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Growing Dry Pea in Montana

by Perry Miller[a], Kent McKay[b], Clain Jones[c], Sue Blodgett[d], Fabián Menalled[e], Jack Riesselman[f], Chengci Chen[g] and Dave Wichman[g]

This publication contains extensive information about one of the plants best adapted to Montana's climate. It includes sections on use and markets, growth characteristics, varieties, field selection, agronomy, pest management and harvesting.

Dry pea had record production in Montana in 2004, third in the USA behind North Dakota and Washington (Figure 1). This is a result of increased N fertilizer costs and the need for crop diversity in no-till systems, coinciding with reduced price risk through the implementation of loan rates for dry pea in the 2002 Farm Bill. Herbicide residues and local development of market infrastructure are two factors that may hinder pea production.

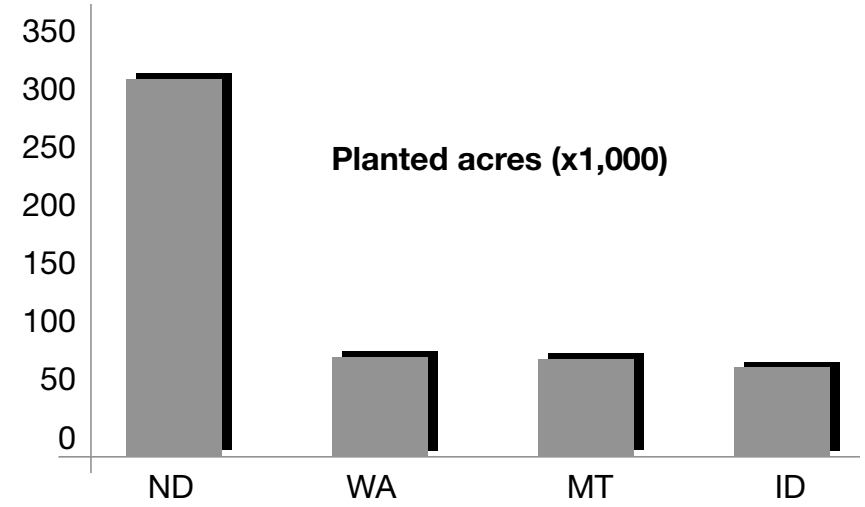

Figure 1. Major USA Pea acreage in 2004.

Use and Markets

Dry pea is a versatile crop, sold for human consumption and livestock feed markets, or as seed for annual forage and green manure uses. Although prices received for feed pea represent the lowest value, opportunities exist to enhance the value of feed pea by using the commodity as an on-farm livestock feed source. Pea has high levels of the amino acids lysine and tryptophan, which are low in cereal grains. Grain protein in pea can range from 19 to 27 percent, but is most commonly 22 to 24 percent. Pea contains high levels of carbohydrates, is low in fiber and contains 86 to 87 percent total digestible nutrients. These feed characteristics, combined with high palatability make pea an excellent livestock feed.[1] Pea contains 5 to 20 percent less of the trypsin inhibitors than soybean. This allows it to be fed directly to livestock without having to go through the extrusion heating process. Dry pea is often cracked or ground and added to cereal grain rations.

Research has shown that dry pea is an excellent protein supplement in swine, cow, feeder calf, dairy and poultry rations.

Premium prices are associated with human food and seed markets. Selling pea in the premium markets is a greater challenge than marketing a traditional small grain crop. Premium pea markets are normally limited and require a more aggressive approach by the grower. Pea markets should be identified before seeding to optimize the ability to harvest a crop that will meet quality standards. For example, when marketing food-grade pea, numerous factors that affect market grade include class (e.g. green or

[a]Extension Cropping Systems Researcher; [b]Extension Cropping Systems Specialist; [c]Extension Soil Fertility Specialist; [d]Extension Integrated Pest Management Specialist; [e]Extension Cropland Weeds Specialist; [f]Extension Plant Pathology Specialist; [g]Extension Cropping Systems Researcher, respectively, Montana State University.

yellow cotyledon, specialty types), seed size and shape, splitting potential, harvest moisture, seed handling techniques during harvest and storage and seed damage factors (e.g. bleached, cracked seed coats, splits, shriveled seed, earth tag, chalk spot, etc.). After harvest the crop needs to be graded to determine what markets are options for the grower.

