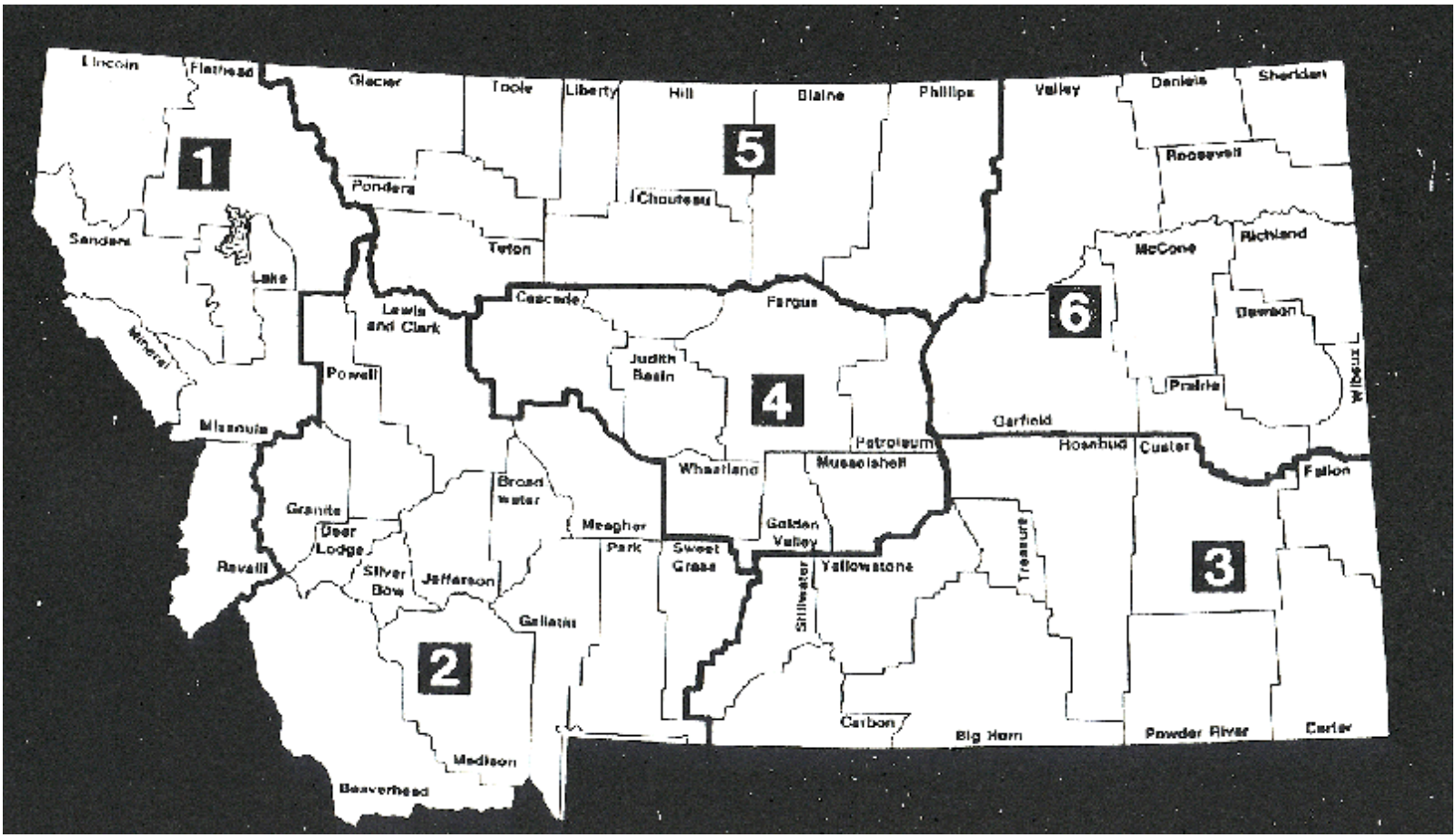
Crop Profile for Dry Peas in Montana

Prepared Feb, 2002

General Production Information

- **National Ranking:** 4th
- **Montana's contribution to total US production:** 6.7%
- **Acres Planted:** 28,000
- **Acres Harvested:** 24,000
- **Total Yield (bushels):** 233,000
- **Total Yield (cwt - 1999):** 663,000
- **Yield (bushels per acre):** 9.7
- **Yield (pounds per acre):** 1,700
- **Price Per Bushel:** 4.70
- **Value of Production:** 1,095,000

Dry Pea Production Areas in Montana:



Cultural Practices

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

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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.

