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MONTANA STATE UNIVERSITY EXTENSION

MontGuide

Chickpea Production

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Chickpea (*Cicer arietinum* L.) is an annual grain legume or 'pulse crop' sold as human food. Commercial types include large Kabuli, small Kabuli, and Desi. Chickpea production has significantly increased in the U.S. over the past 5 years with 96,000 acres harvested in Montana in 2016 and with acreage projected to increase.

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Introduction

Chickpea (*Cicer arietinum* L.) is an annual grain legume or 'pulse crop' sold as human food. Commercial types include large **Kabuli**, small Kabuli, and Desi. The Kabuli type (also known as garbanzo bean) contains small to large seeded varieties, has a rounded seed and a cream-colored seed coat. These are often made into snacks, ground into **hummus**, or canned whole for the salad market. The less commonly grown Desi type are smaller (nominally 1500 seed/lb) angular seeds with yellow to brown **corticated** (hard) seed coats. There are also red, dark green, and black varieties. Desi chickpea is usually prepared for consumption by dehulling and splitting, or dehulling and grinding into flour, while small Kabuli types may be processed into flour without dehulling. Chickpea is native to the Mediterranean region and is a major ingredient of many Middle Eastern, Mediterranean, and Indian dishes, such as hummus, **falafel**, **curry**, and **dal**. Chickpea is beneficial to a healthy diet. For example a half-cup serving provides 7 g of protein (10% of our daily requirement) and 6 g of fiber (20% of our daily requirement)*(1)*.

World Production

The majority of this crop is grown overseas with India producing and consuming the most (Figure 1). The U.S. produces only 1% of the world total. Still, chickpea production has significantly increased in the U.S. over the past 5 years (Table 1) with 96,000 acres harvested in Montana in 2016 and with acreage projected to increase in the future. Montana accounts for a large percentage of the U.S. increase from 2001 to 2016 where chickpea acreage grew from 134,000 to 320,000 acres.

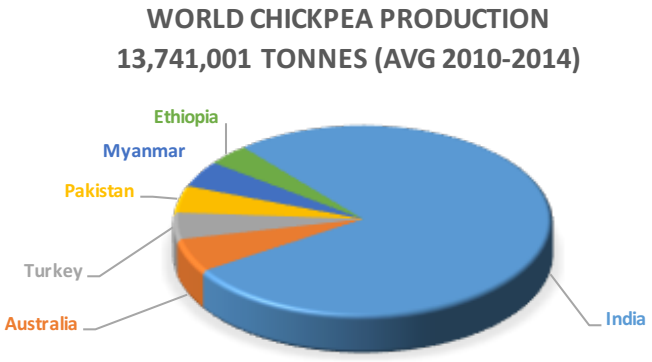

FIGURE 1. India dominates in World chickpea production. The U.S. production of approximately 125,000 metric tons is approximately 1% of world annual production *(2)*.

Growth habit

Chickpea develops a taproot and lateral roots to a depth of about 30 inches. The plant has an **indeterminate** growth habit which allows plants to develop new leaves after flowering has begun. Typically, chickpea growth and development is terminated by some form of environmental stress, such as drought or extreme heat. Late season rains can cause plants that appear to have gone dormant to resume development including flowering and seed set, complicating harvest management. Chemical desiccation to terminate growth is often necessary. Mature plants will be 15-30 inches tall, heavily branched, appearing as small bushes. Optimally, there will be 1-2 seeds per pod. A greater number of seeds per pod typically leads to smaller seed size at maturity. Kabuli chickpea usually matures in 110 to 120 days. Desi type will mature somewhat earlier.

TABLE 1. Chickpea production (1,000 of harvested acres) since 2012 in the U.S. (*3*).

Location	2012	2013	2014	2015	2016
Idaho	75.6	77.5	73.0	69.0	90.0
Montana	22.6	17.7	31.2	40.6	96.0
Washington	79.5	96.5	89.0	74.0	107.4
US Total	206.3	218.6	212.1	202.3	320.0

TABLE 2. Trial yield means (lb/acre) for chickpeas at locations across Montana, 2011-2016 *(4, 5)*.