A representative 2-lb sample may be sent to:

State Grain Laboratory, PO Box 1397, Great Falls, MT 59403-1397.

Dry pea grading No. 1 or 2 qualifies for the human food market.

Due to limited market opportunities for human food grade pea, make sure regional buyers are aware of the quality and quantity of crop you have available for sale. A listing of potential buyers and market opportunities is available from the *North Dakota Dry Pea and Lentil Association* (www.ndpealentil.org).

Adaptation

During the 1940s, fresh peas were a major cash crop in several southern Montana counties, supplying canneries in Bozeman and Red Lodge. However, due to severe disease outbreaks, fresh pea production disappeared in Montana. Historically, Montana Ag Experiment Station research has shown dryland pea production to be agronomically viable in the northern plains, but weak economic viability has hindered adoption. Recent research has confirmed this adaptation, and highlighted a positive role in dryland cropping systems in the northern Great Plains region.[2] Dry pea offers great versatility in cropping systems since it can be used for grain (food or feed), forage (hay or grazing) or green manure production.

Spring pea is generally earlier maturing than spring wheat. Flowering occurs after the 10- to 14-leaf stage, generally about 50 to 60 days after seeding in Montana, and maturity typically requires less than 90 days. High temperatures during flowering (more than 80 degrees F) can cause flowers to blast, and limit yield potential. Pea yield is strongly related to the number of days of flowering. Unlike wheat, pea has a shallow root system that limits its ability to utilize stored soil water below 2 feet and thus is more sensitive to intermittent drought than wheat (where soil water in the 2 to 4 ft soil zone is available). However, pea is very efficient at converting intermittent rain showers into growth.[2] In the northern Plains, pea yields are often similar to recropped hard red spring wheat when both crops are compared on wheat stubble[2], a useful assumption to begin budgeting.

Types of Peas

Growth characteristics

Dry pea is self-pollinated, resulting in pods about three inches long containing four to nine seeds. Dry pea is an **annual or winter annual** grain legume species that includes both pigmented (purple flowers and mottled seed coats) and non-pigmented (white flowers and clear seed coats) varieties. Non-pigmented types are further divided into market classes based on the color of their cotyledons within the grain; yellow or green. Montana's natural environment provides a competitive edge in meeting the food quality standards for dry green and yellow pea production, but the yield potential of dry green pea typically averages 90 percent of dry yellow pea. In addition to seed and flower color characteristics, important genetic variations of dry pea include: 1) seed size, 2) plant height (semi dwarf to tall), 3) leaf type (fully leafed, afila leaf type, or semi-leafless where leaflets have been converted to tendrils) and 4) stem stiffness important for lodging at maturity. Today most grain pea varieties are semi-dwarf semi-leafless types with white flowers, clear seed coats and large seed size. The best forage and green manure varieties are tall, fully leafed types with pigmented flowers, mottled seed coats and small seed size.

Varieties

Factors to consider in selecting the right variety for your farm includes market class, yield potential, harvest ease, vine length, maturity, seed size and disease tolerance. Variety testing of dry pea is very limited in Montana (http://ag.montana.edu/carc/). Growers can find additional variety information from North Dakota (http://www.ag.ndsu.nodak.edu/aginfo/variety/index.htm), Alberta (http://www.pulse.ab.ca/Seed/trials.htm) or Saskatchewan (http://www.agr.gov.sk.ca/docs/crops/cereals/var2005.pdf).

