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# 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.*

## Uses

Chickpea (*Cicer arietinum* L.) originated in what is now southeastern Turkey and Syria and was domesticated about 9,000 B.C. Chickpea 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 color and shape. Kabuli chickpea, sometimes called garbanzo bean, has a white to cream-colored seed coat with a “ram’s head” shape and range 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, angular seeds. Before selecting a cultivar, contact potential buyers to ensure it is accepted in the market you are targeting.

Chickpea is a high-value crop adapted to deep soils in the semiarid northern Great Plains. However, disease risks are high, and

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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-cost 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.

### Markets

Before planting chickpea, knowing where the crop is going to be sold is essential. 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.

Chickpea is used predominantly for human food products but also can be used in animal feed. Chickpeas have a wide variety of food uses, including salads, hummus and cooked in stews or curry. Chickpea flour is used as batter for deep-fried meats and vegetables or an ingredient to make flat breads and desserts. Chickpea dishes are widespread in South Asia, the Middle East and Mexico.

Because chickpea is largely a food-grade product, crop quality and consistency are very important. Price premiums are paid for large-sized seeds, but price discounts often apply for damaged, broken or discolored seeds. Tests for restricted-use crop chemicals often are conducted and a buyer may reject a load if amounts are above the maximum residual levels.

Approximately 65% of U.S. chickpea production is used domestically. Major export destinations include India, Europe and the Middle East.

## 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. Chickpeas root deeper than dry peas or lentils and are more drought tolerant because they can tap into stored subsoil moisture when available.

### Photoperiod

The flowering time of chickpea is influenced by photoperiod. Some varieties are highly photoperiod sensitive, while some are not. Some varieties have an intermediate response. Fewer degree days are required for flowering in photoperiod-insensitive varieties.

### Temperature

Cool growing season temperatures and early fall frost can prevent chickpea from fully maturing. Chickpea frost tolerance 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 indeterminate growth, and producers must manage to meet market specifications for green seed (less than 1% for U.S. No. 1 grade, USDA-GIPSA).

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% of the canopy, and then swath or desiccate.

## Varieties

Variety evaluations for North Dakota appear in Table 1.

Chickpea yields range widely in North Dakota. Although some varieties possess some level of *Ascochyta* tolerance, many varieties have very low levels of tolerance. 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.

## Plant Growth Habit

Chickpeas have hypogeal emergence in which the cotyledons remain below the soil surface and emerge by elongating the epicotyl. This allows the seedling to tolerate late spring frost and have the ability to regrow from the below-ground buds if the top growth is damaged.

Most chickpea varieties have compound leaves that exhibit a fern-like 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, reaching a height of 8 to 24 inches.

**Table 1. Chickpea seed yield at various experiment stations in North Dakota, 2016-2019.**

Variety	Leaf type <sup>1</sup>	Days to flower	2016			2017			2018		2019		
			Hettinger	Minot	Williston	Minot	Carrington	Dickinson	Hettinger	Carrington	Hettinger	Carrington	Minot
		DAP <sup>2</sup>	yield in pounds per acre										
<b>Kabuli</b>													
CDC Frontier	C	50	2,119	1,422	1,872	1,136	2,468	1,150	1,802	2,980	1,483	1,147	642
CDC Luna	C	49	2,054	1,014	1,564	1,185	2,196	764	1,589	2,900	1,850	992	1,044
CDC Orion	C	45	—	2,315	—	1,187	1,952	—	1,456	3,328	1,918	1,074	594
Sawyer	S	49	1,387	965	1,392	1,192	1,608	891	1,439	2,660	—	544	780
Sierra	S	50	879	—	895	1,053	1,487	573	1,066	2,043	—	—	906
<b>Desi</b>													
CDC Anna	C	48	2,136	1,011	1,545	1,146	--	775	1,687	2,645	1,791	787	1,032
Mean		48	1,715	1,345	1,454	1,150	1,942	831	1,507	2,759	1,761	909	714
LSD 0.10		—	268	604	246	87	304	113	208	457	284	432	428

<sup>1</sup> C = compound, S = simple.

