Field Pea Production

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Field pea is a cool-season legume crop that is grown on over 25 million acres worldwide. Field pea or "dry pea" differs from fresh peas in that field pea is marketed as a dry, shelled product for either human or livestock food, whereas fresh peas are marketed as a fresh or canned vegetable.

The major producing countries of field pea are Russia and China, followed by Canada, Europe, Australia, and the United States. Europe, Australia, Canada and the United States raise over 4.5 million acres and are major exporters of peas. In 1998, there were approximately 300,000 acres of field peas grown in the United States.

Field pea production in the United States has been primarily in the Palouse region of Washington and Idaho. The majority (over 70 percent) of the field pea produced in the United States is exported. Green pea comprises over 90 percent of the export market followed by yellow pea.

Recently North Dakota, South Dakota, Montana, and Minnesota have begun producing dry peas. In 1991 there were approximately 1,600 acres of dry peas in North Dakota; by 1998 there were over 102,000 acres.

**Uses**

Field pea is primarily used for human consumption or as a livestock feed. Being a grain legume, field pea is commonly used throughout the world in human cereal grain diets.

Field pea has high levels of amino acids, lysine and tryptophan, which are relatively low in cereal grains. Field pea contains approximately 21-25 percent protein. Peas contain high levels of carbohydrates, are low in fiber and contain 86-87% total digestible nutrients, which makes them an excellent livestock feed. Field pea contain 5 to 20% less of the trypsin inhibitors than soybean. This allows them to be directly fed to livestock without having to go through the extrusion heating process. Field pea is often cracked or ground and added to cereal grain rations.

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

Field pea is often used in forage crop mixtures with small grains. Field pea forage is approximately 18 to 20 % protein. Pea interseeded at 60 to 100 pounds per acre with a small grain such as oat can increase the protein concentration of the mixed forage by 2 to 4 percentage points and increase the relative feed value by 20 points over oat seeded alone.

Field pea also may be grown as a green manure or green fallow crop. With either option, soil and future crop productivity will be maintained or improved. Use of field pea for green fallow instead of black fallow protects the soil from erosion, improves soil quality, substitutes water loss by evaporation or leaching from black fallow with transpiration through plant growth, and exploits rotational benefits. Costs of tillage and idled land in black fallow are substituted with costs of field pea establishment and termination (at early flowering) in green fallow.

Field pea in a green fallow system yielded 3425 pounds per acre of biomass and 103 pounds per acre of accumulated nitrogen in aboveground biomass at the Carrington Research Extension Center during 1990-1992. Spring wheat averaged 39 bushels per acre over a two-year period at Carrington when grown without additional N fertilizer following green fallow as field pea or following black fallow. This demonstrates that wheat following pea green fallow can be as productive as wheat grown on black fallow, plus the numerous rotational benefits of the legume can be utilized.

**Adaptation**

Field pea is an annual cool-season legume (pulse) crop. There are two main types of field pea. One type has normal leaves and vine lengths of 3 to 6 feet; the second type is the semi-leafless type having modified leaflets reduced to tendrils resulting in shorter vine lengths of 2 to 4 feet. Pea normally has a single stem but can branch from nodes below the first flower.

Most varieties of pea produce white to reddish-purple flowers, which are self pollinated. Each flower will produce a pod containing four to nine seeds. Pea varieties either have indeterminate or determinate flowering habit.

Indeterminate flowering varieties will flower for long periods and ripening can be prolonged under cool, wet conditions. Indeterminate varieties are later in maturity ranging from 90 to 100 days. Determinate varieties will flower for a set period and ripen with earlier maturity of 80 to 90 days. Field pea is sensitive to heat stress at flowering, which can
drastically reduce pod and seed set. Indeterminate varieties are more likely to compensate for periods of hot, dry weather and are more adapted to arid regions. Determinate, semi-leafless varieties that have good standability are more adapted to the wetter regions.

Pea roots can grow to a depth of 3 to 4 feet; however, over 75% of the root biomass is within 2 feet of the soil surface. A relatively shallow root system and high water use efficiency make field pea an excellent rotational crop with small grains, especially in arid areas where soil moisture conservation is critical.

Field pea is well adapted to cool, semi-arid climates. Field pea seed will germinate at a soil temperature of 40°F. Emergence normally takes 10 to 14 days. Field pea has hypogeal emergence in which the cotyledons remain below the soil surface. Seedlings are tolerant to spring frosts in the low 20s and if injured by frost a new shoot will emerge from below the soil surface.

Flowering usually begins 40 to 50 days after planting. Flowering is normally two to four weeks, depending on the flowering habit and weather during flowering.