Environment	Location	Yield	C.V. (%)	Obs.
Dryland	Bozeman	1213	37	13
	Conrad	2603	50	27
	Corvallis	1368	27	24
	Huntley	919	52	8
	Moccasin	1123	36	52
	Richland	1138	82	61
	Sidney	3168	23	8
Irrigated	Huntley	3076	30	20

Note: Trial entries varied but averaged 11 kabuli and 1 desi variety each year.
n/a = not applicable. C.V. = coefficient of variation over years and varieties.
Obs. = number of observations

Chickpea germinates similar to dry pea with the seed coat and **cotyledons** remaining below ground (**hypogeal germination**). Developing plants will have 1-2 **scale nodes** on the stem just below the soil surface. These nodes serve as points of regrowth if the seedling is damaged (a late frost for example). On average, a new node (leaf) is produced every 3 to 4 days.

Yield potential and markets

Statewide variety trials conducted at the MSU Research Centers for the past five years show yields averaging over 1500 lb/acre (Table 2) across all varieties. Areas around Corvallis and Sidney have shown more stable production across varieties but yields in Conrad have been superior to other locations in the state. Irrigated production at Huntley shows promise with a trial average of more than 3000 lb/acre.

Varieties

Most Montana producers contract with a company to grow a specific variety prior to planting although some open market options are available. Results of statewide variety trials indicate a yield potential between 850 and 3000 lb/acre under dryland conditions. Variability in yield is high due to environmental factors like hail, disease incidence, and drought. Irrigated production in Huntley has greater yields as compared to dryland with minimal additional water (2-3 inches per season). Irrigating too often can lead to high disease incidence and enhanced **indeterminate flowering** and maturity resulting in poor quality.

The better performing varieties in these trials have been those from Canada, with Frontier and Orion leading the list (Table 3). Myles has been the only Desi type tested and has performed consistently well over the past 5 years. Prices for Kabuli types are driven by quality factors such as color, consistency, and number of split seeds, but the main factor for price is seed size with larger diameter seeds being premium. For example, at this writing 9 mm diameter Kabuli seed was priced at 35 cents/lb while 8 mm was 26 cents/lb at Great Falls. For seed sizes less than 7 mm diameter there is often no market or only a nominal price for the seed. The largest input cost for chickpea production is typically seed cost, although if disease pressure becomes an issue, multiple applications of fungicides can add significantly to input costs. Because of the threat of disease, and the risk of poor quality due to bleaching, uneven color, or harvest damage, chickpea is a high maintenance crop requiring constant monitoring and field scouting. Proper grain handling after harvest is also critical to maintaining a high quality food product which is destined for human consumption.

Climate

Chickpea is a cool season crop that grows best when daytime temperatures are between 70 and 84 °F, and nighttime temperatures are between 64 and 70 °F. The crop does well in regions with 6-10 inches of growing season precipitation. Temperatures above 98 °F can cause stress during early flowering and pod development, resulting in reduced yields. But chickpea performs better than dry pea and lentil under heat and drought stress. Chickpea as a crop is somewhat drought tolerant.

Cultural Practices

Soil

Chickpea grows best on well drained soils with a neutral pH. It is not well adapted to saline soils and does not tolerate wet or waterlogged soils. Chickpea can be successfully grown in a wide range of soil types.

TABLE 3. Chickpea yields in dryland statewide variety trials, Montana *(4,5)*.

Variety	Class	2011	2012	2013	2014	2015	2016	Avg
CDC Alma	Kabuli		1386	2236	745		1784	1538
CDC Frontier	Kabuli	1714	1608	2258	929	1511	2705	1788
CDC Orion	Kabuli		1617	2329	837	1602	1687	1614
Myles	Desi	1519	1307	1640	1090	1280	2144	1497
Sawyer	Kabuli	1514	1029		1049	1083	1650	1265
Sierra	Kabuli	1219	815			1066	1509	1152

Note: Not all varieties were present in each location every year. Locations included Bozeman, Conrad, Corvallis, Huntley, Moccasin, Richland, and Sidney MT.

CHOOSING AN INOCULANT

Peat powder inoculant: Applied directly to the seed with a non-toxic sticking agent. This formulation is a finely ground peat that contains over a billion rhizobia per gram. Peat powder inoculant is one of the most common types.

Liquid inoculant: This formulation also contains over a billion rhizobia per gram and is applied directly to the seed. Because it comes in liquid form, a sticking agent is typically included in the fluid. Liquid inoculant comes in bags that make it easy to distribute evenly onto the seed while it is being loaded into a truck box or grain drill.

