



3

CHAPTER

USA Dry Pea, Lentil & Chickpea Production



USA DRY PEA &
LENTIL COUNCIL



Cool season food legumes, including dry peas, lentils, and chickpeas, are an important feature of the dry farm lands of the western U.S. The two principal growing regions include the Northern Plains, comprised of Montana, North Dakota, and South Dakota, and the Palouse, which includes eastern Washington, northern Idaho, and northeastern Oregon.

Lentil production began in the Palouse in 1916, dry pea production in the 1920s, and chickpea production in 1981. The region offered excellent growing conditions and a growing season with annual rainfall of 15 inches to 24 inches (400 mm to 600 mm), most of which fell in the fall and winter months.

More recently, the Northern Plains region has become an increasingly important production area. Since the 1990s, the lion's share of U.S. food legume production has moved from the rolling hills and loess soils east of the Palouse into the Northern Plains region, where pulses fit well with the established crop rotation.

By 2009, North Dakota had become the largest producer of pulse crops in the U.S.

Montana occupies the second position, cultivating the greatest number of yellow peas in the U.S., in addition to significant acreage devoted to lentils. Pacific Northwest farms in Washington and Idaho remain the largest producers of green peas and chickpeas. For U.S. production numbers for 2008, see tables on pages 45-54.

In those areas that receive sufficient rainfall to support annual cropping, food legumes continue to replace summer fallow. The region boasts considerable potential and its role as an important producer of dry peas and lentils is expected to continue. Meanwhile, the range of U.S. food legume varieties has changed over time and is likely to continue to evolve as breeding programs develop improved types.

The field history is an important consideration in pulse production. To allow for proper site preparation, the decision to grow pulses in a given field is usually made a year or two in advance. Approached this way, the "pre-plant" period for any field includes each of the production seasons that followed the previous pulse crop and the late fall, winter, and early spring that preceded planting of the pulse crop.

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The previous crop is especially important if the pulse crops are directly seeded into stubble. Sowing pulses into clean fields is preferred, but pulses are frequently seeded on stubble. In such situations, weed com-



petition is often an issue and can be complicated further by volunteer plant growth.

Seed selection includes considerations like crop quality potential, adaptability to the *planting conditions* (i.e., disease and environment), and improvement in the overall rotation—both economic and environmental.

Some varieties are well adapted to particular regions due to maturity rate, disease resistance, blooming date, and tolerance to temperature variations. Other considerations are based on quality such as color consistency, resistance to bleach and pod shatter, harvestability, and handling concerns like cracking during shipment. Pulses are best grown following a cereal crop like winter wheat or spring barley as cereals are less likely to carry pulse diseases.

Another benefit of planting pulse crops in rotation with cereals is that cereal crop yields often increase due to cereal pest (disease, insect, and weed) cycles being disrupted. In addition, food legumes conserve soil moisture and limit soil erosion by offering an option other than summer fallow. Pulses also increase the nitrogen

content of the soil. This is a significant consideration, providing value to the producer in addition to the crop.

When it comes to seeding, maintaining firm seed-to-soil contact is critical, making moist soil, and the avoidance of dry soil, a critical step. Most pulse seeds can emerge from deep seeding depths due to their large size. Deep seeding is not a necessity provided that the seed is placed in firm, moist soil.

After planting, pulse crop beds are rolled to smooth the soil surface. This improves the harvest rate by reducing losses and breakage of low-hanging pods at harvest. Rolling also buries rocks, making harvest easier and safer. Harvest typically takes place in August. The crop must dry out on the vine to a certain degree first, which usually occurs without the aid of chemicals.

Chemicals that aid drying are, however, important during cool, wet summers when natural drying is not possible. Waiting for natural drying to occur can lead to pod shattering, sprouting, seed coat slough, and seed bleaching. When weeds are not a problem, dry peas and lentils are mechanically swathed or direct harvested.

India is the world's major producer of food grain legumes (about 13 million tons in 2003/2004): chickpeas (5.3 million tons), lentils (0.8 million tons), dry beans (about 3 million tons), and other pulses. Canada, Australia, and Turkey are the main world suppliers of chickpeas and lentils. Approximately 75 percent of U.S. cool season food legumes are exported.

Most U.S. legumes are used for food either as whole pulses, as with decorticated Crimson and Red Chief lentils, or as deco-

rticated and split peas, as seen with green and yellow dry peas. New and novel uses, including incorporation into starches and snack items, continue to grow as interest in these healthy, versatile foods increases.