Dry peas are a cool-season annual crop, classified as a grain legume or pulse. Dry peas emerge and perform well planted in a variety of seedbeds including direct seeding into grain residue. Dry peas typically are grown following winter wheat or spring barley. Cereal stubble that is fall plowed or chiseled is cultivated for weed control then harrowed and rolled. Optimal seeding rates vary with the dry pea variety and seed size, but typically range between 120-175 lbs/acre. Dry peas are drilled in rows 6-7 inches apart.

Optimal planting dates range from mid-April when soil temperatures are above 40 degrees F to mid-May. In most years, delayed planting past April lowers quality and seed yield. Dry peas are adapted to grow during the cool season when evapo-transpiration is minimal. In most of the production area, they rely on stored soil moisture for a large part of their growth cycle. Depending on the variety, dry peas start flowering after a specific number of nodes are reached, and continue until drought or nitrogen deficiency ends flowering.

Maturity is reached about 100 days after emergence. Dry pea harvest starts late July when pods are dry and seed moisture is less than 13%. Dry peas are combined directly in the field. Timely harvest is critical to avoid post maturity disease, seed bleaching and seed shatter.

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 spacing 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, North Dakota 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.

Seeding Rate:
Optimal seeding rates vary with the dry pea variety and seed size, but typically range between 120-175 lbs/acre. Dry peas are drilled in rows 6-7 inches apart. The desired plant stands in Idaho and Washington are 6-9 plants per square foot. Always select high quality, disease-free seed. When seeding pea, always adjust for germination and adjust the seeding rate using pure live seed. Drills should be calibrated to allow for seed and inoculant to flow properly without cracking the seed or plugging the opener. Lower seeding rates apply to drier areas and heavier seeding rates are more suitable for well fertilized soil under irrigation, or in more humid areas.

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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 for 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. Sulphur is sometimes beneficial as well.

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. 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.

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. Sulphur is sometimes beneficial as well.

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.

Dry Pea Description and Uses:

Field pea is a cool-season legume crop that is grown primarily in North Dakota, Washington, Idaho, Montana, Oregon and southern Canada.. 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.

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 standibility 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, North Dakota 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.

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. North Dakota and Montana are now growing dry peas.

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, as a green fallow crop, as a rotational crop with small cereal grains (wheat, barley), and as a cash crop. They provide the means to break the disease and weed cycle in winter cereals, conserve soil moisture relative to other rotational crops, improve soil fertility by fixing nitrogen and increase yields in the next crop planted. On highly erodible land, dry peas in rotation with winter cereals limit soil erosion compared to summer fallow. 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 can yield 3425 pounds per acre of biomass and 103 pounds per acre of accumulated nitrogen in aboveground biomass. Spring wheat can average 39 bushels per acre over a two-year period 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.

Varieties 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 pea fertilizer recommendations for Montana	
Phosphorous (P)	**Potassium (K)**

Soil Test Level (ppm)	Apply P_2O_5) (lb/A)	Soil Test Level (ppm)	Apply K_2O (lb/A)
>15	0-20	200	0-15
9-15	30	150	35
<9	40	100	55
		<50	75

Insect Pests

Insects that attack pea crops include these pests: cutworms, armyworms, grasshoppers, loopers, aphids, weevils, moths, maggots, and wireworms.

*** Note:**Read the product label before making any pesticide applications. Always check with your dealer or the Montana Department of Agriculture to make sure the product is registered in Montana. When using insecticides, always protect pollinating insects.

Pest	Description and Damage	Control (a.i. per acre) unless noted otherwise	Remarks
Variegated Cutworm (Peridroma saucia) **Alfalfa looper** (Autographa californica) **Cabbage looper** (Trichoplusia ni) **Western yellowstriped armyworm** (Spodoptera praefica)	Cutworms usually feed at night. They cut off young plants or feed on foliage of older plants. Cutworms are primarily a pest of alfalfa and clovers but will attack other legumes. Cutworms are usually dull gray, brown, or black, and may be striped or spotted. The often curl up when disturbed. Field peas are not often seriously damaged by cutworms	* carbaryl-1 to 2.5 lb * carbaryl bait - 1.5 lb * Asana Xl - 0.03 to 0.05 lb * bacillus thuringiensis * Spinosad (Success) - 4 - 6 oz./ acre	Do not exceed 0.2 lb ai/per season. Do not feed or graze treated vines. Javelin, Xen Tari - Apply no more than 12 ounces per acre per season
Pea Aphid (Acyrthosiphon pisum)	The common light green aphid found on legume plants. They feed by sucking plant juices. They can transmit virus diseases and can reduce yields when abundant.	* dimethoate - 0.17 lb * malathion- 1 to 1.25 lb * Di-syston - 1 to 2.5 lb * Asana Xl - 0.03 to 0.05 lb	See label for feeding restrictions Apply by drilling or broadcating at planting time or as a sidedress after emergence. Do not apply more than once per season. Do not feed vines or hay. Do not exceed 0.2 lb ai/per season. Do not feed or graze treated vines.
Pea Weevil (Bruchus pisorum)	A small grayish-brown weevil 1/5 inch long, marked with dark and light spots. Larvae feed within the seed and destroy its viability. Insecticides are applied to kill adults before they lay eggs. Once eggs are laid on the pods, it is too late to prevent weevily seeds. therefore, apply insecticide when first pods appear and before eggs are	* Imidan - 0.75 to 1 lb * methoxychlor - 1.5 lb * malathion- 1 to 1.25 lb * Asana XL - 0.03 to 0.05lb	Do not exceed 0.2 lb ai/per season. Do not feed or graze treated vines