Granular soil inoculant: Unlike peat powder or liquid inoculants, granular soil inoculant is not applied directly to the seed but rather, with the seed in the seed row. This formulation does however contain the same amount of rhizobia as both the powder and liquid inoculants and is popular because of its convenience and increased reliability. Since it is delivered separate from the seed, the drill must have a separate metering system.

Field selection

Choose fields that are fairly weed free and without troublesome perennial weeds such as bindweed or Canada thistle since herbicide options are few and the growth habit of chickpea allows light to penetrate the canopy to the benefit of weeds. Crop disease risks limit the recommended frequency of chickpea production to no more than 1 in 3 years (and less often is likely better). This restriction also applies to bordering fields to reduce the risk from disease organisms that can infect a new chickpea crop.

Seed preparation

Fungicide treatments (see Disease Control section for details) should be applied to the seed first and allowed to dry prior to mixing with inoculum. Follow all label instructions for the agricultural chemical selected. **Inoculants** are specific to each plant species. For chickpea the inoculant species needed is *Mesorhizobium cicero* or *M. mediterraneum*. Check the inoculant label for either of these names or that the label specifically lists the crop being planted (chickpea may be listed as garbanzo). Some inoculants are actually mixtures that contain several different species.

Rhizobium bacteria (either on the seed or in the package) die when exposed to high temperatures, drying winds, or direct sunlight. Inoculant must be stored in a cool place and should be used before the expiration date. Never mix inoculant with granular fertilizer as inoculants are quite sensitive to high salt content. Banding fertilizer away from seed is recommended. Check the label of both the inoculant and the seed treatment for compatibility. Generally it is advisable to inoculate seed the day of seeding.

Granular inoculants are less affected by dry seedbeds and seed-applied fungicides than other forms of inoculants. All inoculant formulations will perform equally well if properly applied and environmental conditions are ideal. But under adverse conditions the best performing formulation is granular, followed by peat, and then liquid.

Seedbed preparation

For no-till operations, an even distribution of previous crop residue helps in establishing a uniform population. Weeds must be killed prior to planting. This can be accomplished with a labeled application of **glyphosate** which should be applied 1 or 2 weeks prior to seeding. In tilled systems, the seedbed should be free of most residue, finely worked with no large clods or aggregates. Rolling to push down rocks is not necessary for chickpea management as the growth habit of chickpea is more upright than peas or lentils and seeds are set higher on the plant. If you are rolling a field, do so prior to seed emergence as newly emerged stems can be broken.

Seeding rate and date

A final minimum population of 4 plants/ft^2 or 175,000 plants/acre should be targeted. Due to their thin seed coats and large size, garbanzo seed can easily be damaged or split during processing and planting resulting in field survival values of only 70-80%. Seed size varies significantly across different types so adjust seeding rates for seeds/lb, germination percentage, and field survival. Large Kabuli seed rates can be as high as 200 to 250 lb/a in order to achieve the target population. Because of the high seed cost per acre, consider custom planting if there isn't a suitable drill available. Row spacing should be between 6 and 12 inches. Narrow rows provide an increased level of competition against weeds. Plant chickpea within a week or two of the optimum date for local seeding of spring wheat. Early seeding dates improve yield potential because plants flower prior to the heat of summer. But very early planting also runs the risk of frost damage to emerged plants. If frost or other damage occurs new growth can initiate from the scale nodes just below the soil surface but yield potential is usually reduced.

Crop rotation

Small grains like wheat and barley have greater overall disease resistance than pulse crops which lowers risk to bacterial and fungal disease infections. Pulse crops such as chickpea have disappeared from production in areas once certain disease organisms (namely, Ascochyta blight) become established. Since many disease organisms survive on plant residue, a break in pulse crop production of three or more years provides enough time for pulse residue to completely disappear which is good management for long-term production of this crop. Small grains complement pulse crops by providing a bed of straw and residue in which to plant. Standing straw encourages upright growth, higher seed set, and is effective in minimizing evaporation while conserving precipitation for use by the pulse crop.