Given such developments, the future for food legumes in the U.S. looks bright. There is considerable room for expansion of production in the Dakotas, Montana, and the western states of Washington, Idaho, and Oregon. The trend to replace summer fallow in these states is opening additional acreage for legume production to meet increasing demand.

Finally, as of this writing none of the pulses available worldwide are genetically modified, and there are no plans to begin production of such pulses.

Environmental Benefits of Legumes

While cool season legumes directly contribute to the economy of the Palouse, the Northern Plains, and other U.S. production areas, they also contribute indirectly through their positive effects on other crops. Dry peas, lentils, and chickpeas are typically grown in *rotation* (i.e., alternating years) with cereal grains. In contrast to dry beans, the cooler weather preferred by legumes during the growing season, especially at bloom, fits well with the climates conducive to small grains like wheat or barley.

The crop rotation strategy boasts a number of advantages. The pairing with grains reduces the potential for diseases and helps to control weeds, insects, and other pests in both crops. The grains also benefit from the increased nitrogen and other nutrient

values in the soil after rotation with lentils, dry peas, or chickpeas.

Legumes produce their own nitrogen from the atmosphere through a symbiotic relationship with a soil bacterium. As a result, commercial nitrogen applications are unnecessary or significantly reduced for the legume crops. The same is true with regard to the need for commercial nitrogen or other fertilizers in the grain crops, which can utilize the remaining nitrogen in the soil to reduce the input cost for the producer. Reduced nitrogen applications also reduce the use of the natural gas necessary to produce the nitrogen, thereby helping reduce greenhouse gas production. For both the producer and the environment, using nitrogen produced by the plant is a much better approach and promises a smaller ecological impact.

The Harvesting of Legumes

The harvesting of a cool season legume crop consists of a single pass with a combine, a mechanical harvesting device that integrates many operations. It cuts the plant from the ground, separates the seeds from the rest of the foliage, distributes the



residue across the field, and transfers the resulting product to a storage bin via a truck. In the U.S., the harvest generally begins in August and is conducted through September.

Harvesting of lentils, dry peas, and chickpeas is carefully timed. Using the combine on the crop prematurely can result in an immature, underdeveloped crop. Harvest the crops too late and the excessive dryness can cause crop loss due to the shatter of the pods prior to or during harvest.

Moisture Content of Harvested Material

Ideal harvest timing includes waiting for moisture content to be acceptable for storage. Harvesting too early can result in a product with too much moisture content for storage, making it prone to spoilage.

The crop is usually cut when the product is not yet ready to shatter but dry enough to store without damage. No product is stored at more than 15 percent moisture, with 12 percent or less being the optimum moisture level for a harvested crop.

Differences in Harvest Times

Although dry pea, lentil, and chickpea crops are relatively drought-tolerant, both the timing and amount of precipitation affect growing duration and the scheduling of harvest times. In the Palouse, for example, late-season rains after July 15 will delay harvest, while early-season drought prior to July 1 will significantly accelerate harvest dates. Planting is typically done in April and May, with an August harvest.



In Idaho and Washington, dry pea crop maturity is reached about 100 days after emergence, with harvest starting in late July when pods are dry and seed moisture is less than 13 percent. The peas are harvested directly in the field. In the Northern Plains, the planting date and harvest dates are typically two to three weeks later because of colder winter soil temperatures. Harvest is typically starts in August and completes in early September.

Lentil crops also reach maturity about 100 days after emergence, with harvest in mid-August, when the crop is swathed and then combined. In Washington, lentils bloom approximately 60 days after crop emergence and all varieties are harvested in August, being cut and swathed into windrows approximately one week before combining.

Swathing of lentils in the Northern Plains in Montana and North Dakota is risky due to frequent wind storms, which would blow away the windrows. Lentils are cut directly by the combine in this region. In all cases, a timely harvest is critical to avoid seed bleaching, seed shatter and post-maturity disease. All of these issues degrade the quality of the crop and reduce the yield.

Storing Legumes

Once the pulse has been threshed, the seeds must be carefully stored prior to delivery to the processing plant. Excessive heat can lead to discoloration. Excessive moisture can result in mold and fungal problems. Clean, protected facilities and aeration during periodic transfers from one storage bin to another help guard against post-harvest pest infestation or damage.

When properly selected, legumes can be safely kept in storage for long periods of time without deterioration, allowing end-users to buy in bulk. With dry peas, the pea weevil can emerge during post-harvest storage, leaving damaged seeds that must be separated in processing. The pea weevil is most effectively controlled in the field during the growing season, helping prevent higher processing costs. Generally, all peas are held long enough to allow for the emergence of the pea weevil larvae prior to processing.