	laid. Usually 1 weevil per 25 sweeps of an insect net will result in 10% weevily peas at harvest.		
Pea Leaf Weevil (Sitona lineata)	Adults are small, grayish-brown, faintly striped weevils about 1/6 inch long. They appear in large numbers in spring and sometimes late summer. Adult feeding amy cause considerable notching and ragging of leaves to young plants in the spring, but this damage has not been observed to cause appreciable reduction in stand or yield of peas.	* Imidan - 0.75 to 1 lb * methoxychlor - 1.5 lb * Asana XL - 0.03 to 0.05lb	Do not feed to forage or livestock within 7 days of applications. Do not cut fresh pea forage for hay within 10 days. Do not exceed 0.2 lb ai/per season. Do not feed or graze treated vines.
Wireworms (Hylema platura)		* Telone II, C17 or C-35	Pre-plant fumigant
	There are a few insects that are of economic importance in field pea. Aphids that infest peas are small, about ½ inch long, and light green in color. Aphids do not usually overwinter in Montana 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. 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.		

Weeds

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 emerging weeds on small (0.5- to 2-inch tall) field pea. Pea stand reduction probably will occur with post-emergence tillage.

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.

*** Note:** Read the product label before making any pesticide applications. Always check with your dealer or the Montana Department of Agriculture to make sure the product is registered in Montana.

PREPLANT/PREEMERGENCE:

* trifluralin + triallate (**Buckle 13G**)	**Rate:** 10 to 12.5 lb of 13G granules/A **Timing:** Apply preplant and incorporate in fall or spring **Remarks:** Incorporate thoroughly 1 to 2 inches deep right after applicaton. Use the lower trifluralin rate for coarse soils. See remarks in trifluralin section. It can be applied in the fall approximately 3 weeks before normal soil freezeup. **Caution:** Do not use foliage from treated peas for feed or forage.
* metolachlor (**Dual Magnum or Dual II Magnum**)	**Rate:** 1 to 2 pt/A **Timing:** Apply preplant incorporated or preemergence in spring. **Remarks:** Application rate depends on soil type and organic-matter content. Apply Dual brands to the soil and incorporate in the top 2 inches of soil within 14 days of planting using precipitation, irrigation or an implement capable of thorough soil and herbicide mixing (finishing disk, harrow, rolling cultivator, etc.) Use a preplant incorporated application of Dual if in-furrow irrigation is to be used or when a period of dry weather is expected after application. For preemergence applications, apply Dual during planting (on the planter) or after planting, but before weeds have emerged. Dual will not control emerged weeds. **Caution:** Do not cut for hay within 120 days after application. See label for recropping restrictions.
* triallate (**Fargo**)	**Rate:** 1 to 1.25 lb/A or 12.5 to 15 lb granules/A **Timing:** Apply preplant or postplant and incorporate. **Remarks:** Preplant incorporate with a field cultivator set 3 to 4 inches deep and follow with a second more shallow incorporation. If applied postplant, incorporate twice at different angles with equipment depth set shallow enough to avoid disturbing seed. **Caution:** Do not graze treated areas.
* metribuzin (**Lexone or Sencor 75 DF, 4F**)	**Rate:** 0.5 to 0.75 pt/A **Timing:** Preemergence: Apply after seeding but before the peas germinate. Postemergence: Apply when weeds are less than 2 inches high and before the peas are 6 inches high. **Remarks:** Labeled for use in Montana. Metribuzin will not control nightshades. Metribuzin may be incorporated to a depth of 1 to 2 inches if the soil is dry. If moisture is present or expected, a preemergence treatment is best. **Caution:** Do not use on coarse-textured soils with less than 1.5% organic matter. Do not apply on very moist soils or wet crop foliage. Do not apply on peas seed less than 2 inches deep Do not apply within 50 days of harvest of peas. Do not apply postemergence within 3 days of cool, wet, cloudy weather. Crop injury may occur if peas are under stress conditions caused by cool weather, low fertility, disease, or insect damage.