The effective rooting depth of chickpea is no more than 30 inches and the crop uses water mostly from the top 12 inches of soil *(6)*. Chickpea is a full-season crop that will continue to grow into August or even early September in many Montana locations. Depending on precipitation recharge in late summer, it may be difficult to follow chickpea with winter wheat. A spring crop (wheat, barley, canola, flax) may be a better choice to follow chickpea. The crop the year following could be winter wheat or any of the spring crops just listed, prior to returning to chickpea in the rotation. Chickpea would benefit from a fallow period before planting, but since it accesses only the top 30 inches of soil for water, it might not be the best overall candidate after fallow. Chickpea stubble creates a dark surface which helps warm soils in the spring often permitting earlier seeding as compared to wheat stubble.

Fertility

Chickpea needs approximately 60 lb nitrogen (N) for every 1000 lb of grain produced *(7)*. Normally about 70% or more of the N in the plant comes through biological fixation, with the remainder supplied through the soil as nitrate mineralized from organic matter or from starter fertilizer. Nodules should develop within a few weeks of plant emergence, and are healthy and working to fix N if they are pink on the inside. When plants fail to nodulate or nodulate weakly, N deficiency will begin to occur as available N from the soil is exhausted. Soils rich in N may actually reduce nodulation leading to longer periods of vegetative growth with delayed flowering and seed set.

Phosphorus (P_2O_5) and potassium (K_2O) are important for healthy chickpea growth and should be applied based on soil tests. There is little information on sulfur (S) fertility for chickpea, but if soils are shallow or of lighter texture, S application should be considered. A sulfate source is preferred rather than elemental S for current year fertility. Chickpea is very sensitive to salt and germination rates can be reduced in the presence of fertilizer. Starter fertilizer applications with the seed should not exceed a total of 15 lb of K_2O + N per acre.

Weed Management

Chickpea is a poor competitor with weeds at all stages of growth. Slow growth during the seedling stages, in addition to an open canopy architecture and low growth nature of chickpea plants, reduces its ability to compete with weeds. Producers have identified weed control as a major challenge to profitable chickpea production. 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. A greater intensity of weed control will be required in the rotational crops (e.g. wheat) and the non-crop periods to reduce weed density in the chickpea crop due to the poor crop competition provided by chickpeas and the few herbicides available for use in the crop. More intensive weed control in rotational crops coming out of chickpeas is also needed to compensate for the heavy weed seed production which can occur in the chickpea crop.

TABLE 4. Minimum herbicide rotational intervals for chickpea in Montana.

Herbicide	Plant-back interval (months)
Ally extra	22
Everest 2.0	11/18*
Starane Flex	9
Powerflex	9
Goldsky	9
Orion	9
Olympus	10
Osprey	3
Rimfire Max	10**
Huskie	9
Curtail	18**
Stinger	18**
Widematch	18**
Tordon	36**

*11 months for soil pH < 8.0; 18 months for soil pH ≥ 8.0

**Conduct in-field crop bioassay prior to planting to ensure that soil residues have declined to a safe level.

Kochia, Russian thistle, wild mustard, wild buckwheat, common lambsquarters, and nightshade species are the most problematic weeds in chickpea, and can cause season-long interference and problems for direct-harvesting. Generally, the earlier emerging weeds including kochia, Russian thistle, common lambsquarters, and wild oat are the most competitive to chickpea. However, some weeds will continue to emerge throughout the growing season, especially warm-season annuals such as green foxtail (pigeongrass), wild proso millet, hairy nightshade, common purslane, and pigweeds, and may be favored by delayed seeding. In the semi-arid dryland wheat-pulse rotations, carry-over concerns from Group 2 and 4 herbicides used in wheat needs serious consideration to avoid chickpea injury and yield reductions (Table 4).

The weed control program in chickpea is comprised mostly of pre-emergence (soil-residual) herbicides. Among post-emergence herbicides, quizalafop (Assure II), sethoxydim (Poast), and clethodim (Select or Select Max) can be used effectively for grass weed control (Table 5). These herbicides are foliar active, and a good spray coverage is essential.

A pre-plant or pre-emergence application of glyphosate (Roundup or other generics) can be used to keep fields clean by controlling emerged weeds and volunteer cereals prior to chickpea planting. There has been some research conducted at MSU that indicates fall burndown (in combination with soil-residual herbicides mentioned below and in Table 5)

TABLE 5. Herbicides labeled for use in chickpea in Montana.