Field pea has shown to be well adapted to most regions of the Northern Great Plains. Field pea yields can be compared to, and are very similar to, spring wheat on a pound or bushel basis within a specific region. A six-year average (1993-1998) of 'Profi' field pea yield on re-crop at the North Central Research Extension Center at Minot was 2784 pounds per acre or 46 bushels per acre, compared to spring wheat on re-crop at 2148 pounds per acre or 36 bushels per acre.

**Varieties, Types and Performance**

Selecting the appropriate field pea variety should be based on review of the many differences that exist among varieties. Factors to consider should include market class, yield potential, harvest ease, vine length, maturity, seed size, and disease tolerance.

The first criterion for selecting a variety should be market class. The green and yellow cotyledon types will be the primary classes. All field pea varieties may be considered feed peas, but only selected varieties are acceptable for either the green or yellow human edible market.

After market type is determined, growers should review the field pea performance test information from trials conducted across the state with particular attention paid to those trials reflective of their farming area.

Crop harvestability is a very important factor in variety selection and is often noted by harvest ease scores in trial results. Most growers prefer a variety that will stand upright at harvest since it allows a faster harvest, minimal equipment modification and higher quality seed. The newer varieties that have shorter vines and are semi-leafless will be easier to harvest. It is important to review harvest ease data since varieties within this plant type differ greatly in standability.

Another factor to consider in variety selection is the producer’s location. The indeterminate nature of the long-vined normal leaf type varieties may make them a preferred type in western North Dakota where moisture stress is more prevalent. Indeterminate varieties tend to express more stable seed yields when moisture and heat stress impact crop development. This type of variety will normally be heavily lodged at harvest and require special harvest procedures.

Most growers will select among the semi-leafless varieties that are more determinate in development. Selection within these semi-leafless types should consider the impact of vine length. In areas with higher rainfall and cool summers, the shortest-vined varieties may be best, while in the drier regions a grower should choose a semi-leafless type with longer vines.

A wide selection of field pea varieties exists for producers across the region. A good source of information to aid in variety selection is field trial evaluations conducted by the various research extension centers across the state. These trials include the most promising varieties with information recorded on the important traits necessary for making proper variety selection.

**Field Selection**

Field pea can be grown on a wide range of soil types, from light sandy to heavy clay. Field pea has moisture requirements similar to those of cereal grains. However, peas have lower tolerance to saline and water-logged soil conditions than cereal grains. Peas most often will die after 24 to 48 hours in a water-logged condition. Poorly drained and saline or alkaline soils should be avoided when growing peas.
Field peas are most often grown on recrop following small grain with residual nitrogen levels of 30 to 40 pounds per acre. Being a legume, field pea will fix the majority of required nitrogen if the proper rhizobia are present. Residual nitrogen will also be present for the succeeding crop.

Fields that have a history of perennial weed problems such as quackgrass, Canada thistle, perennial sowthistle, and field bindweed should be avoided.

Residual herbicides such as Tordon, Finesse, Amber, Ally, Peak, Assert, and Curtail will severely damage pea seedlings. These herbicides can remain in the soil from two to five years after application, and consulting the label of these herbicides for rotational restrictions prior to seeding pea is a must.

**Seeding**

Field pea can be grown in a no-tillage or conventional tillage cropping system. Avoid excessive tillage in the spring to avoid drying out the seedbed. Pea seed requires considerably higher amounts of moisture for germination than cereal grains. Field peas are typically seeded in narrow row spacings of 6 to 12 inches. A conventional grain drill or air seeder that is capable of handling large seed without cracking is essential.

Field pea should be seeded early, April to mid May, so flowering will occur during potentially cooler weather in June and early July. Seeding date studies conducted at Minot and Carrington indicate that field pea yields decrease significantly when seeding is delayed beyond mid May. Seeding peas beyond mid May will result in the crop beginning flowering in mid July, which increases the risk of heat stress and disease problems such as powdery mildew reducing yields.

Maintaining firm seed to soil moisture contact is critical. So seeding pea well into moisture is critical and seeding peas into dry soil should be avoided. Seeding depth of 1 to 3 inches is recommended, with a rule of thumb that pea should be seeded at least a half inch into moisture and never seeded onto the interface where soil moisture meets dry soil.

**Inoculation**

Field pea is a legume crop and has the inherent ability to obtain much of its nitrogen requirement from the atmosphere by forming a symbiotic relationship with Rhizobium bacteria in the soil.