Genetic improvement of pea has occurred at a rapid pace resulting in pea varieties being steadily replaced by superior ones. Thus, growers should revisit their varietal choices every five years or more frequently. All varieties are suited for feed markets, however, only a few green and yellow pea varieties meet standards for the edible market. Before raising dry pea for the edible and split pea market, contact potential buyers to make sure your planned variety is acceptable.

Field Selection

Soil Residual Herbicides

The sensitivity of peas to herbicides commonly used in wheat production that persist in the soil for more than a year is the leading cause of yield loss in Montana. Examples are Amber, Ally, Finesse, Peak, Rave and Tordon. Using these long residual herbicides will result in pea injury for several years, and in some cases beyond five years. Curtail and WideMatch residues persist for a shorter time in the soil than the examples above, however, there are plantback restrictions for dry pea in Montana. Consult the label of any soil-active herbicide for rotational restrictions prior to seeding pea.

Soil Type

Dry pea can be grown on a wide range of soil types, from sandy to clay soil. Pea has water requirements similar to spring barley, but has low tolerance to saline and waterlogged soil conditions. Dry pea may be injured, or even killed, after more than 24 hours in waterlogged soils.

Crop Sequence

Several crop sequence studies in the northern Plains region have shown that pea yields are highest when direct-seeded into wheat stubble, and vice versa. Thus dry pea complements wheat and barley production. Recent research by the Montana Agricultural Experiment Station (MAES) indicated that pea can help diversify and intensify no-till cropping systems while minimizing the risk of continuous cropping, especially if managed as an early harvested forage. Preliminary results show that pea forage and green manure terminated at first flower can precede a late summer fallow period without seriously compromising soil available water for a subsequent crop. Dry pea in a cropping system can also aid in management of troublesome grassy weeds and perhaps help mitigate disease and insect pests.

Recently the Risk Management Agency developed a new coverage rate for cereal crops grown after pea that is nearer the coverage available for cereals grown on fallow. Check to see if this provision is available in your county.

Nitrogen Credits

Dry pea is an excellent nitrogen-fixing crop that typically needs no N fertilizer and most often contributes soil-available N to a subsequent crop through the next growing season. Pulse crop N credits have traditionally been estimated based on pea grain yield (0.5 to 1.25 lb N per bushel of yield) but new research studies suggest that 'flat' or constant N credits are likely more appropriate.[1] Based on research in regional contexts relevant to Montana, N credits following a pea grain crop have ranged from 0 to 20 lb N/ac on any field in any given year, and have averaged near 10 lb/N ac. When the pea crop is terminated early for forage or green manure preceding a partial summer fallow period, the N credit could be doubled.

Agronomy

Seeding

Dry pea can be grown in no-till or tilled cropping systems. Pea requires greater moisture for germination than wheat so spring tillage should be minimized. Row spacing from 6 to 12 inches is optimal. Importantly, the seeder must be capable of handling large seed without excessive cracking.

Dry pea is tolerant of cold soil temperatures, but is heat sensitive during flowering, so planting date in the northern Plains should be similar to barley (late March to early May). If seeding early in cold soil, the seed must be treated with metalaxyl fungicide (common trade names are *Allegiance* or *Apron*). Under the same field conditions, pea emergence typically requires 2 to 4 days more than spring wheat. Seedlings are tolerant to spring frosts in the low 20s, and if severely injured by frost, a new shoot will emerge from nodes below the soil surface. Numerous researchers have documented that yield declines with delayed seeding, with losses as severe as 1 bu/day after May 1.[3]

Winter pea production has not been well researched in Montana. But to date but it appears that Austrian (pigmented) winter pea has exhibited greater winterhardiness than the new white-flowered cultivars (e.g. Spectre). Preliminary research results have shown that winter pea should be seeded one to two weeks earlier than the optimal date for winter wheat in Montana and should be considered only in regions where winter wheat survival is very reliable.[4] Winter pea survival is enhanced when sown within standing cereal stubble or in deep furrows, and it is essential that winter pea germinate sufficiently early in the fall for a seedling to emerge and establish a rosette. Dormant planting of winter pea has not been successful.