Seed moisture must be carefully watched when storing pulses to prevent disease or damage. Peas can safely be stored at 15 percent moisture, chickpeas and lentils at 14 percent. If moisture levels are too



high, grain dryers are often used, though always with extreme caution as they can cause mechanical and thermal damage to pulse crops. Moisture is tested several times during the first few weeks of storage to maintain proper levels and to prevent seed sweating. Aeration is used to cool and dry the seed and to avoid storage complications.

A significant amount of the chickpea crop remains at least for a short time stored on the farm before being delivered to the processor. Once chickpea seed is harvested, its outside seed coat usually has a lower moisture level than the inside of the seed. But if left to sit in the storage bin, the moisture level can balance out (also called *tempering* or *sweating*), causing the overall moisture level to rise.

In this way, chickpeas that were harvested at a safe moisture level can just a week later exceed the recommended 14 percent level. Left untreated, the crop can spoil. For this reason, chickpea producers often store the crop in a hopper-bottomed bin that has aeration, which can help bring down the moisture level.

Lentils are also commonly stored on the farm for a time before delivery to the processor. As with chickpeas, it is most common for lentils to be stored in a hopper-bottomed bin with aeration. If the crop includes a great deal of green weed seeds, the lentils, though safely stored at 14 percent moisture, are typically cleaned or aerated as soon as possible after harvest to prevent heat damage. Lentil varieties with green seed coats will discolor with age, decreasing the grade and price of the crop.

If they are not kept in cool, dark conditions at a moisture content at or below 14 per-

cent, those lentils with green seed coats can discolor as tannins within the seed coat oxidize. Other factors such as high humidity and high temperatures can also cause color change. In each case, such changes in color impact the grade and price received for the crop.

“Dry peas, lentils, and chickpeas can be safely stored for three to four years.”

Moisture levels up to 16 percent and temperatures below 59 degrees F (15 degrees C) are considered safe for dry pea storage. If supplemental heat drying is necessary, air temperatures are kept below 109 degrees F (43 degrees C) to preserve germination. Temperatures up to 158 degrees F (70 degrees C) should only be used for drying feed peas. A great deal of respiration occurs in pea seed after it is placed in storage.

Dry peas, lentils, and chickpeas can be safely stored for three to four years. Storage lengths of this duration can, however, result in color loss, moisture absorption, and desorption as well as hardness or case hardness issues.

Post-Harvest Handling

Deterioration Factors and Their Control

As noted above, moisture control via temperature control and proper aeration can

minimize crop loss due to deterioration. Exposure to sunlight can also cause a degradation in color. Good storage facilities maintain the product by protecting it from direct sunlight.

Care needs to be taken when handling chickpea seed in order not to damage the beak or crack the seed coat, which impact the quality. This is especially important under conditions of extreme cold. The cold can damage the seed coat by causing it to become quite fragile and crack easily when handled. Many pulse producers forego use of the typical grain auger and elect to use a conveyor to transport the chickpea to the bin to minimize the risk of damaging the seed.

Similar sensitivity is shown when handling lentil seed to avoid cracking the seed coat. In fact, handling is minimized where possible and the use of conveyors favored. Extremely dry seed can be tempered in the spring before seeding to decrease the risk of mechanical damage. The lentil seed coat, like pea seed, is prone to greater fragility under extreme cold and can crack easily when handled.

Methods of Reducing Deterioration

Handling and storage procedures described above reduce deterioration due to seed coat damage or heat. Pesticide and fungicide use is minimized when pre-harvest and post-harvest controls are carefully monitored. In addition to reducing the cost of storage, limited chemical use maintains the crop well below maximum residue limits (MRLs).



Quality Control Procedures

Quality control begins with the seed source. Producers generally work with the processor to select the best varieties from reliable seed producers to ensure the harvested product is the best quality and offers good, marketable traits.

Product Grading Standards

The inspection of legumes is a service provided under the Agricultural Marketing Act of 1946. It is offered upon request by either a Federal Grain Inspection Service (FGIS) designated cooperator (e.g., the State of Washington) or an FGIS field office, depending upon the location of the lot and the type of inspection requested. Official inspections are performed by trained and licensed (or authorized) official personnel employed by FGIS or a cooperator.

The U.S. Grade Standards provide the produce industry with the uniform language for describing the quality and condition of commodities in the marketplace. In partnership with industry members, the Agriculture Marketing Service (AMS) of the United States Department of Agriculture (USDA) develops and revises these stan-

dards so that they always reflect modern business practices.