<sup>2</sup> DAP = Days after planting.



Photo 1. Chickpea with compound leaf. (C. Keene, NDSU)



Photo 2. Chickpea with simple leaf. (C. Keene, NDSU)



Photo 3. Flowering desi chickpea variety with compound leaves. (T.R. Stefaniak, NDSU)

On average, the plant produces a new node every three to four days and flowers approximately 50 days after plant emergence, at about the 13- or 14-node stage. The plant flowers profusely and has an indeterminate growth habit, continuing to flower and set pods as long as climatic conditions allow.

Kabuli and desi chickpea types can be identified easily 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. Kabuli types often are slightly taller than desi types.

Growth stages for chickpea are divided between vegetative and reproductive phases (Table 2). However, because the plant is indeterminate, new leaves continue to develop after flowering begins.

## 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

Table 2. Growth stages of chickpea.

Chickpea Growth Stages Description	
<b>Vegetative Growth Stages</b>	
VE	Seedling emergence
V1	First multifoliolate leaf fully expanded
V2	Second multifoliolate leaf fully expanded
V3	Third multifoliolate leaf fully expanded
V4	Fourth multifoliolate leaf fully expanded
Vn	nth multifoliolate leaf fully expanded
<b>Reproductive Growth Stages</b>	
R1	Early bloom, one open flower
R2	Full bloom, most flowers on the plant open
R3	Early pod, pods visible on lower portions of the plant
R4	Pods have reached their full size but still are flat
R5	Early seed, seed in any single pod fills the pod cavity
R6	Full seed, seeds fill the pod cavity
<b>Physiological Maturity</b>	
R7	Leaves start to yellow and 50% of the pods are yellow
R8	90% of the pods are mature color (gold to brown)

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 cereals 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. Ideally, the field should not have been planted to 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 an 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 2019.

To select appropriate fields for chickpea, consider previous herbicide use, weed 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 NDSU Extension publication W253, "North Dakota Weed Control Guide," for more information.

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. Sulfonyleurea 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), sulfonyleurea 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 the previous year's chickpea 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 chickpeas can be injured by waterlogged soil relatively quickly, compared with other nonlegume broadleaf or cereal crops.

## 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 NDSU Extension publication PP622, "North Dakota Field Crop Plant Disease Management Guide.") Using high-quality seed free of *Ascochyta* (less than 0.3%) 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. The target for established plant densities for kabuli and desi types is 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:medium:small 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 chickpeas.

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. Avoid rolling during plant emergence due to increased risk of injuring plants.

## Inoculation

A requirement for efficient production of chickpea is inoculation with specific N-fixing rhizobium bacteria. Chickpea requires an inoculant with the rhizobium species *Mesorhizobium ciceri* or *M. mediterraneum*. 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.

Inoculants usually are available as a granulated product. They are applied similarly to an in-furrow fertilizer application: a liquid product, which is best applied to the seed and mixed, and a powder, which requires a sticking agent and is mixed with the seed similar to what is required for the liquid products.

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 seedbed conditions.

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.

Inoculants are live bacteria, so they need to be handled and stored correctly. Avoid extreme heat or cold; storing them in a cool, dark environment until needed is best. Avoid pretreating seed and storing it for more than one day.

Studies that have examined the value of inoculants to legume grain crops indicate that 50% to 90% of the N used by chickpea during a season comes from N-fixation by the symbiotic N-fixing bacteria. Most studies that have examined N fertilization of chickpea found no value, and sometimes a yield reduction, from adding more than 10 pounds of N per acre to chickpea.

Avoid growing chickpea on soils with more than 60 pounds of residual N per acre in the 2-foot depth because this resulted in lower yield than chickpea grown in soil with lower residual N.