* pendimethalin (**Prowl 3.3 EC**)	**Rate:** 0.5 to 1.5 lb ai/A (1.2 to 3.6 pints/A Prowl). Use the lower rate on coarse soils, the higher rate on fine soils. **Timing:** Apply up to 60 days preplant and incorporate by following label instructions. **Remarks:** Rate depends on soil type. thouroughly mix the previous crop residues into the soil to a depth of 4 to 6 inches by plowing or disking prior to application. Incorporate thoroughly to a depth of 1 to 2 inches. Apply in a minimum of 10 gal/A water or in 20 gal/A or more liquid fertilizer. **Caution:** Do not apply preemergence. Avoid post-plant tillage that will bring untreated soil to the surface. Do not apply more than once during the cropping season. Do not apply to peas or lentil forage, silage, hay, or straw grown for feed.
* imazethapyr (**Pursuit W (2 AS) 70DG**)	**Rate:** 3 oz/A of 2 AS; 1.1 oz/A of 70DG **Timing:** Apply and incorporate shallowly into soil within 1 week before planting; or apply after planting, but before crop emergence. **Remarks:** Controls wild buckwheat, kochia, wild mustard, redroot pigweed, shepherdspurse, and Russian thistle. **Caution:** Pre-slurry DG formulation in water if applying in liquid fertilizer suspensions. Do not incorporate greater than 3 inches. Plant peas at least 1.2 inches deep to reduce risk of crop injury. Do not apply if cold and/or wet conditions are present or expected within 1 week after application. Injury potential is greatest on sandy soils. Allow at least 60 days between application and harvest. Sensitive crops such as sugarbeets, canola, and leafy vegetables may be injured by spray drift. Crop rotations following the use of Pursuit are limited. Read the label before planning a crop rotation program.
* glyphosate (**Roundup Ultra**) (**Roundup Ultra RT**)	**Rate:** 0.5 to 1 pint/A **Timing:** Prior to crop emergence. **Remarks:** Rate needed depends on weeds. **Caution:** Do not allow glyphosate to contact desirable plants. Do not harvest or feed treated vegetation for 8 weeks following application
* ethalfluralin (**Sonalan**)	**Rate:** 0.56 to 0.75 lb ai/A (1.5 to 2 pints/A Sonalan) **Timing:** Apply preplant and incorporate by following label instructions **Remarks:** Controls many annual grasses and some broadleaf weeds. Weak on groundcherry, mustards, wild sunflowers, and nightshades. Use low rates on coarse-textured soil and high rate on medium textured soil. **Caution:** Do not exceed labeled rates or crop injury may occur. Do not graze or plant forage crop in treated soil or cut for hay or silage. In Montana, plant only canola, safflower, sunflower, or irrigated spring barley or fallow the land the year following Sonalan use. Not all varieties of peas have been tested for Sonalan tolerance so check to make sure Sonalan use is safe on your varieties.
*trifluralin (**Treflan and others** formulations, 4EC, 5G, 10G))	**Rate:** 1 to 3 pints of 4 EC formulation/A **Timing:** Apply preplant and incorporate in spring or fall **Remarks:** Incorporate thoroughly 2 to 3 inches deep right after applying. Use lower rate on coarse soils. Controls some broadleaf weeds: weak on nightshade, mustard and mayweed. Use lower rates on coarse-textured soils with low organic matter. Incorporate twice, once within 24 hours. Incorporate to a depth of 1 to 2 inches. **Caution:** Do not combine with fertilizers, fungicides, or insecticides. Consult label about planting subsequent crops. Trifluralin may injure stressed crop seedlings.
*** Note:**Read the product label before making any pesticide applications. **Always check with your dealer or the Montana Department of Agriculture to make sure the product is registered in Montana.**	

POSTEMERGENCE:

* quizalofop (**Assure II 0.88 EC**)	**Rate:** 0.04 to 0.08 lb ai/A (6 to 12 fl oz/A Assure II) **Timing:** Apply to emerged weed grasses or volunteer grains within height ranges specified on the baled (between 2 and 10 inches tall, depending on species). For best results, apply when grasses are in the 3 leaf to pre-boot stage. **Remarks:** Fro control of emerged annual grass weeds, volunteer cereals and quackgrass in dry and succulent peas. Approved for ground applications. always include a nonphytotoxic petroleum based crop oil concentrate or a nonionic surfactant. Rate is dependent on weed species, size and density. Use high label rates on larger weeds and higher populations. Subsequent flushes of grasses require additional treatment. May be tank mixed with Basagran, but will require increasing the rate of Assure by 2 oz/A. Supplemental label (05/29/96) **Caution:** Reduction in grass control is possible when Assure II is applied immediately before or after a postemergence broadleaf herbicide. Wait at least 24 hours after applying Assure before applying a broadleaf herbicide. In fields already treated with broadleaf herbicide, wait 7 days before applying Assure. Do not mix with any pesticide or adjuvant not listed on the label. Do not apply with 30 days of harvesting succulent peas or 60 days of harvesting dry peas. Do not apply through any irrigation system. Do not apply more than 14 oz per acre per season.
* bentazon (**Basagran 4 SC and various brands 94S**)	**Rate:** 1.5 to 2 pints/A **Timing:** Apply after peas have 3 pairs of leaves (or 4 nodes) and after weeds emerge, but before they reach maximum size listed on the label. **Remarks:** Pea injury can be very pronounced but is usually outgrown. Weeds that are not actively growing because of moisture stress may not be controlled. It may be necessary to irrigate prior to treatment to ensure that weeds are actively growing. For Canada thistle and yellow nutsedge, use the higher rate and apply 2 times, 7 to 10 days apart. Apply to Canada thistle after it is 8 inches tall to the bud stage. May be tank-mixed with Thistrol or MCPA **Caution:** Do not apply within 30 days of harvest. Do not apply more than 4 pt/A per season. Rainfall or overhead irrigation soon after application may reduce effectiveness.
* sodim salt of MCPA or MCPA amine (**Chiptox, various brands & formulations**)	**Rate:** 0.5 to 1.5 pts/A **Timing:** Apply when peas are 4 to 6 inches tall and before first flowering and when weeds are less than 2 inches in diameter or height. **Remarks:** Peas may show slight injury after application, but they usually recorver a few days after treatment. Apply in 15 - 30 GPA with ground equipment **Caution:** Do not treat drought-stressed peas. Do not apply MCPA amine if peas are taller than 7 inches or when temperatures exceed 80ºF for the next 24 hours. Do not graze treated fields or feed treated vines to livestock.
* pronamide (**Kerb 50W**)	**Rate:** 1.5 to 3.0 lbs/A **Timing:** Apply to winter peas from mid-fall to early winter, early post emergence to the peas (2-3" tall) when temperatures do not exceed 55ºF but prior to freezeup. **Remarks:** Apply in 20 - 50 GPA **Caution:** Kerb is a **RESTRICTED USE PESTICIDE.** If small grains are planted within one year after peas, the highest rate of Kerb should not be used.
* sethoxydim (**Poast**)	**Rate:** 0.5 to 2.5 pints/A **Timing:** Apply to actively growing grasses listed on the label. **Remarks:** Rates vary according to region, weed species and weed size. Always add a nonphytotoxic oil concentrate at 2 pt/A or a methylated seed oil at 1.5 pt/A. Grasses beyond recommended growth stage may be controlled but may require 2 applications. Maximum cumulative rate per season is 4 pts/A. **Caution:** Control may be erratic if grasses are stressed due to drought, temperature extremes, insect damage, or herbicide injury. Do not apply if rainfall is expected within 1 hour. Do not cultivate within 5 days before or 7 days after application. Allow at least 30 days after application before harvest. Do not mix or apply with any other pesticide, additive, or fertilizer except as directed on the label.

* MCPB (**Thistrol**) (**Various brands & formulations, 2EC, 4EC**)	**Rate:** 1 - 3 qts/A **Timing:** Apply when peas have 6 to 12 nodes, but before flower buds form and after Canada thistle stems elongate, but before stems are 8 inches tall. Apply after annual weeds emerge but before they are more than 3 inches tall. **Remarks:** use higher rate during periods of cool weather. Use at least 20 GPA by ground sprayer. **Caution:** Do not spray when temperatures are expected to exceed 90ºF for the next 24 hours or when peas are drought stressed. Do not feed treated vines or peas to livestock. Do not permit MCPB to drift off target

*** Note:**Read the product label before making any pesticide applications. Always check with your dealer or the Montana Department of Agriculture to make sure the product is registered in Montana.

WEEDS LISTED ON FIELD PEA HERBICIDE LABELS

1 - Buckle 4 - Lexone 7 - Sencor 10 - Assure II 13 - Kerb
2 - Dual 5 - Prowl 8 - Sonalan 11 - Basagran 14 - Poast
3 - FarGo 6 - Pursuit W 9 - Treflan 12 - Chiptox 15- Thistrol