The USDA post-harvest inspection standards assess insect infestation, color, odor, moisture content, standardization in size and color, and many other factors. FGIS provides a system by which grain can be tested and graded anywhere in the U.S. under consistent and uniform procedures. Inspections involve securing a representative sample from each lot and classifying each of the individual peas or lentils in accordance with the established grades. The inspector's report shows the percentage of peas or lentils in each of the various grades. Application of the standards requires the services of private or official inspectors.

“For green peas, the most important grading factor for the human market is seed color.”

Crops are tested for pesticide and fungicide residue and are not allowed to exceed set limits for these factors. Strict sampling standards ensure proper grading of the product. Dry peas, lentils, and chickpeas are sampled first for insect infestation and are not sampled for other factors if sufficient evidence of infestation is found. Special care is typically taken to protect samples from manipulation, substitution, and improper handling.

There are many ways in which a sample may lose its representativeness. A sample will no longer be considered representative if it is:

1. Spilled, no matter how little is lost or how much could be recovered.
2. Stored in an improper manner or in an area not under the control of official personnel.
3. Not analyzed on the same day as it is obtained and stored in a cool, dry place to prevent any change in condition.
4. Transported by means that do not ensure the integrity of the sample.

When marketing food-grade dry peas, numerous factors affect market grade, including 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.).

For green peas, the most important grading factor for the human market is seed color. Green varieties are susceptible to bleaching as they near maturity, often caused by high humidity, bright sunshine, and warm temperatures. Other major factors in down-



grading pea quality include soil particles, splits, cracked seed coats and shriveled, immature seed.

Unlike other legumes, *decorticated lentils* (i.e., lentils from which the hulls have been removed) are treated as a processed product and are considered a non-standardized commodity. They may be inspected for quality factors (e.g., damaged kernels, skinned lentils, etc.) but not graded.

For inspected legumes, a certificate is issued for the individual lot or submitted sample whether for kind, class, grade, factor analysis, equal-to-type, or other quality designations as defined in the standards or instructions, or for any other approved services performed. Other services that may be shown on the certificate include check weighing, check loading, check counting, condition of food containers, plant approval, and observation of loading.

Organic/Natural Dry Peas, Lentils, Chickpeas, and Other Special Varieties

In response to its continued growth, the USDA began tracking overall organic food production in 2009. U.S. organic food sales amount to approximately 4.5 percent of total food sales, though the portion that is made up of organic pulses remains uncertain. As organic pulses have only recently begun to attract attention, there remains a dearth of market statistics. A significant portion are grown as a green manure, cover, or forage crop, and less for human consumption.

At the retail level, overall organic sales have grown 15 percent to 20 percent each year for the past couple of decades, led



most recently by dairy and meat. The dramatic growth in dairy is an indicator that many more organic feed peas are grown now than were grown 10 years ago. Peas are, in fact, likely the largest organic pulse crop as they are relied on by larger organic farmers as an important feature of their crop rotation plan to increase the quality of the subsequent wheat crop.

Though a definite figure has not yet been established by the USDA, it is estimated that the number of acres devoted to the production of organic pulse crops is in the thousands—about 1.5 percent of total agricultural acreage. In 2001, according to the USDA, certified organic dry peas and lentils were grown on more than 9,300 acres. North Dakota led with over 3,500 acres. Organic dry peas and lentils accounted for approximately two percent of the total dry pea and lentil acreage in the U.S. The European Union total is about equal to the U.S. market for organic sales, though its percentage of organic food sales to total sales is larger.

Much of the overall organic food consumed in the U.S. is imported from producers outside the U.S. Currently, a significant quantity of those organic legumes are imported from Canada, Turkey, India, China, and South

America. Foreign organic legume production has always been larger than domestic U.S. production, with Canada, Australia, Turkey and India being key producers.

The challenges of organic pulse farming include the following:

- Organic farmers cannot use synthetic herbicides or pesticides, so weed pressure is always an issue. Chickpeas are a particular challenge since toxic or synthetic seed treatments are prohibited, highlighting the risk of ascochyta blight.
- Organic farmers are required to use organic seed when available. Seeding rates also tend to be higher than for cereal grains, meaning that seed costs per acre are significantly higher for organic legumes than for organic wheat.
- The organic pulse market remains niche in size. As a result, there are a limited number of buyers in a given region and often no local markets for feed-grade product.
- Organic edible legume markets tend to be very quality sensitive, making it difficult to sell anything less than a top-grade lentil in most years.
- Competition is aggressive in both domestic and foreign markets.
- There is little university research on organic legume production and organic variety development.