Herbicide*	Application Timing	Product Rate per acre	Weeds	Remarks
Assure II (Quizalofop)	POST	7 to 12 fl oz	Annual grasses and quackgrass	Apply oil adjuvant at 1% v/v
Poast	POST		Annual grasses	
Select Max (Clethodim)	POST	9 to 16 fl oz/a	Annual grasses and quackgrass	
Dual (Metolachlor)	PPI, PRE	1 -2 pt	Grasses (not wild oat), some broadleaf weeds	PPI improves activity
Outlook (Dimethenamid-P)	PPI, PRE	16 to 21 fl oz	Grasses and some broadleaf weeds	PPI improves activity, PRE requires precipitation to activate.
Prowl (Pendimethalin)	PPI. Fall or spring	1.75 – 3.6 pt 3.3 EC; 1.5 to 3 pt 3.8 ASC	Grass (not wild oat) and some broadleaf weeds	Adjust rate to soil type
Treflan (Trifluralin)	PPI	1 – 2 pt 5 – 10 lb 10 G	Some annual grass and broadleaf weeds	Adjust rate to soil type
Sonalan (ethalfluranlin)	PPI Fall or Spring	1.5 – 2 pt 5.5 – 7.5 lb 10 G	Some annual grass and broadleaf weeds	Adjust rate to soil type
Spartan (Sulfentrazone)	PPI, PRE	2 – 5.33 oz	Kochia, Russian thistle, common lambsquarters, pigweed, suppress buckwheat	Adjust rate to soil type and OM
Spartan charge (Carfentrazone and sulfentrazone)		3.75 to 7.75 fl oz		
Sharpen (Saflufenacil)	PPI, PRE	1 to 2 fl oz	Burndown control of emerged broadleaf weeds	Apply with MSO and AMS/ UAN
Roundup (Glyphosate)	PRE-HARVEST	up to 2.25 lb ae	Harvest aid and weed desiccant	Apply with AMS at 8.5 lb/100 gal. Do not apply on crop grown for seed. Allow a 7-day PHI
Gramoxone (Paraquat)	PRE-HARVEST	1.5 to pt 2SL	Harvest aid and weed desiccant	Apply with NIS or COC. Allow a 7-day PHI
Sharpen (saflufenacil)	PRE-HARVEST (at least 80% yellow/brown pods and no more than 40% of leaves still green)	1 to 2 fl oz	Harvest aid and weed desiccant	Apply with MSO and AMS or UAN Allow a 2-day PHI
Valor	PRE-HARVEST (at least 80% yellow/brown pods and no more than 40% of leaves still green)	2 to 3 oz	Harvest aid and weed desiccant	Apply with MSO Allow a 5-day PHI

*Refer to the herbicide label for complete information on herbicide use and rotational restrictions.

may be more effective than spring burndown applications. Saflufenacil (Sharpen) can be used as a pre-plant/pre-emergence burndown herbicide in chickpea, especially for glyphosate-resistant kochia, Russian thistle, or marestail (horseweed) control. MSU research suggests that these glyphosate-resistant weeds are an increasing concern in wheat-pulse rotations in Montana, and proactive herbicide resistance management programs should be implemented. Furthermore, Group 2 resistance in kochia and Russian thistle is widespread in Montana production fields. Do not apply saflufenacil (Sharpen) when chickpea has reached ground-crack stage, or after emergence, because severe crop injury will occur. Troublesome broadleaf weeds like kochia and Russian thistle can be controlled in chickpea with sulfentrazone (Spartan). Sulfentrazone applied pre-emergence in chickpea is very effective on kochia and Russian thistle, while higher rates of this herbicide may be needed to control wild buckwheat. Sulfentrazone can be applied from up to 30 days prior to planting to 3 days after planting. Soil factors such as pH, texture, and organic matter content affect sulfentrazone activity in soils. A burndown herbicide like glyphosate may be tank mixed with sulfentrazone if broadleaf or grass weeds have emerged before planting.

Trifluralin (Treflan), ethalfluralin (Sonalan) and pendimethalin (Prowl) incorporated pre-plant or pre-emergence will control certain broadleaf weeds plus foxtail and barnyardgrass, but not wild oat or quackgrass. Imazethapyr (Pursuit) can be incorporated pre-plant or applied pre-emergence with pendimethalin to control certain broadleaf weeds such as Russian thistle, wild buckwheat, and mustards. However, imazethapyr will not control ALS-resistant kochia or Russian thistle, which are widespread in Montana, and there may be a potential risk

of crop injury. Check the label for herbicide application rate, timing, and rotational restrictions. Research conducted at MSU suggest that a pre-emergence application of pendimethalin tank-mixed with dimethenamid-P (Outlook) can provide acceptable weed control in chickpea depending on soil moisture.