Grain legumes vary widely in the proportion of the crop’s total nitrogen requirement that may be met through nitrogen fixation. The total amount of nitrogen fixed by the crop also depends on favorable growing conditions. Hot temperatures and dry soils during the later vegetative and early reproductive stages are especially detrimental to N-fixation. Field peas are among the most highly efficient nitrogen fixing crops and may obtain as much as 80% of their total nitrogen requirement under good growing conditions.

However, for this relationship to occur, the seed must be properly inoculated with the appropriate strain of Rhizobium bacteria. Producers must be certain that the inoculum product they obtain is specific for field pea. Use of an inoculum labeled for soybean, clover or other legume will not allow the nitrogen fixation process to occur. Inoculants are available in various forms including dry peat, liquid and granular.

Application of inoculant to the seed is an extremely important procedure. Many failures with nitrogen fixation have been associated with improper application technique. Thorough coverage of the seed is critical since seeds not exposed to the bacteria will result in plants unable to fix nitrogen. Inoculants are living organisms, so proper storage and handling is important.
Granular inoculant, a relatively new form of inoculant, has alleviated many of the concerns with inoculant applications. This inoculant is metered through the planter and delivered directly into the seed furrow.

Producers should refer to the manufacturer's package labels to review proper inoculum rate and handling procedure.

Growers should check their fields to determine if inoculation was successful. Normally, nodules will form on the roots two to four weeks after emergence. To check for nodulation, carefully dig up a number of plants and gently clear the soil from the root mass. Nodules will be present both on the primary root and on the lateral roots. Effective nodules will have a pink to red coloration on their interior. If nodulation does not occur and soil nitrogen levels are low, an application of nitrogen fertilizer over the top may be required to optimize seed yields. Nitrogen fixation will take place from about four weeks after emergence to about two weeks after flowering.

Fertilization

Under most conditions the use of inoculants will satisfy the nitrogen requirement of a field pea crop. A soil test should be conducted to determine the status of the primary nutrients.

Addition of a nitrogen fertilizer may be required when field pea is planted on land with less than 30 pounds of available nitrate N in the top 2 feet of the soil profile. Under these conditions the addition of about 30 pounds of nitrogen with commercial fertilizer is necessary to meet the needs of the developing field pea plant until nodulation becomes fully effective.

Producers should avoid high levels of nitrogen regardless of whether the source is a high testing field or high nitrogen fertilizer rates. Excess nitrogen will promote vegetative development over reproductive seed production. Higher nitrogen levels will also reduce the potential of nitrogen fixation and increase the potential for lodging.

Field pea’s response to other nutrients would be similar to that of other grain legumes like soybean or dry bean. Beyond nitrogen nutrition, phosphorus fertilization is likely the primary concern for field pea growers.

Research has indicated the importance of adequate phosphorus fertility for optimizing seed yield. The method of application and the source of phosphorus fertilizer are major factors in successfully meeting the phosphorus needs of field pea. Proper fertilizer source, rate and placement are necessary to avoid reductions in plant stand while at the same time meeting the P needs of the field pea plant.

Refer to NDSU Extension Service circular SF-725, Fertilizing Field Pea and Lentil, for additional information that relates to field pea nutrient requirements.

A rule of thumb is that a 1.25 pounds of nitrogen per acre is fixed for every bushel of peas (field pea has a standard bushel weight of 60 pounds) produced per acre. For example, a field pea crop of 40 bushels per acre will fix 50 pounds of nitrogen per acre.

Weed Control

Field pea is a poor competitor with weeds, especially during the first month after planting. Relatively slow early-season growth and lack of complete ground cover by the crop canopy allow weeds to be competitive. Field pea is most competitive with even, rapid emergence. A well established stand of seven to eight plants per square foot is critical for field pea to be competitive with weeds.

Perennial weeds and annual weeds that emerge early in the season including common lambsquarters, kochia, volunteer grain, wild mustard, and wild oat are very competitive with pea. For example, a Canadian trial indicated that two wild mustard plants per square foot reduced pea yield as much as 35%. Good weed control is also very important in raising high quality human edible pea. Weeds such as kochia, Russian thistle, and wild buckwheat can cause harvest problems with fields that are intended to be straight combined. Nightshade berries can stain the pea seed, causing a reduction in quality.

Cultural methods that should be used as part of an integrated weed management system include crop rotation, field selection, rapid crop establishment at an adequate density, and use of clean seed. Pre-emergence or early post-emergence tillage with a rotary hoe or harrow can reduce populations of shallow-emerging weeds such as common lambsquarters, foxtail, kochia, and pigweed. Post-emergence tillage with a rotary hoe or light spring-tooth harrow needs to be timed to control
DiSefJses
There are several soil-applied and post-emergence herbicides labeled for weed control in field pea. Generally, post-emergence herbicides should be applied to small weeds and pea (2- to 4-inch height) to maximize weed control and minimize crop injury. Pre-harvest desiccants also may be labeled to dry-down weeds for a more efficient harvest.