All indications are that organic markets at the retail sales level will continue to grow at 10 percent to 20 percent per annum for the foreseeable future. Expectations are that demand for organic food will continue to outpace growth in all other food categories. This, combined with the increasing awareness of the connection between diet and health, suggests that the demand

for organic legumes will also increase and that organic legume production will grow as an important, albeit small, part of overall production.

“Pea crops are monitored closely to determine the proper stage for harvest.”

A Comparison of the Production of Pulse Varieties

Dry Peas

Soil and Seeding

Dry peas can be grown in a wide range of soil types, from light sandy to heavy clay. Despite having moisture requirements similar to those of cereal grains, dry peas have a lower tolerance to saline and water-logged soil conditions than do cereal grains. Because they can die after 24 to 48 hours in a water-logged condition, dry peas are not planted in poorly drained or saline or alkaline soils.

At the same time, maintaining firm seed-to-soil moisture contact is critical as dry peas rely on stored soil moisture for a large part of their growth cycle. A seeding depth of one to three inches is customary.

Seedbed preparation is also essential for dry peas. Traditionally, a finely worked, firm seedbed is prepared for use with pre-plant herbicides. After seeding, a packer is used to smooth and firm the soil surface for good seed-to-soil contact. A plant stand of 15 to 20 plants per square foot after emergence is desired for optimum yield.

Dry peas are self-pollinating and emerge and perform well in a variety of seedbeds, including direct seeding into grain residue. They are typically grown following cereal crops like winter wheat or spring barley. Most are spring-seeded, with optimal planting dates ranging from mid-March to mid-May when soil temperatures are above 40 degrees F (4 degrees C).

Emergence normally takes 10 to 14 days. Pea roots can grow to a depth of three to four feet, though more than 75 percent of the root biomass resides within two feet of the soil surface. The older, bottom pods mature first, and the crop is at maturity when all pods are yellow to tan in color. During hot, dry weather, peas mature very rapidly. Because high temperatures during blossoming results in reduced seed set, production of dry pea as a summer annual in the U.S. is limited to the northern states.

Due to the prostrate vines that some varieties develop by the time they reach maturity, dry pea plants can be difficult to harvest. Increasingly, growers prefer a dry pea variety that stands upright at harvest, such as the semi-leafless types with shorter vines, because they allow a faster harvest, minimal equipment modification, and higher quality seed.

Pea crops are monitored closely to determine the proper stage for harvest. In most cases, plants mature from the bottom up. They are near maturity when the bottom 30 percent of the pods are ripe, the middle 40 percent of pods and vines are yellow, and the upper 30 percent of pods are in the process of turning yellow.

Dry peas are usually harvested the same time as wheat, or as soon as the seed is hard. If harvesting is delayed, seeds may



shatter. To reduce such losses dry pea harvesting is typically carried out before all pods are dry, or at night or early morning, when pods are wet with dew. Because dry peas do not ripen as uniformly as other crops, it can be necessary to harvest while there are green leaves and pods remaining.

Harvest usually begins in late July when seed moisture is 8 percent to 18 percent, depending upon the growing region. Harvest of determinate varieties occurs 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. They are harvested directly in the field, with each pod typically containing six to eight mature peas.

Production Trends

Dry peas rank fourth in terms of the world production of food legumes below soybeans, peanuts, and dry beans. Yellow peas and green peas, along with other minor classes, are the most commonly grown, with yellow peas accounting for approximately two-thirds of U.S. production.

The largest use of dry peas in Europe and North America is in the compound feed industry, whereby whole seeds are ground

and mixed with ground cereal seeds to produce feeds.

In 2004, dry peas were produced in over 84 different countries for a total world production of approximately 11.91 million metric tons. Canada, France, and China, are the major dry pea producers in the world followed by Russia, India, and the United States.

From 1993 to 2002, world dry pea production steadily declined to a low of 9.859 million metric tons. As of 2008, total production worldwide is estimated to be 10.3 million metric tons.

About 2.5 million metric tons were exported in 2003. Over 140 countries imported dry peas in that year. Europe, Australia, Canada, and the United States raise nearly 4.5 million acres and are the major exporters of dry peas.

The U.S. accounted for just over four percent of world dry pea production in 2004. Acreage devoted to dry peas is on the increase, rising from 149,000 acres in 1993 to a record high 530,000 acres in 2004. By 2006, there were approximately 924,174 acres of field peas grown in the U.S. Because of their high quality, U.S. dry peas are used primarily for human consumption.