To ensure optimal yields, growers should target a final stand density between six and eight plants per square foot. Pea yield potential can be viable

Table 1. Field pea fertilizer P and K recommendations for Montana (Jacobsen et al., 2003).			
Phosphorus (P)		**Potassium (K)**	
Soil Test Level (ppm)	**P_2O_5 (lb/ac)**	**Soil Test Level (ppm)**	**K_2O (lb/ac)**
> 16	0-15	>250	0-20
14-16	15	225-250	20
10-14	20	175-225	25
6-10	25	125-175	30
<6	30-35	<125	35-45

at densities of three to four plants per square foot but weed interference becomes a much more significant factor. Seed size varies strongly among varieties, and can even vary considerably within a variety. As a result, actual seeding rates required to achieve these target plant densities can vary from 80 to 280 lb/ac, assuming excellent germination.

Dry pea typically requires slightly deeper seeding than wheat because pea seeds are larger and require more moisture to complete germination. Also, late spring seeding dates often require greater seeding depths than early spring dates because warmer air temperatures can quickly dry the disturbed surface soil. The surface layer of loosely tilled soils is especially susceptible to moisture losses to the atmosphere. The use of some herbicides, i.e. metribuzin (Sencor) and sulfentrazone (Spartan), requires deeper seeding depths to avoid pea seedling herbicide injury.

Plant Nutrition

For dry pea to rely on biological N fixation, it must be inoculated at planting with the correct strain of Rhizobia, especially if pea or lentil has not been grown recently in that field. Commercially available pea and lentil inoculants are cross-infective but rhizobia from alfalfa, chickpea, dry bean and soybean will not infect pea. Placing peat granular inoculant in the seed row with the seed is the most effective method to insure nodulation and N-fixation, but most properly applied peat-based inoculants have been reliable. Peat seed coating products work best with a 'sticker' solution (http://www.saskpulse.com/library/ppm/plant_nutrition.pdf). Water provides only temporary adhesion of inoculant to the pea seed coat. Beware that dry seed coat inoculants typically slough a significant percentage of the inoculant from the seed coat and can accumulate at the bottom of the seed cart on an air drill, causing mechanical difficulties. Liquid inoculant has not been effective in some instances due to the short life on the unplanted seed and interaction with some soil conditions.[5] Do not store inoculant or inoculated seed in direct sunlight or warm places as these conditions rapidly cause rhizobia mortality.

Three to four weeks after seeding, check the root systems for nodule formation. Nodules begin as small round white growths on the lateral roots and enlarge into either round or multi-lobed nodules. Beefsteak red color on the inside of the nodules indicates that they are actively fixing nitrogen. If neither nodules nor N-fixing activity is evident, consult an agronomist to decide if immediate top-dressing of fertilizer N is required or justified.

Canadian research has consistently shown that N fertilizer is not required for optimal pea yields. However, there is anecdotal evidence that in very N limited soils (less than 20 lb NO3-N/ac) plant N status was insufficient to permit N-fixation to occur. In these cases a small amount of top-dressed N (10 to 20 lb N/ac) was successful in enabling the plant to initiate symbiotic N-fixation and resume growth.

Pea fertilizer rates for phosphorus (P) and potassium (K) are similar to annual small grain crops for high production of forage or seed (see Table 1 below). As with other crops, fertilizer application rates should be based on a soil test (see *Soil Sampling*, MontGuide 8602-AG). **If the fertilizer goal is for soil fertility maintenance, pea removes approximately 0.7 lb P_2O_5, 0.7 lb K_2O and 0.1 lb S for each bushel of yield.** Fertilizer can be broadcast in the fall or spring during field preparation, or deep banded with the seed at planting. Pea seedlings are very sensitive to salt, and proper fertilizer placement is critical to avoid injury. Avoid placing fertilizer directly with the seed.