For a listing of registered herbicides and directions for use, consult NDSU Extension Service circular W-253, North Dakota Weed Control Guide, and herbicide labels.

Diseases
Controlling disease in field pea begins with crop rotation. A four-year rotation between broadleaf crops such as sunflower, flax, canola, crambe, dry bean, lentil, and field pea is recommended. Long-term crop rotational research in Canada indicates that a rotation of small grain/canola, or flax, or lentil/small grain/field pea has been successful without any major buildup of disease.

Mycosphaerella and ascochyta foot rot are the main diseases of economic importance in field pea. It is often difficult to distinguish between them in the field. They are fungus diseases that cause purple spots or lesions on the leaves, stems, flowers, pods, and seeds. Disease is most severe with continuous wet weather. Disease spreads by rain, splashing spores to uninfected tissue. Severely infected leaves will prematurely die resulting in premature ripening of the plant. Lesions on pods can develop, resulting in the seed becoming infected. Infected seed will be shrunken and discolored. Ascochyta foot rot will form blackish-purple lesions on the stem at the base of the plant. Severe infections will result in premature ripening, lodging, shriveled seed and reduced yields.

Both fungi survive on plant debris, and spores can survive for years on field pea stubble. Spores of both fungi can also be carried on the seed, and planting disease free seed is very important. Producers who buy or use their own seed should know the level of seed borne inoculum present on the seed.

Sclerotinia stem rot can infect field pea. Symptoms of the disease include a white, frothy, fungal growth found on dead or decaying tissue. The fungal growth can develop into hard black bodies (sclerotia) found inside the stem which can cause premature ripening of the plant. Typically, long vine varieties having normal leaf arrangement are more susceptible to sclerotinia for they tend to lodge after flowering, forming a dense canopy close to the soil surface and increasing the risk of infection. Generally, semi-leafless pea that has good standibility will avoid any serious sclerotinia infections.

Powdery mildew is an economic disease with late planted field pea. The disease overwinters on plant residue. Powdery mildew infection usually does not occur until mid summer. Yield loss typically doesn't occur unless the infection occurs prior to or during early pod set. Research indicates that planting field pea beyond mid May will result in plants more susceptible to powdery mildew.

Powdery mildew will cause a white "powdery" spot on the lower leaves and stems. Wet or heavy dew conditions help in spread the disease to upper leaves, flowers, and pods. Severely infected plants will not mature normally. In most instances, infected plants stay green while healthy plants mature and ripen normally. This will result in harvest moisture problems at harvest and decreased seed yield.

Insects
There are a few insects that are of economic importance in field pea. Aphids that infest peas are small, about ⅛ inch long, and light green in color. Aphids do not overwinter in North Dakota and are often blown in from southern states in early summer. Populations usually increase as the summer goes along. Aphids usually don't reach economic importance in field pea. Aphids will pierce the plant tissue and suck plant juices, causing the plant to weaken, especially under drought stress. There are no threshold populations developed for aphids in field pea. Aphid populations are usually kept low by heavy rains or by beneficial insects such as lace wings or the lady bird beetle.
The lygus bug or “tarnished plant bug” has been documented as a serious pest of many fruit and vegetable crops, but has not yet been documented in field pea. Lygus bugs feed preferentially on meristematic tissue or developing reproductive tissue.

One effect of Lygus feeding is shriveled seed. “Chalk spot” is a damage consideration in field pea. It has been documented in Idaho that the Lygus bug caused chalk spot in lentil. Chalk spot is a chalky white spot which may appear on the cotyledons of some legumes. It is considered as damage mainly because it severely affects the appearance of the seed, lowering the grade and marketability. In 1996, chalk spot was a major concern in the North Dakota pea crop. Chalk spot damage to some pea samples was as high as 27%; however, it could not be documented that it was the lygus bug that caused the damage. The other probable cause was that the pea was harvested at too high moisture. Peas harvested at high moisture are susceptible to bruising as they are harvested or handled roughly, causing damage similar to chalk spot.

Grasshoppers are usually not a major problem in pea. Pea is not typically a preferred host, but grasshoppers can cause damage to field pea, especially to pea that is in the flower to pod-filling stages.

**Harvest and Storage**

Harvest management is especially important if field pea is to be marketed as human food or as seed. Growers should have a goal of producing high-quality peas to receive a premium price for their crop in the human food or seed markets. 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 likely be the only option. The following suggestions will help growers maintain a high-quality crop during harvest and storage.