For years, U.S. dry peas were primarily grown in the Palouse region of Washington and Idaho. In the 1990s, North Dakota and Montana began production efforts of their own. In 1991, North Dakota planted about 1,600 acres of dry peas. By 2002, the state produced 47 percent of total U.S. output, followed by Washington at 31 percent, Idaho 15 percent, Montana five percent, and Oregon two percent.

Total U.S. production of dry peas reached approximately 517,962 metric tons in 2004, nearly doubling the previous record high of 269,164 metric tons recorded in 1998.

North Dakota's role in dry pea production continued to grow in the new century, reaching 610,350 acres by 2006, fully 66 percent of total U.S. production.

More than 70 percent of the total U.S. dry pea production is exported to India, China, and Spain for food and feed processing.

Lentils

Soil and Seeding

For lentils, the seeding depth should be 1.2 inches to 3 inches. Proper packing after seeding is very important to make the ground smooth and even for harvest, and it also helps prevent moisture loss. While tolerant to frost, lentil seedlings are very sensitive to wind damage. In such cases, new lentil seedlings will typically emerge from nodes beneath the surface.

Performing well in a variety of seedbeds, lentils are often seeded directly into grain residue or standing stubble if residues are insufficient to protect the soil surface. They are typically grown following winter wheat or spring barley.

Usually sown in late April or early May, lentils are most successful when soil temperatures are above 40 degrees F (4 degrees C). In North America, lentils are planted in early spring and harvested in late summer. By seeding early, farmers are able to increase the height and size of the plant at first bloom. Lentils planted after April typically result in a lower crop quality and smaller seed yields.



Lentils are drilled in rows six to seven inches apart. The crop is adapted to grow during the cool season and in most of the production region lentils rely on stored soil moisture for a large part of their growth cycle.

Lentils are self-pollinating. As with other legumes, lentils start flowering after a specific number of nodes have been reached and continue until drought or nitrogen deficiency ends flowering. Maturity is reached about 100 days after emergence.

No drying is necessary, as the crop naturally dries in the field. All varieties are harvested in August and September. Lentils are cut and swathed into windrows approximately one week before harvesting to dry down the weeds and the lentils in instances of uneven crop maturity or heavy weed infestation. Swathing improves moisture uniformity of the lentil seed and reduces the amount of seed discoloration.

Swathing occurs when about 30 percent of the lowermost pods turn tan and their seeds rattle. Doing so under conditions of higher humidity may reduce shattering. Lentils can also be straight-cut (i.e., meaning one-pass with the same implement cuts and harvests the seed from the pods).

Swathers or straight-cut combines are best equipped with a flex header, or a pick-up reel and vine lifters, since lentil plants tend to lay quite flat on the ground at harvest.

Because dry seed is prone to chipping and peeling during threshing, producers try to thresh at about 18 percent moisture and use aeration to dry the sample to 14 percent for safe storage.

“Disease pressure limits the crop rotation for lentils to once every three to four years.”

Harvested lentils are shipped back to the buyer from the farm and then shipped to market or further processed per specifications of the buyer. Processing can entail hulling and splitting of the lentil before shipping. As a food, lentils can be stored indefinitely in a cool, dry place without losing nutritional value, taste, or freshness.

Disease pressure limits the crop rotation for lentils to once every three to four years.

Production Trends

Nearly 90 percent of the lentil crop in the U.S. is exported, although domestic consumption is on the rise. Export markets include Asia, the Middle East, Latin America, Europe, and Africa. Recent niche markets for small Spanish brown lentils (Pardina variety, grown for sale to Spain) and red lentils (Crimson variety, grown for sale to the Asian market) have provided greater profitability than the traditional large yellow cotyledon (Brewer variety) market. An in-

creasing number of acres in the U.S. are being seeded with specialty lentils like the Pardina and Crimson.

Chickpeas

Soil and Seeding

Seeding rates for chickpeas tend to provide three (Kabuli) to four (Desi) plants per square foot to help promote adequate seed size at harvest. Seeding depth is about 1 inch below moisture for Desi and up to 2 inches below moisture for Kabuli chickpeas, though Kabulis can be planted down to 4 inches to use available soil moisture for germination.

The chickpea has deeper taproots than peas and lentils, giving it more drought tolerance. Chickpea resistance to early or late frost is similar to that of peas and lentils, with chickpeas offering a higher temperature tolerance during flowering than peas. Plant height of the Kabuli ranges from 14 inches to 22 inches and from 10 inches to 20 inches with Desi types. Kabuli chickpeas generally mature two weeks after Desi types.