If weeds are present at harvest time, glyphosate (Roundup or other generics), paraquat (Gramoxone), saflufenacil (Sharpen), and flumioxazin (Valor) can be used for chickpea and weed desiccation. Do not apply glyphosate or saflufenacil to chickpea grown for seed because reduced germination/vigor may occur. Use only registered formulations and follow the application timing and pre-harvest interval (PHI) as per the herbicide label. Follow precautions while using paraquat, since it is very toxic if ingested.

Disease Control

Ascochtya Blight

Ascochyta blight, caused by the fungus *Aschochyta rabiei,* is the most significant challenge in the production of chickpeas in the Northern Plains and around the world. Growers in the past have experienced complete yield loss and sizeable reductions in seed quality *(8).* In the field, signs of Ascochyta blight are observed as distinct, circular or oblong lesions containing concentric rings that resemble a target *(9)*. The darkened rings present in the lesions containing small brown-black fungal structures called pycnidia are the key diagnostic feature of the disease.

Use of resistant cultivars, such as CDC Frontier (medium-seeded Kabuli) or CDC Luna (large-seeded Kabuli) is the most cost-effective means of controlling Ascochyta *(10).* Ascochyta is seed-borne, therefore it is best to plant certified disease-free seed. The MSU Regional Pulse Crop Diagnostic Laboratory performs this certification (contact information is on the back of this publication). Given that seed availability is limited in Montana and that some seed lots will have Ascochyta contamination, amounts of Ascochyta less than 0.3% can be used. Regardless of the presence of Ascochyta, seed should be treated with fungicides. Seed treatments containing active ingredients such as thiabendazole (Mertect), prothioconzole (Proline), or fluxapyroxad (Priaxor) have been found to be effective against seed-borne Ascochyta. Crop residues are a major source of inoculum, therefore a minimum rotation of 3 years is recommended. Frequent field scouting and timely application of foliar fungicides is also suggested as Ascochyta can move from other pulse growing fields through windblown spores *(9)*. Many foliar fungicides are effective against Ascochyta blight, however, due to resistance found in North Dakota and Montana to strobilurin (Prosaro) fungicides such as pyraclostrobin (Headline) and azoxystrobin (Quadris), QoI FRAC 11 chemistries are not recommended *(11)*. If disease is not observed, a preventative application of chlorothalonil (Bravo) is advised before bloom, particularly if there has been rain or high humidity as disease can reach devastating levels quickly *(10)*. It is suggested that 7 to 10 days after bloom a systemic fungicide such as prothioconazole (Proline), boscalid (Endura), fluxapyroxad (Priaxor), or pyraclostrobin (Headline), etc. be applied. If disease is observed or weather remains favorable, additional applications are recommended every 10 to 14 days.

NEED HELP CHOOSING A FUNGICIDE?

A search for "NDSU Fungicide Guide" will bring up the latest information on available products. Search within that guide using the keyword "chickpea" to quickly navigate to the tables for rates and application information.

https://www.ag.ndsu.edu/extplantpath/publications-newsletters/

Root diseases

Damping off and root rots of pulses are a disease complex caused by several species of fungi. The first sign of damping off is poor seedling emergence followed by yellow seedlings with a brown/black taproot *(9)*. For seedlings that have emerged, several factors can contribute to root rot. These include cool wet weather early in the growing season, soil compaction leading to poor drainage, nutrient deficiency, and short crop rotations. In chickpea, Pythium, Fusarium, and Rhizoctonia are most often the cause of both disorders. The root rot pathogen, *Aphanomyces euteiches* Drechs. has been found in Montana pulse fields, however, chickpeas are partially resistant and disease only occurs with very low incidence and severity *(12*). Kabuli chickpeas have thin seed coats that leave them particularly susceptible to Pythium, a common pathogen in Montana soils *(11)*. To prevent both root rot and damping off, all pulse seed should be treated. Metalaxyl (also referred to as Mefanoxam, Apron XL) and Ethaboxam (Intego) are seed treatments registered for use in chickpea to control Pythium and should be combined with a fungicide seed treatment to control Fusarium and Rhizoctonia.