Field pea may be swathed before combining or straight (direct) combined. Peas are normally swathed to preserve quality if a there is uneven crop maturity or heavy weed pressure present. If green-cotyledon pea harvest is delayed, bleaching may occur. Bleaching is caused by rainfall at maturity, high humidity, bright sunshine, and warm temperatures. If green peas are swathed, timely harvest is essential, for green pea will be more susceptible to bleaching in the swath than if left standing.

When swathing peas, the seed needs to be at physiological maturity. At this stage of growth, the majority of pods should have turned from green to a yellow color. The crop matures from the bottom pods upward. Swathing will normally result in increased harvest losses, but swather modifications make the procedure easier and will reduce harvest loss. Vine-lifters enable producers to get under the pea vines and lift them over the cutting knife. Many growers use a pickup reel as well. Peas should be swathed in the early morning or late afternoon when the pods are tough to reduce shattering losses. Combining should not be delayed after swathing, because pea swathes are susceptible to movement by wind.

Straight combining is possible, depending on pea cultivar and harvest equipment. Many short- to medium-vine and semi-leafless pea cultivars have characteristics that allow straight harvesting compared to cultivars with indeterminate and prostrate-vine growth. For example, semi-leafless pea have a more open canopy, remain erect longer, and dry down more rapidly after a rain or heavy dew than indeterminate long-vine type.

The first choice for direct harvest of short- to medium-vine and semi-leafless pea varieties is a combine header with a floating cutter bar or flex head. Also, attachments such as lifter guards and pickup reels reduce losses and improve harvest efficiency. Direct harvesting of weak- and prostrate-vine cultivars is most efficient with an aggressive pickup attachment and a lead coulter on a standard combine.

Field peas should be combined with seed moisture of 14% to 20%. At this moisture level, the seeds are firm and no longer penetrable with a thumbnail. Harvest should occur during humid conditions to minimize seed shatter. However, pea vines must be dry or harvest will be extremely slow and difficult. Seed that is too dry will be susceptible to seedcoat breakage or peeling.
Correct combine settings and operation are important to maintain seed quality. Reel speed should be slow to minimize seed shatter. Low cylinder speeds, normally 350 to 600 rpm, should be used to minimize seed cracking or splitting. Initial concave settings of 0.6 inch clearance at the front and 0.2 inch at the rear are suggested. Adjust combine settings as crop and weather conditions change.

Combine and portable augers should be operated at full capacity and low speeds to reduce pea seed damage. Alternative seed handling equipment such as belt conveyors should be considered for handling seed intended for seed or the human food market. Minimize the number of times seed is handled. Also, don't handle peas during cold temperatures as potential for seed damage dramatically increases.

Green weed seeds or foreign material should be cleaned from the crop before storage to avoid spoilage and fewer market opportunities. Seed should be stored at 16% moisture. Seed that is marketed in the human edible market often requires moisture below 14%. Pea seed at 18% moisture can be stored for 20 weeks at 68 degrees F, but only for four weeks at 77 degrees F. An aeration system should be present in the storage facility. The recommended airflow volume for bins is about 1 to 2 cubic feet of air per bushel per minute. Warm seed should be immediately cooled after binning, even if seed moisture is low.

**Markets**

Primary field pea market opportunities are for livestock feed, seed, and human food. Markets are readily available with minimal quality restrictions for peas sold as livestock feed. Prices received for feed peas should be considered base prices. Opportunities exist to enhance the value of feed peas by using the commodity as an on-farm livestock feed source.

Premium prices are associated with the human food and seed markets. Selling peas 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 peas are produced to optimize the ability to harvest a crop that will meet market standards. For example, when marketing food-grade peas, numerous factors that affect market grade include market class (e.g. green or 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. bleach, 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-pound sample may be sent to the Federal Grain Inspection Service: USDA-GIPSA FGIS, P.O. Box 13427, Grand Forks, ND 58208-3427. Peas grading U.S. No.1 or 2 qualify for the human food market.

It is important to keep abreast of current markets by using sources such as written or electronic agricultural publications. Due to limited market opportunities for human food grade peas, make sure local, state, or regional buyers are aware of the quality and quantity of crop you have available for sale. An additional market option for human food grade peas is the PL-480 program, a U.S. government program designed to distribute surplus commodities to aid developing nations. A listing of potential buyers and market opportunities is available from the North Dakota Dry Pea and Lentil Association (4023 State Street, Bismarck, ND 58501; telephone 701-222-0128) or NDSU Extension Service offices.