Seed color is the most significant factor in determining a chickpea crop's marketability as dark or discolored seed coats may make them unacceptable to food processors. Decisions such as harvest timing and methods have the greatest impact on developing seeds with the light yellowish-cream color preferred by the market.

It is also important that the small protruding beak-like structure that distinguishes chickpeas must not be damaged during harvesting. Chickpeas can be harvested at 18 percent moisture and stored at 14 percent seed moisture.



Chickpea plants are distinguished by stiff stems and generally upright growth, with pods developing several inches above ground. There is a threat of pod loss if there is a break in the small stem that attaches the pod to the plant. Pod shattering, on the other hand, is not as common as in some other legumes.

Chickpeas are usually straight-cut but can be swathed ahead of the combine if straight-cut equipment is not available. To reduce pod loss, swathing is generally done when the plants are slightly damp. Wind is also a factor as it can damage swaths.

Since green, immature seeds can result in chickpeas being downgraded and their value impacted, producers prefer to harvest when the majority of the crop is mature. This can require the field to be harvested in stages, leaving immature areas to a later date.

Producers normally harvest when the seeds are at approximately 18 percent moisture. Care must be taken not to damage the seed, especially the large Kabuli types. Due to their different seed coats, Kabuli and Desi chickpeas are handled in a slightly different way.

The recommended crop rotation for chickpeas is once every four years, mostly because of the aggressive nature of ascochyta blight, one of the major diseases for the chickpea. A once-in-four-year rotation will allow for the breakdown of chickpea residue on which the disease thrives.

Production Trends

World chickpea production is roughly three times that of lentils. Among pulse crops marketed as human food, world chickpea consumption is second only to dry beans. The major chickpea exporters include Turkey, Australia, Syria, Mexico, Argentina and Canada. About 90 percent of the crop, mostly of the Desi type, is consumed in India.

North American chickpea production was once concentrated in California and the Pacific Northwest. Today, U.S. chickpea production is located in Idaho, Washington, Oregon, Montana, North Dakota, South Dakota, Nebraska, Colorado, and California. Production has also expanded to over 1 million acres in the Canadian Prairies (primarily Saskatchewan).

In the U.S., Kabuli chickpeas are most commonly sold as canned garbanzo beans for use in salads. They are also marketed in a dry form and used in ground flour for baking. If used as human food, Desi chickpeas are decorticated, which involves adjusting the moisture level of the seeds so the thick seed coats can be removed. Decorticated Desi chickpeas are used in East Asian processed products as well as South Asian cuisines.

2008 USADPLC CROP PRODUCTION REPORT
TOTAL U.S. PRODUCTION

REGULAR GREEN PEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	308,429	124,914	1,475	454,848,250	206,318
2007	331,247	134,155	1,798	595,666,181	270,192
2006	382,406	154,874	1,542	589,801,822	267,532
2005	391,664	158,624	1,676	656,522,845	297,797
2004	276,456	111,965	2,467	682,052,193	309,377
2003	232,007	93,963	1,590	368,843,629	167,306
6 Year Average	320,368	129,749	1,758	557,955,820	203,498

SMALL SIEVE GREEN PEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	2,639	1,069	2,060	5,437,040	2,466
2007	2,666	1,080	1,713	4,565,921	2,071
2006	2,960	1,199	2,042	6,043,003	2,741
2005	3,652	1,479	1,859	6,788,589	3,079
2004	4,754	1,925	2,365	11,241,771	5,099
2003	3,566	1,444	1,480	5,278,705	2,394
6 Year Average	3,372	1,366	1,920	6,559,172	2,975

LARGE LENTILS***					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	32,322	13,090	822	26,557,024	12,046
2007	35,298	14,296	1,319	46,567,997	21,123
2006	19,280	7,808	1,162	22,406,300	10,163
2005	20,329	8,233	1,002	20,365,039	9,238
2004	5,319	2,154	2,225	11,832,954	5,367
5 Year Average	20,057	8,123	1,427	25,293,073	11,473

SMALL CHICKPEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	8,398	3,401	1,730	14,526,035	6,589
2007	15,065	6,101	1,110	16,726,000	7,587
2006	31,978	12,951	1,125	35,970,119	16,316
2005	10,760	4,358	1,427	15,357,975	6,966
2004	1,540	624	652	1,003,738	455
5 Year Average	13,548	5,487	1,209	16,716,773	7,583