Weeds	**Preplant/Preemergence**									**Postemergence**					
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
barley, volunteer										X			X	X	
barnyardgrass		X			X	X	X		X	X				X	
Canada thistle											X	X			X
chickweed, common					X		X	X	X			X			
chickweed, mouseear												X			
cocklebur, common				X		X					X	X			
corn, volunteer													X		
crabgrass		X			X	X	X		X				X		
downy brome									X			X			
green foxtail	X	X			X	X	X		X	X			X		
gromwell, corn								X							
henbit							X	X	X				X		
jimsonweed				X		X					X				
knotweed, common								X	X						
	1 Buckle	2 Dual	3 FarGo	4 Lexone	5 Prowl	6 Pursuit	7 Sencor	8 Sonalan	9 Treflan	10 Assure	11 Basagran	12 Chiptox	13 Kerb	14 Poast	15 Thist
kochia					X	X	X		X						
lambsquarter				X	X	X	X	X	X		X	X			X
marshelder						X					X				
mustard, tall				X				X							
nightshade, black		X				X	X								
nightshade, hairy		X				X	X				X				
oat, wild	X		X				X		X	X			X	X	
oat, volunteer													X	X	

pennycress, field				X				X							
pigweed, prostrate				X	X		X	X	X						
pigweed, redroot		X		X	X	X	X	X	X						X
prickly lettuce								X							
prickly sida				X				X			X				
purslane, common		X		X	X	X	X		X		X	X			
quackgrass										X				X	
ragweed, common				X		X					X	X			
ragweed, giant						X					X	X			
	1 Buckle	2 Dual	3 FarGo	4 Lexone	5 Prowl	6 Pursuit	7 Sencor	8 Sonalan	9 Treflan	10 Assure	11 Basagran	12 Chiptox	13 Kerb	14 Poast	15 Thist
redstem filaree								X							
Russian thistle				X			X		X						
shepherdspurse								X			X				
smartweed				X	X	X					X				X
sowthistle															X
spurge, prostrate					X	X									
velvetleaf				X	X	X					X				
wheat, volunteer										X			X	X	
wild buckwheat							X				X				
wild mustard				X		X		X			X	X			
wild proso millet		X				X								X	
wild radish															
wild sunflower						X					X				
witchgrass					X									X	
yellow foxtail	X	X			X	X	X		X	X				X	
yellow rocket											X				

Diseases

Field pea acreage has increased dramatically during the l990s. Field peas, including Austrian winter pea, green and yellow peas and speckled types are grown both for forage and seed production as well as green manure. Their use is also beneficial for pest management in a rotation and for nitrogen fixation. Potential disease problems include:

Ascochyta diseases

Three different Ascochyta fungi cause diseases in field peas. Ascochyta blight, caused by A. pisi, results in slightly depressed, tan lesions with distinctly darkened borders. On leaves and pods the lesions are circular whereas they elongate on the stem. Stem lesions are generally speckled with numerous small black bodies (pycnidia) which produce secondary spores capable of infecting additional tissue. This disease has become a major threat to pea production in cool, humid regions of the Canadian prairies resulting in yield losses nearing l00 percent. Our drier production regions are less likely to experience severe infections.

A. pinodella and Mycosphaerella pinode, different states of the same fungus, cause a disease complex known as "foot rot

and Mycosphaerella blight." Producers commonly refer to this as the "Ascochyta" disease. Where peas are grown year after year the disease complex becomes endemic, although varying in severity. In higher moisture regions of Manitoba, the foot rot stage has essentially eliminated pea production.

Foot rot symptoms begin with bluish-black discoloration starting at the seed and moving up to slightly above the soil line. Severe foot rot infections result in reduced harvestablity due to lodging. Blight symptoms appear as small purple lesions without definite margins. They can enlarge with age, eventually forming larger brown to black lesions with a target like appearance. Affected leaves dry prematurely but remain attached to the primary stem. Floral infections may occur resulting in blossom drop. Pod infections result in small purple lesions that can lead to seed infection with varying degrees of shrinkage and discoloration.

Fungi responsible for these diseases may be carried in seed. They also survive from year to year in infested crop debris. Resting stages of these fungi are known to survive in soil. Where the disease has grown to limit yield and quality, producers have used 4 to 5 year rotations to manage the disease. Seed produced in low rainfall areas reduces the risk of seed-borne infections. To assure low Ascochyta levels in seed, a laboratory analysis is recommended. These are routinely done in Canada.

Mertect LSP (thiabendazole - Novartis) and Gustafson LSP currently have a section 24 Special Local Needs label in Montana for Ascochyta.

Pea anthracnose

Pea anthracnose, caused by C. pisi, can occur on all above-ground plant parts. Foliar lesions are gray with tan centers. Pod lesions are circular, slightly depressed with a reddish brown center and margin. The disease is most common in warm, humid pea-growing regions.

The fungus is transmitted by seed but seed produced in the semiarid western regions is nearly free of anthracnose. Pea anthracnose should present little threat to Montana pea growers, especially if good rotations are practiced.