## Soil pH

Chickpea can achieve its yield potential on a wide range of soil pH from 5.3 to greater than 7. Even at acidic pH, yields might be maintained if a granular inoculant is used instead of a liquid or powder formulation. At low soil pH, the activity of symbiotic bacteria is reduced, but the use of the granular inoculant overcame that issue in one study focused on this issue.

# Fertilization

Yield in a given year depends on the environment: rainfall, temperature and other factors. Within the environment, fertilizer rate is important. In a lower-yielding environment caused by too much water or not enough, nutrients are not as efficiently taken up, so rates relative to final yield are higher.

In a high-yielding environment with close to ideal soil moisture and seasonal temperature, the efficiency of nutrient uptake is much higher, as is the release of nutrients from the soil and previous residues. The rates indicated in Table 3 are not related to yield goal but are appropriate for all yield environments.

## Nitrogen (N)

A small amount of starter N increased early vegetative growth in one study and led to a slightly earlier maturity. Producers have little reason to apply more than 10 pounds of N per acre, usually contained in the P fertilizer source, to chickpea.

## Phosphate (P)

Desi-type chickpeas have a lower demand for P, compared with the kabuli types. Kabuli chickpea growers often receive a premium for larger seed size, which requires higher P rates. Also, a small amount of P (about 10 pounds of P<sub>2</sub>O<sub>5</sub> per acre) resulted in greater height of lowest pods due to increased early vegetative growth, which might be of benefit if the field has exposed rocks. Under all but the driest of soil environments, chickpea is relatively tolerant to up to 20 pounds of P<sub>2</sub>O<sub>5</sub> per acre.

## Potassium (K)

Chickpea has a similar low demand for K as field pea and lentil (Table 3).

## Sulfur (S)

Soil testing for soil sulfur is not diagnostic, so it should not be used in any consideration of S fertilization. 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 nutrition through its relationship with N-fixing bacteria when inoculated, it has no means to support the production of S. Application of 10 pounds of S per acre as ammonium sulfate or another sulfate-containing fertilizer would supply enough S for a growing season, provided a heavy rain did not result in S leaching on sandy-textured soils.

## Micronutrients

No evidence indicates any micronutrient deficiency in chickpea in North Dakota and therefore application is not recommended.

## Soluble Salts

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

Determine soil salt (EC) levels in areas that struggle to produce chickpea grain and plan to seed a more salt-tolerant crop there in the future if salt is an issue. A comprehensive strategy to address salinity issues within fields helps expand future crop options. For more information on addressing soil salinity, visit the NDSU Soil Health website ([www.ndsu.edu/soilhealth](http://www.ndsu.edu/soilhealth)).

## Organic Production

Soil fertility is probably one of the minor management considerations for organic production of chickpea. Compost/composted manure would be a source of P, K and other nutrients for chickpea production.

The restriction would be to apply compost/manure the year prior to chickpea production so that too much N is not released during the early pulse growing season. Lacking access to compost/composted manure, buckwheat grown the year before and used as a green manure prior to buckwheat seed set, can make some P available to the chickpea.

Weed control and control of Ascochyta blight will be major limitations of organic chickpea production in North Dakota.

**Table 3. Phosphorus and potassium recommendations for desi- and kabuli-type chickpea.**

Chickpea type	Olson P, ppm					K soil test, ppm	
	0-3	4-7	8-11	12-15	16+	<100	>100
	P <sub>2</sub> O <sub>5</sub> rate to apply in pounds per acre					K <sub>2</sub> O rate to apply in pounds per acre	
Desi	40	30	20	10	0	30	0
Kabuli	60	40	30	20	10	30	0

# » Disease Management

Pythium and Rhizoctonia seed decay and damping off and Ascochyta blight are the primary diseases of concern in chickpea production, and without proper management, severe losses may result.

## Seed Decay and Damping-off Diseases

Chickpeas are very susceptible to Pythium and Rhizoctonia seed decay and damping off, and significant reductions in plant establishment and crop vigor can result from these diseases. The causal pathogens, including numerous *Pythium* species and *Rhizoctonia solani*, are ubiquitous in agricultural soils.