Rolling

Land rolling should be done where stones may interfere with an unusually low cutting height due to drought stressed plants or where tall vine varieties (such as forage types) susceptible to severe lodging are grown for grain. Rolling is best done when the soil surface is dry within a few days of planting or after the crop emergence but prior to the 7th node stage. **Rolling should be avoided near plant emergence to prevent burying seedlings. Use caution when deciding to roll clay soils that are damp because long lasting "bricks" can result.**

Pest Management

Weeds

Dry pea is a poor competitor with weeds in most field situations, especially at the seedling stage, due to relatively slow early season growth. Once leaf drop begins, warm season broadleaf weeds such as kochia and Russian thistle can cause problems and interfere with harvest. An even, well established stand of six to eight plants per square foot is critical for dry pea to be at all competitive with weeds.

Recent experience has shown that the most problematic weeds in Montana pea fields are kochia, Russian thistle, wild mustard, wild buckwheat and prickly lettuce. Producers should refer to the latest version of the *Montana, Utah and Wyoming Weed Management Handbook*, which is available through Montana State University Extension offices. *The North Dakota Weed Control Guide* is also an excellent source of information on herbicide efficacy in dry pea (www.ag.ndsu.nodak.edu/weeds/). It is difficult to control annual broadleaf weeds in pea. It is most often recommended to apply a pre-emergent or pre-plant herbicide for annual broadleaf weed control in pea. There are few effective post-emergent herbicide options and they do not control multiple flushes of broadleaf weeds.

Using field peas in small grain rotations offers producers an excellent opportunity for controlling grassy weeds. For example, quackgrass or wild oat can be controlled during the pea rotation. Additionally, dry pea or small grain/pea mixtures produced for forage under high rainfall or irrigated conditions are very effective "smother" crops. When harvested for silage or hay, many weeds under the crop canopy are unthrifty and produce fewer seeds. Forage harvest can be timed to prevent viable weed seed set. In green manure systems, many annual weeds are immature at the time that the pea crop is terminated by mechanical or chemical fallow methods. These features of field peas have been noted by producers, but no long-term crop rotation studies have quantified the effects of peas on weed populations in different cropping systems.

Diseases

Controlling disease in dry pea begins with crop rotation. A preferred crop rotation would have at least two years between dry pea crops. Early seeding into cold soil risks severe stand losses to damping off if seed is not treated with metalaxyl (*Allegiance* or *Apron*) or oxadixyl (Anchor), especially for large seeded cultivars.

There are other seed- and soil-borne fungi that can also cause problems for pea producers. They include Fusarium, Rhizoctonia and, to a lesser degree, Ascochyta, Phomopsis and Sclerotinia. Seed treatments registered for suppressing these fungi include captan (not effective on seed borne Ascochyta), fludioxonil (Maxim), PCNB and thiram. Always check the label for compatibility with rhizobial inoculants. A biological, Kodiak, is also registered for Rhizoctonia and Fusarium suppression. Caution: apply rhizobial inoculant after the fungicidal seed treatment has dried on the seed, and just prior to seeding.

Environmental conditions are generally not conducive to major pea diseases common to subhumid regions of the northern Plains such as ascochyta/mycosphaerella, powdery mildew and sclerotinia. Powdery

mildew rarely causes yield loss in Montana although it my cause premature ripening. Excellent varietal resistance to powdery mildew is available. Growers should strive to plant pea seed with as low levels of ascochyta infection as possible but seed infection rates up to 0.7% may be tolerated without fungicidal seed treatment. Even though the environment is generally not conducive for foliar pea diseases, extended periods of humid wet weather or irrigation can lead to sporadic outbreaks of bacterial blight, Mycosphaerella and/or Ascochyta blight, Botrytis gray mold and Sclerotinia white mold. Should conditions favorable for these diseases occur the only fungicide registered for use is Endura. Do not apply within 7 days of harvest. Bacterial blight is controlled primarily by planting pathogen free seed. Do not save seed from fields with significant levels of bacterial blight.