Sclerotina stem rot

Sclerotinia sclerotiorum, the causal agent, is capable of attacking a wide host range including most members of the legume family. Canola, sunflower and potato are other Montana crops susceptible to this pathogen. This disease causes only minor losses to peas grown in the semiarid west. The largest concern with this disease on peas in Canada is that it can provide infection sources for subsequent canola crops.

When observed, the infections generally occur in small patches. Stems become soft, particularly near nodes, and are soon covered with white cottony fungal growth. Premature death will occur, leading to brown patches of peas intermingled with healthy plants. Control is seldom warranted and when peas are grown in rotation with cereals, the disease is rarely observed.

Root rots and seedling blights

Root rot and seedling blights can occur wherever peas are grown. Root rot fungi, including Fusarium, Rhizoctonia and Pythium species often cause root deterioration when less than ideal emergence conditions exist. These soil-borne fungi do increase when peas or related crops, including alfalfa, are frequently produced on the same land.

Several seed treatments, including PCNB, Thiram, and Captan are registered as general protectants. PCNB has historically provided good protection against Rhizoctonia. Thiram and Captan protection include Fusarium and some Pythium suppression.

Seedling blights caused by Pythium sp. can reduce stands. Canadian researchers have observed that seed which was damaged or immature at harvest is particularly susceptible to this seedling blight. In general, round seeded field peas are less prone to infection than wrinkled processing peas. Where Pythium is the predominant problem, products containing metalaxyl give the best level of control.

Mildews

Both powdery mildew, Ersiphe polygoni, and downy mildew, Peronospora viciae are widespread but generally considered to be minor diseases in Montana. In Canada, however, powdery mildew has become common and severe. Several of the new CDC-Saskatoon varieties have good resistance to mildew which has led to their widespread adoption in the prairie provinces.

Powdery mildew begins as small specks on leaves that enlarge and merge until the entire leaf becomes coated with a white, powdery growth in which small, dark fungal fruiting bodies are commonly observed. Rotation, residue destruction and early seeding minimize powdery mildew infections. Resistant lines are available should the disease become serious in Montana.

Downy mildew can be serious in cool, cloudy pea production areas or where the crop is irrigated. Infections are characterized by a fluffy bluish grey growth on the underside of infected leaves with the upper leaf surface exhibiting yellow blotches corresponding to the underside infection. Stems and pods may also be infected but these infections are rare in Montana.

Crop rotation reduces the risk of serious downy mildew infections. Seed produced in low rainfall areas also reduces the risk of introduction. If downy mildew becomes a problem, growers can select resistant varieties.

Fusarium wilt

This disease, caused by Fusarium oxysporum, was responsible for the decline of the pea industry in many regions of the U. S. including Montana's Gallatin valley during the middle 1900s. Since that time, several races of the pathogen have been identified. Fortunately good levels of resistance to Fusarium wilt are available in most commercially available varieties. Resistance to Race l has essentially eliminated this wilt disease as a constraint to production. Rotation also reduces the risk of Fusarium wilt.

Harvest and Storage

Field peas require a growing season of 85 to 110 days, depending on variety, seeding date, precipitation, and heat units. Harvest should be based on crop maturity and seed moisture. The older, bottom pods mature first, and the crop is at physiological maturity when all pods are yellow to tan. Producers should monitor several representative areas of the field and check maturity of the bottom, middle, and top pods. During hot, dry weather, peas mature very rapidly. Under ideal conditions, harvest of determinate varieties should occur when the bottom peas rattle in the tan to brown pods, the middle and top pods are yellow to tan and the seeds are firm and shrunken. In indeterminate varieties such as Austrian winter peas or under moist conditions, the top pods will be less mature and fully expanded. However, harvest should occur before significant shattering of lower pods. In Montana, peas are harvested by direct combining, or swathing and combining. In surrounding states and provinces, chemical desiccants are used to uniformly kill pea vines before harvest. In hotter years, most determinate field peas can be direct combined in Montana; however, with indeterminate varieties, or under cool, moist conditions, swathing is advisable. Swathing is done when most of the pods and vines have turned yellow to tan in color. Up to one-third of the vines or pods may still be light green, but these will mature with limited seed shrinking in the swath. At this stage, most seeds will be difficult to dent with the thumbnail. When most of the field is ready for swathing, producers should swath the entire field, even though plants in scattered low areas re-main green. The yield and quality of the majority of the pea crop should not be jeopardized by delaying harvest for the low areas of the field to mature. Lodging will occur in most pea crops before harvest, and swathing or combining operations should occur at a 90-degree angle to the direction the crop is lodged. Swathing should occur with a dew to prevent shattering. Short pea crops that have most of their pods near the ground are best swathed when partially green in order for the pickup reel to lift the crop with minimal shattering. If these crops mature while standing, there may be insufficient vine material to lift the crop above the ground without severe shatter loss. Heavy, long vined crops are best handled by taking a narrow cut where wind is prevalent. The swath should be rolled to prevent wind damage to dry, fluffy wind-rows. If the crop was mostly mature, and weather conditions are favorable for immediate combining, the ideal swath will be wide and uniform to promote fast drying. Field peas can be combined when seed moisture is less than 20 percent. Combining at too low a moisture content will cause high cracking and splitting losses which will result in downgrading for seed or food markets. Combining at too high a moisture content will in-crease combine power requirement and result in plugging and wrapping problems, plus the crop will require immediate aeration or drying. Very low cylinder speeds (350 to 600 rpm) should be used to reduce splitting Concave settings should be about 0.6 inch, and if the crop is very dry the concaves