Chickpea, in particular large-seeded kabuli types, is highly susceptible to *Pythium*. Symptoms include poor emergence due to seed rot, damping off/death of seedlings and root rot. Damage is most severe when chickpea is planted into cool, wet soils. Managing *Pythium* with crop rotation is difficult because *Pythium* can infect many crops, including small grains, pulse crops, soybean and *Brassica* crops. Additionally, *Pythium* can survive for many years in the soil due to the production of long-lived survival structures called oospores.

At the time of publication of this guide, seed treatments containing metalaxyl (FRAC 4), mefenoxam (FRAC 4) or ethaboxam (FRAC 22) are highly effective against *Pythium* seed rot and damping off. However, fungicide resistance to metalaxyl or mefenoxam has been observed in other chickpea-growing regions of the U.S., so consulting the most up-to-date information when selecting a seed treatment to manage *Pythium* is important.

If fungicide resistance to metalaxyl/mefenoxam occurs, ethaboxam still may provide protection against *Pythium*. In fields with a history of *Rhizoctonia* root rot, fungicide seed treatments registered for use against *Rhizoctonia solani* should be used in combination with mefenoxam, metalaxyl or ethaboxam. Planting into warmer and drier soils also will help reduce losses due to *Pythium* and *Rhizoctonia*.

## Ascochyta Blight

The foliar disease Ascochyta blight can cause complete crop loss in chickpea even on fields with no prior history of the disease. 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 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.

The pathogen is specific to chickpea and does not infect pea or lentil. It also is very aggressive on chickpea, and more importantly, the pathogen in chickpea has developed resistance to QoI fungicides (FRAC 11, also called strobilurins) in our region 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 blight cannot be managed 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. Ascochyta can affect all above-ground plant parts, including stems, leaves, pods and seeds. 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 shelter belts or in low areas.

### Disease Cycle

The pathogen causing Ascochyta blight can survive for at least 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 overwintered infected residue 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 has never been planted to chickpea, is not near other chickpea fields, and is planted with clean seed still is not immune to 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



**Photo 4. Brown Ascochyta blight foliar lesion with a dark border and small black pycnidia arranged in concentric rings. (S. Markell, NDSU)**



**Photo 5. Brown Ascochyta blight stem lesions with dark brown border and small dark pycnidia. (S. Markell, NDSU)**

a second spore type (conidia) that are dispersed easily by rain splash and cause new infections within the field. If multiple infection cycles occur, an epidemic can decimate a chickpea crop quickly. 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 disease-free 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 chickpea varieties with reduced susceptibility to Ascochyta blight. While selecting a variety completely resistant to Ascochyta blight is not possible, some varieties are less susceptible than others.

The use of chickpea seed that has tested negative for seed-borne Ascochyta, combined with seed treatment with fungicides that suppress the transmission of Ascochyta from seeds to seedlings, reduces the risk of Ascochyta development from diseased seed but does not eliminate that risk. When seed is tested for seed-borne Ascochyta, testing is conducted on small samples of seed, and the tests can fail to detect low levels of seed-borne disease.

Seed treatment fungicides reduce but do not eliminate seed-to-seedling transmission of the disease. Even when seed testing negative for seed-borne Ascochyta is planted and that seed is treated with a fungicide seed treatment that suppresses seed-to-seedling transmission of Ascochyta, the introduction of Ascochyta blight into a field from diseased seed is still possible.

Fungicides also can be an effective tool to manage Ascochyta blight, but field scouting, application timing, fungicide selection and fungicide rotation are critical for success. See NDSU Extension publication PP622, “North Dakota Field Crop Plant Disease Management Guide,” for registered products. Multiple fungicide applications likely will be needed to manage the disease in a growing season.