Insects

There are few insects of economic importance to dry pea. Generalist herbivores like cutworms and armyworms feed on pea seedlings. Most species occur in early spring to early summer. Damaging populations have been encountered, especially when there is moderate to heavy plant residue on the soil surface. Grasshoppers damage dry pea in the flower to pod-filling stages, although pea is not a preferred host plant. Grasshopper control is advised whenever 20 or more adults per square yard are found in field margins or eight to 14 adults per square yard occur in the crop.

Lygus bug: The lygus bug has the potential of being a serious insect pest in dry pea. Lygus bug adults are slightly less than 1/4 in. in length, about half as wide as they are long. They range in color from pale green to light brown with a distinct lighter colored triangular shaped marking near the center of the back. Nymphs are brighter green in color with wing pads that become more pronounced in later nymphal stages. Smaller first and second instar nymphs somewhat resemble pea aphids, however, they are much more active than pea aphids.

Lygus bugs feed preferentially on meristematic tissue (developing reproductive tissue), resulting in shriveled seed. A result of lygus feeding damage is "Chalk spot," the appearance of a chalky white spot that may appear on the dried seed. Chalk spot may be confused with bruising or rough handling when dry pea is harvested at high moisture (a condition when the pea is more susceptible to damage). In 2002, chalk spot was a concern in the North Dakota pea crop. Chalk spot damage to some pea samples was as high as 27 percent. Lygus bugs may move from nearby alfalfa or canola fields, especially after alfalfa hay is cut. In Idaho the threshold for lygus bugs in field peas is seven to 10 lygus per 25 sweeps.[6]

Pea aphid: Pea aphids may damage peas directly through sucking plant juices, resulting in stunted, less vigorous plants that produce fewer and smaller seeds. Heavy populations or prolonged feeding by pea aphid may cause severe stunting, yellowing, wilting and ultimately death of the plants. Aphids are known to be a vector of pea enation mosaic, pea streak, pea seedborne mosaic, alfalfa mosaic, bean yellow mosaic and pea leaf roll. The importance of aphid-vectored viral diseases varies with environmental factors that influence viral infection and outbreaks.

Early planting allows plants to become well established before aphids move from alfalfa into pea fields. Younger plants are more susceptible to aphid feeding damage and impact of virus infection is apt to be more severe. If there are 30 to 40 aphids per sweep and few, if any, natural enemies are present, insecticide treatment is justified. However, if natural enemies such as ladybird beetles are present, resample in two days. If numbers are the same or decreased, treatment may not be needed.

Conditions that increase the risk of pea aphid outbreaks include:

1. Abundant regrowth of nearby perennial host plants (alfalfa) in the fall
2. Late killing fall frost, allows for abundant production of overwintering forms
3. Mild January and February temperatures
4. Stresses on perennial host plants (alfalfa) in spring resulting in early movement of aphids to pea.
5. Pea aphids migrate to pea fields from nearby alfalfa fields and may be of particular concern after nearby fields of alfalfa hay are cut.

Pea leaf weevil: The pea leaf weevil is a seedling pest of peas that has caused problems in research plots and commercial fields in the Gallatin Valley in recent years. The adult is gray-brown in color measuring between about 1/5 of an inch, with a short, blunt shaped beak. It has three light but inconspicuous stripes that run lengthwise from the thorax to the wing covers. Adult feeding results in scalloped leaf edges that can coalesce, causing significant injury to seedlings,

especially if feeding occurs on the 'clamshell' growing point of dry pea. Typically the damage is more severe on edges of fields adjacent to grassland, pasture, riparian areas or other similar refuges. More insidious, weevil larvae feed on nitrogen-fixing nodules on roots, causing economic damage in at least one case reported in a commercial field in the Gallatin Valley.

