reduced germination/vigor may occur.</td>
</tr>
<tr>
<td></td>
<td>1.02 to 1.53 oz.</td>
<td></td>
<td>Valor = 5 days</td>
<td></td>
</tr>
<tr>
<td>Valor SX</td>
<td>2 to 3 oz. WDG</td>
<td></td>
<td>PH: 7 days</td>
<td></td>
</tr>
<tr>
<td>Valor EZ + (flumioxazin)</td>
<td>2 to 3 fl. oz. SC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 pt.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This publication was authored by Kent McKay, former NDSU Extension cropping systems specialist; Perry Miller, Jack Riesselman, Karness Neill, Dave Buschena and A.J. Bussan, all associated with Montana State University; and Brian Jenks, NDSU weed specialist, November 2002.

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