Ascochyta initially develops as a few small, scattered disease lesions in the canopy during mid to late vegetative growth or early bloom, often at low incidence. In susceptible varieties such as ‘Sierra’ or ‘Sawyer,’ the disease can spread significantly, even prior to bloom initiation when the canopy is completely open, and the use of these varieties is not recommended in the northern Plains. In more resistant varieties such as ‘CDC Leader,’ ‘CDC Frontier’ or ‘CDC Orion,’ significant spread of disease generally does not occur until bloom, when the canopy begins to close, trapping humidity.

Ascochyta blight can be difficult to manage once significant disease development has occurred. A foliar fungicide application during early bloom generally is advised when periodic rains and/or high humidity are occurring or forecast. Subsequent fungicide applications should be made at 10- to 14-day intervals as needed on the basis of rainfall patterns and disease risk.

At the time of the publication of this guide, 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 active ingredients such as pyraclostrobin and azoxystrobin, which are sold as stand-alone fungicides (for example, Headline and Quadris) and in premixes with other active ingredients.

However, at the time of the publication of this guide, DMI fungicides (FRAC 3; also called triazoles) and SDHI fungicides (FRAC 7) can be used to manage the disease, but the pathogen population could develop resistance to them in the future. Older contact fungicides such as chlorothalonil (FRAC M5) are generally less efficacious but can be useful in fungicide rotation or tank-mix strategies and, due to the multisite mode of action, are lower risk for the development of fungicide resistance.

*When preparing to manage Ascochyta blight with fungicides, consult the most up-to-date information on fungicide timing, efficacy and rotation strategy.*

### **Other Foliar Diseases of Chickpea**

Under conditions of extended cool, wet weather, Sclerotinia stem rot (white mold) and Botrytis gray mold can develop (Photo 6). Sclerotinia stem rot generally has only a moderate impact on chickpea yield, and it rarely causes significant economic loss in chickpea. However, Botrytis gray mold is a devastating chickpea disease that can cause complete crop loss.

Botrytis is most severe in dense chickpea canopies. It develops in the canopy interior where it is difficult to obtain adequate fungicide coverage. Botrytis is very difficult to manage with fungicides in chickpea, and the disease can cause total crop loss even when fungicides are applied every 10 to 14 days.



**Photo 6. Botrytis gray mold on chickpea stem. (M. Wunch, NDSU)**

# » Weed Management

Chickpea is a poor competitor with weeds at all stages of growth. 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. 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 nonselective 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.