can be removed or lowered to reduce splitting. Ideal threshing and separation occurs when the crop is at about 16 percent seed moisture and with uniform pickup speed and proper cylinder speed. 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. For safe storage, pea moisture content should be 15 percent or less. New specialized machinery for swathing and combining field peas is rapidly becoming available in large production areas such as Western Canada and the Pacific Northwest. Inexpensive, spring-loaded vine lifters can be easily attached to cutter bars of swathers or combines to improve harvesting lodged pea vines. Pickup reels with modified fingers or vine lifters can also be adapted for both swathers and combines. Montana producers are encouraged to examine new equipment and products available in other regions that have greatly improved harvest efficiency of field peas.

Yield:
Field pea yields in Montana research trials have ranged from 900 to 3500 pounds per acre. Across diverse dryland locations, pea yields were about 2000 pounds per acre. Several growers in the Madison and Shields Valleys have produced over 3000 pounds per acre under irrigation or high rainfall. Since 1987, market prices for field peas in the Pacific Northwest have ranged from $5.50 to over $11.00 per hundred weight (FOB warehouse), indicating potential gross returns of $82.50 to $165.00 for dryland peas that produced 1500 pounds per acre.

Straw Management:
Pea straw can be well-chopped when harvested during hot and dry conditions. If not well-chopped, pea straw can cause branching when seeding the following crop.

Storage and Handling:
Peas can safely be stored at 16 per cent. When combined tough, peas should be aerated to 16 per cent seed moisture content. Peas used for seed or human consumption should be moved with a belt conveyor to avoid seed-coat injury or seed cracking.

Grading:
Major factors in downgrading peas are pale colour in greens, soil particles, splits, cracked seed coats and shriveled, immature seed.

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.

On-line Resources

- North Dakota State University Field Pea Production - http://www.ext.nodak.edu/extpubs/plantsci/rowcrops/a1166w.htm
- Montana Agricultural Statistics Service - http://www.nass.usda.gov/mt/
- Dry Pea Production in Washington - Crop Profile - http://pestdata.ncsu.edu/cropprofiles/docs/wapeas-dry.html
- Dry Pea Production in Oregon - Crop Profile - http://pestdata.ncsu.edu/cropprofiles/docs/Orpeas.html
- Dry Pea Production In Idaho - Crop Profile - http://pestdata.ncsu.edu/cropprofiles/docs/IDpeas-dry.html
- Growing Peas in Montana, Montguide #9520 - http://www.montana.edu/wwwpb/pubs/mt9520.pdf
- North Dakota Dry Pea and Lentil Information - http://www.ndpealentil.org/general.html
- Manitoba Field Pea Production and Management - http://www.gov.mb.ca/agriculture/crops/pulsecrops/bhe01s01.html
- Minimizing Risk and Increasing Yield Stability in Field Pea Production - http://ssca.usask.ca/98-Proceed/CLAYTON.html
- Pulse Crop Diseases, Montguide #9907 -http://www.montana.edu/wwwpb/pubs/mt9907.html
- USA Dry Pea and Lentil Coucil - http://www.pea-lentil.com/about.html

References

1. Crop Profile for Commodity in State. http://pestdata.ncsu.edu/cropprofiles/instructions.html (accessed Sept 2000).
2. Herbicide Carry-Over Impacts Crop Rotation Options, Montana State University Communications Services. http://www.montana.edu/ wwwpb/ag/caryover.html (accessed May 2001).
3. Pacific Northwest Insect Control Handbook; Extension Services of Oregon State University, Washington State University, and the University of Idaho: Corvallis, OR, 2000.
4. Pacific Northwest Weed Control Handbook; Extension Services of Oregon State University, Washington State University, and the University of Idaho: Corvallis, OR, 2000.
5. Peas Herbicides, Peas (Green or English) http://osu.orst.edu/dept/hort/weeds/peas.htm (accessed Sept 2000).
6. Pacific Northwest Plant Disease Control Handbook; Extension Services of Oregon State University, Washington State University, and the University of Idaho: Corvallis, OR, 2000.