Insects

Chickpea has a natural resistance to insects due to the hairy nature of the plant's leaves, stems, and pods. The plant excretes malic acid from these hairs, leaving the crop unattractive to most insects. Worldwide the insect that causes the most economic damage in chickpea is the corn ear worm *(Helcoverpa armigera)*. Currently there are not enough corn (or chickpea) acres in Montana to attract significant populations of this insect, but monitoring for its appearance should be a priority, especially as corn production continues to move west in the Great Plains.

Seedling insects such as armyworm (*Spodoptera* spp.), cutworm (multiple species), or wireworm (*Elateridae* spp.) can cause stand loss and fields should be scouted early for signs of damage. Grasshoppers (*Caelifera* spp.) at the end of the growing season can be found feeding on plants when populations increase in regional cycles. Some damage from alfalfa looper *(Autographa californica)* has been reported but damage is usually restricted to field edges or where fields border alfalfa.

Harvest

Chickpea has a low shattering potential, especially compared to dry pea and lentil. Pod drop and pod shattering can occur once seeds have dried down and are ready for harvest. Direct cutting without desiccation usually results in higher yields and larger seed size. In some regions it is advantageous to swath and then combine, since delayed harvests can result in darkened or stained seed coats. A desiccant will not speed maturity but it may be used as a harvest aid to terminate the crop, and to burn down immature weeds which can cause seed staining. Desiccants should be used only after pods have matured, seeds have changed color, and the seeds have detached themselves inside the pods (pods rattle upon shaking). Threshing can begin when seed reaches 18% moisture. However, lower moisture percentages are necessary for long term storage or for processors to accept.

Monitoring of seed color is most important to determine proper harvest timing and management. Harvesting too early increases the chances of green seed in the crop. Early frost during ripening can result in immature green seed in the crop. Occurrence of green seed lowers the grade and crop value leading to dockage.

Harvest using stripper headers can reduce occurrence of weed seeds and shriveled chickpea seeds as compared to samples from straight cut or from harvested windrows. Stripper headers are available that can strip off ripened pods at harvest and leave green leaves on the plant, improving harvested grain quality. Whatever combine is used, follow the manufacturer guidelines to reduce damage to harvested grain. Adjust cylinder speed and concave, sieve, and air settings throughout the day to prevent seed breakage and recover clean grain.

Storage

Chickpea can be stored at 15% seed moisture. Use conveyor belts rather than augers to move grain and minimize handling to preserve quality. If augers must be used, operate them at slow speeds, keeping the auger filled to minimize damage to the seed. Damaged seeds and broken kernels are significant dockage factors.

Glossary

Corticated: having a cortex or similar specialized outer layer like a bark or rind.

Cotyledons: the first leaf or one of the first pair or whorl of leaves developed by the embryo of a seed plant.

Curry: a food, dish, or sauce in Indian cuisine seasoned with a mixture of pungent spices; also: a food or dish seasoned with curry powder.

Dal: dried legumes (such as lentils, beans, or peas); also: an Indian dish made of simmered and usually pureed and spiced legumes.

Falafel: a spicy mixture of ground vegetables (such as chickpeas or fava beans) formed into balls or patties and then fried.

Glyphosate: a systemic organophosphate herbicide ($C_3H_8NO_5P$) used to control herbaceous and woody weeds especially within croplands.

Hummus: a paste of pureed chickpeas usually mixed with sesame oil or sesame paste and eaten as a dip or sandwich spread.

Hypogeal: germination where the cotyledons remain below the ground (contrast to epigeal where cotyledons open above the ground surface upon germination).

Indeterminate: characterized by growth in which the main stem continues to elongate indefinitely without being limited by a terminal inflorescence (flower). (contrast with determinate where vegetative growth ceases when the reproduction [flowering] phase begins.)

Inoculant: agricultural amendments that use beneficial microbes to promote plant health.

Kabuli: A common name for large chickpeas which originates from the name of a city and capital of Afghanistan on the Kabul River.

Scale nodes: points along a plant stem between the crown and the first true leaf where new leaves or branches can develop and are characterized by scale-like plant tissue. These usually consist of only 1 or 2 points located on the main plant stem just below the soil surface.

References

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Common chemical and trade names are used in this publication for clarity of the reader. Inclusion of a common chemical or trade name does not imply endorsement of that particular product or brand of chemical and exclusion does not imply non-approval.

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