**Table 4. Chickpea herbicides for North Dakota.**

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks
<b>Soil-applied Herbicides</b>				
<b>Far-Go</b> (triallate)	<b>1.25 qt. EC</b> (1.25 lb.)	Wild oat	PPI.	PPI immediately after application. A two-pass incorporation improves weed control.
<b>Prowl</b> <b>Prowl H2O</b> generics (pendimethalin)	<b>1.75 to 3.6 pt. 3.3EC</b> <b>1.5 to 3 pt. 3.8ASC</b> (0.72 to 1.5 lb.)	Grass and some broadleaf weeds	PPI Fall or spring.	Adjust rate for soil type. Apply in fall when soil temperature is less than 45 F to reduce fall herbicide degradation.
<b>Treflan</b> / generic trifluralin	<b>1 to 1.5 pt. EC</b> (0.5 to 0.75 lb.)	Poor wild oat and no wild mustard control	PPI Fall or spring.	Refer to label for additional information.
<b>Sonalan</b> (ethalfluralin)	<b>1.5 to 2 pt. EC</b> <b>5.5 to 7.5 lb. 10G</b> (0.55 to 0.75 lb.)			Incorporate once using minimum soil disturbance with a rotary hoe or heavy harrow. Refer to label.
<b>Dual/II/Magnum</b> (S/metolachlor)	<b>1 to 2 pt. EC</b> (0.95 to 1.9 lb.)		Shallow PPI or PRE.	Shallow PPI improves consistency of weed control. PRE requires precipitation to activate herbicide.
<b>Outlook</b> / generic dimethenamid	<b>16 to 21 fl. oz. EC</b> (0.75 to 1 lb.)			Adjust rate for soil type, organic matter and pH. Refer to label for tank-mix options.
<b>BroadAxe XC</b> <b>Spartan Elite</b> (s-metolachlor and sulfentrazone)	<b>20 to 32 fl. oz. EC</b> (0.98 to 1.58 lb. and 1.75 to 2.8 oz.)	Annual grass and small-seeded broadleaf weeds		
<b>Spartan Charge</b> (carfentrazone and sulfentrazone)	<b>3.75 to 7.75 fl. oz. SE</b> (0.16 to 0.34 oz. and 1.48 to 3.05 oz.)	Small-seeded broadleaf weeds		
<b>Authority Supreme</b> (sulfentrazone and pyroxasulfone)	<b>4.3 to 10 fl. oz. SC</b> (1.12 to 2.6 oz. and 1.12 to 2.6 oz.)	Annual grass and small-seeded broadleaf weeds		
<b>Pursuit</b> generics (imazethapyr)	<b>2 fl. oz. SL</b> (0.5 oz.)	Small broadleaf weeds. No control of ALS-resistant weeds.		
<b>Sharpen</b> (saflufenacil)	<b>1 to 2 fl. oz. SC</b> (0.36 to 0.72 oz.)	Small broadleaf weeds including winter annual species	Fall, EPP, shallow PPI and PRE.	PRE requires precipitation to activate herbicide. Provides burn-down control of small emerged broadleaf weeds. Refer to label for tank-mix options
<b>POST-applied Chickpea Grass Herbicides</b>				
<b>Assure II</b> <b>Targa</b> (quizalofop)	<b>7 to 12 fl. oz. EC</b> (0.77 to 1.32 oz.)	Annual grasses and quackgrass	POST PHI: Assure = 60 days	Add oil adjuvant at 1 gallon per 100 gallons water but not less than 1.25 pt. per acre. Refer to label for tank-mix options
<b>Poast</b> (sethoxydim)	<b>0.5 to 1.5 pt. EC</b> (0.1 to 0.3 lb.)	Annual grasses	Poast = 50 days Clethodim = 30 days.	
<b>Select Max 1EC</b> <b>Select 2EC</b> <b>Shadow 3EC/</b> generics (clethodim)	<b>9 to 16 fl. oz. EC</b> <b>4 to 8 fl. oz. EC</b> <b>2.7 to 5.3 fl. oz. EC</b> (1 to 2 oz.)	Annual grasses and quackgrass		

## Insects

As of 2020, no herbicides are registered to be applied postemergence to control broadleaf weeds in chickpea. Group 1 herbicides 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.

Chickpea is a short crop, slow to canopy, and the canopy may not fully close. Without good weed control, yield loss can be substantial.

Several soil-applied herbicides are labeled for managing weeds in chickpea (Table 4). Troublesome broadleaf weeds such as 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 preplant application. NDSU research has shown that spring-applied sulfentrazone provided better season-long control, compared with fall applied.

NDSU 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 to three days after planting.

A burn-down herbicide such as glyphosate may be tank mixed with sulfentrazone if emerged weeds are present. For optimum activity, sulfentrazone needs 0.5 inch of moisture soon after application to become activated in the soil.

Soil factors such as pH, texture and organic matter content affect sulfentrazone activity in soils. Growers should consult the label or a product representative to determine optimum Spartan rates for their fields.

Flumioxazin (Valor) can be applied in the fall prior to planting chickpea. Flumioxazin has shown good residual control of several winter annual weeds as well as volunteer canola. Pendimethalin (Prowl) also can be applied fall or spring for broadleaf and grass control, but best results typically are achieved with the fall application.

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 oats 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, and the user assumes all risk of crop injury.