When more than 25 percent of the leaves are notched or when there is an average of more than 0.2 to one weevil per plant, treatment is justified. Another threshold is between the two- to four-leaf stage when 1/5 of the plants have feeding injury and insects are present. Once the 6-leaf stage is reached, some defoliation can be tolerated. Variety trials conducted in Washington indicate than semi-leafless peas are more susceptible to pea leaf weevil than conventional peas. Another pest, pea weevil, is troublesome in the Pacific Northwest but has not yet been reported to occur in Montana

It is important to monitor for insect pests to detect damaging populations early, before economic damage has occurred. Sweep nets and plant inspections are the most frequently used techniques for detecting insect pests. Because pests damage different pea stages, a comprehensive monitoring program should be developed. Specific information on pest management techniques appropriate for individual pests can be found at the highplainsipm.org website.

Harvesting

Harvest management is especially important if dry pea is to be marketed as human food or for seed. If quality problems exist, including bleached, split, cracked or earth-tagged (dirt attached to seed that cannot be removed) seed, the livestock feed market will be the only option. The following information will help growers maintain a high-quality crop during harvest and storage.

Pea plants mature from the bottom up and are physiologically mature when the uppermost pods develop a 'netted' or slightly wrinkled surface and the peas in the pods have initiated color change for yellow pea. If necessary, the crop can be desiccated chemically or swathed at this stage to control weeds and promote a timely, high quality harvest. Paraquat (Gramoxone) and glyphosate are the only registered desiccants in Montana. Paraquat is a contact herbicide that burns down green plant tissue quickly, while glyphosate is a systemic herbicide especially useful for killing actively growing weeds.

Swathing pea is risky because dried windrows are susceptible to movement by moderate winds resulting in substantial shattering and/or piling in fence rows, coulees or shelterbelts. Some pea growers swath pea to manage uneven maturity across a field landscape but do so only with the aid of a swath roller.

Since summer drought will most often terminate pea growth in Montana, pea fields will typically remain standing until sufficiently ripe to harvest, normally one to two weeks after physiological maturity. Ripe plants of semi-leafless pea varieties generally stand more erect than the ripe leafy varieties. Seed damage can be minimized by harvesting peas near 18 percent moisture, but grain moisture must be below 15 percent to be safe for storage. Pea vines can be difficult to shred unless very dry, and can bind up straw choppers if vines are rubbery. Ideally, pea straw is left on the field to contribute to soil organic matter, but if managing pea residue is a problem, baling pea straw for feed is preferred over burning.

Follow manufacturer's recommended settings for harvesting pea and be prepared to make adjustments of ground, reel (or pickup) and cylinder speed and concave clearance to minimize seed cracking. Pea can be difficult to harvest for an inexperienced operator because significant pod shattering can occur at the header and the seed is susceptible to cracking. In some conditions in Montana it is possible to use a rigid wheat header, but on rolling fields, or where pea height is short or lodged, the use of flex headers with vine lifters is recommended. The combine should be operated at full capacity to reduce seed damage in the cylinder and grain elevators. Augers and loaders should be operated at slow speed to minimize seed damage. If the seed is too dry it may be necessary to limit harvesting to early morning, late evening and night-time periods to minimize seed breakage.

New specialized machinery for swathing and combining dry pea is rapidly becoming available in the northern Plains. Inexpensive, spring-loaded vine lifters can be easily attached to cutter bars of swathers or combines to improve the harvest of lodged pea vines. Pickup reels with modified fingers can also be adapted for both swathers and combines. Montana producers are encouraged to examine new equipment and products that have greatly improved harvest efficiency of dry pea. Grain augers with plastic flighting or belt conveyors minimize damage during handling.

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Footnotes

1. (NDSU Extension Service circular SF-725).

2 (Miller et al. 2002).

3. (Perry Miller, unpublished data).

4. (Chengci Chen and others, unpublished data).

5. (Clayton et al. 2004).

6. (U.I. Bulletin No. 664).

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