Chickpea has few economically important insect pests since the stems, leaves and seedpods are covered with small hairlike glandular structures that secrete malic and oxalic acids, which deter feeding. Researchers have observed that some grasshopper species are reluctant to feed on chickpea. Two soil insect pests, cutworms and wireworms, occasionally damage chickpea stands early in the season. Researchers have also noted that chickpea fields infested with wild mustard will suffer some cabbage looper feeding injury on chickpea adjacent to mustard plants.

### SEEDLING AND ROOT FEEDERS

#### Cutworms (Lepidoptera: Noctuidae)

##### Life Cycle

Several species of cutworms, such as dingy cutworm (Photos 7-8), 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 7).

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 width of a pencil (Photo 8).

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



Photo 7. Dingy cutworm adult. (G. Fauske, NDSU)



Photo 8. Dingy cutworm larva.  
(J. Gavloski, Manitoba Agriculture, Food and Rural Initiatives)

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 9). 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 10). 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 grasses, 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 on or tunneling through the germinating seed or 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. Use 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 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 amount.

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



**Photo 9. Wireworm larva – Elateridae. (M. Boetel, NDSU)**



**Photo 10. Wireworm adult (or click beetle) – Elateridae. (Eric LaGasa, Washington State Department of Agriculture, www.Bugwood.org)**

## FOLIAGE, FLOWER AND POD FEEDERS

### Grasshoppers (Orthoptera: Acrididae)

#### Life Cycle

Grasshoppers (Photo 11) 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 12) 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 laid in non-crop 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 5.



Photo 11. Grasshopper adult. (J. Knodel, NDSU)



Photo 12. Grasshopper nymph. (G. Fauske, NDSU)

Table 5. Threatening levels of nymphs and adults for field peas and chickpeas.

Rating	Nymphs per square yard		Adults per square yard	
	Margin	Field	Margin	Field
Light	25-35	15-23	10-20	3-7
<b>Threatening*</b>	<b>50-75</b>	<b>30-45</b>	<b>21-40</b>	<b>8-14</b>
Severe	100-150	60-90	41-80	15-28
Very severe	200+	120	80+	28+

\*Action threshold.

Insecticides registered for insect pest management in chickpea are listed in the current issue of the “North Dakota Field Crop Insect Management Guide,” E1143. Pesticide applicators must read, understand and follow all label directions.

## Harvesting

Most chickpea is sold as a high-quality human food product. While seed size is a major factor in economic returns for kabuli types, 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 harvest method are the major factors determining if the desirable light yellow to cream color demanded by processors is achieved. 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 growth continues 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 1% green seeds are allowed for the top U.S. commercial grade (No. 1) and more than 5% green seed will result in a substandard 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 these products can reduce germination.

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

## 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 the use of conveyor belts or by keeping augers as full as possible and operating at slower speeds.

## Storage

Chickpea can be stored at 15% 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.**

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	Up to 2.25 lb. ae	Emerged grass and broadleaf weeds	Harvest aid and desiccant PHI: 7 days.	Use only registered formulations. Apply with AMS at 8.5 lb. per 100 gallons of water. <b>Do not apply to crop grown for seed because reduced germination/vigor may occur.</b> For spot treatment, use a 2% solution for perennial broadleaf weeds at or beyond the bud stage. Crop will be killed in treated areas.
		Perennial weeds	Spot treatment  PHI: 14 days.	
Paraquat + NIS RUP	1.2 to 2 pt. 2 SL 0.8 to 1.3 pt. 3 SL (0.3 to 0.5 lb.)	Chickpea and weed desiccant	Prior to harvest greater than 80% yellow/ brown pods and less than 40% green chickpea leaves  PHI: Paraquat = 7 days. Sharpen = 2 days.	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 but antagonism may occur on biennial and perennial weeds.  Do not graze or hay treated plants. <b>Do not apply Sharpen to crop grown for seed because reduced germination/vigor may occur.</b>
Sharpen + MSO adjuvant (saflufenacil)	1 to 2 fl. oz. SC + 1 to 1.5 pt./A (0.36 to 0.72 oz.)			

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