MEDIUM LENTILS** Reported as "Regular Lentils" before 2004					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	143,047	57,934	986	140,979,638	63,948
2007	186,635	75,587	1,293	241,381,853	109,490
2006	295,509	119,681	1,174	346,914,397	157,359
2005	303,043	122,732	1,267	384,090,129	174,222
2004	259,598	105,137	1,191	309,240,698	140,271
2003	76,671	31,052	861	65,999,436	29,936
6 Year Average	210,751	85,354	1,129	248,101,025	112,538

YELLOW PEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	528,089	213,876	1,285	678,631,812	307,825
2007	548,600	222,183	1,955	1,072,502,616	486,484
2006	581,134	235,359	1,434	833,541,060	378,092
2005	403,762	163,524	1,945	785,322,022	356,220
2004	226,383	91,685	1,706	386,248,087	175,201
2003	72,580	29,395	1,790	129,912,434	58,928
6 Year Average	393,425	159,337	1,686	647,693,005	293,792

AUSTRIAN WINTER PEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	11,504	4,659	1,271	14,621,871	6,632
2007	25,220	10,214	1,253	31,606,527	14,337
2006	49,066	19,872	924	45,354,050	20,572
2005	7,170	2,904	1,145	8,210,131	3,724
2004	17,486	7,082	1,565	27,357,702	12,409
2003	18,650	7,553	1,280	23,879,468	10,832
6 Year Average	21,516	8,714	1,240	22,737,083	11,417

LARGE CHICKPEAS****					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	65,327	26,458	1,396	91,196,956	41,367
2007	115,997	46,979	983	114,002,016	51,711
2006	112,751	45,664	1,048	118,211,146	53,620
2005	85,738	34,724	982	84,194,649	38,190
2004	20,198	8,180	1,277	25,787,441	11,697
2003	28,546	11,561	953	27,209,441	12,342
6 Year Average	71,426	28,928	1,107	76,766,942	34,821

SMALL LENTILS* Reported as "Other Lentils" before 2004					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	72,756	29,466	1,094	79,603,188	36,108
2007	91,168	36,923	1,229	112,047,206	50,824
2006	104,986	42,519	950	99,737,766	45,241
2005	68,808	27,867	958	65,939,078	29,910
2004	72,702	29,444	1,037	75,364,122	34,185
2003	158,983	64,388	1,115	177,343,425	80,442
6 Year Average	94,901	38,425	1,064	101,672,464	46,118

2008 U.S. PRODUCTION SUMMARY TABLE				
	Acre	lbs/acre	Pounds	Metric Ton
Green Peas	311,068	1,480	460,285,290	208,784
Yellow Peas	528,089	1,285	678,631,812	307,826
AWP	11,504	1,271	14,621,871	6,632
Lentils	248,125	996	247,139,850	112,102
Chickpeas	73,725	1,434	105,722,991	47,956

* Pardina, Morton, Eston Varieties
** Brewers, Richlea, Merrit, red Chief Varieties
*** Mason, Pennell, Palouse, VanGard, Laird Varieties
**** US Large Chickpeas includes CA Production
Notes:
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Acreage data for 2008 has been amended since posting of the Industry Seeded Acreage Report, July 2008.

USADPLC 2008
PRODUCTION REPORT - PNW

REGULAR GREEN PEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	81,524	33,017	1,649	134,411,267,	60,969
2007	79,587	32,233	1,557	123,950,881	56,224
2006	89,364	36,192	1,506	134,580,322	61,045
2005	114,659	46,437	1,370	157,082,830	71,252
2004	121,307	49,129	1,978	239,984,275	108,856
2003	112,107	45,403	1,281	143,613,629	65,143
6 Year Average	99,758	40,401	1,557	155,603,867	70,582

SMALL SIEVE GREEN PEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	2,639	1,069	2,060	5,437,040	2,466
2007	2,666	1,080	1,713	4,565,921	2,071
2006	2,960	1,199	2,042	6,043,003	2,741
2005	3,652	1,479	1,859	6,788,589	3,079
2004	4,754	1,925	2,365	11,241,771	5,099
2003	3,566	1,444	1,480	5,278,705	2,394
6 Year Average	3,378	1,366	1,920	6,559,172	2,975

LARGE LENTILS***					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	2,631	1,066	925	2,433,832	1,104
2007	3,205	1,298	824	2,642,447	1,199
2006	1,400	567	653	913,700	414
2005	4,329	1,753	442	1,915,039	869
2004	5,319	2,154	2,225	11,832,954	5,367
5 Year Average	3,563	1,443	1,036	4,326,035	1,962

SMALL CHICKPEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	3,006	1,217	1,680	5,049,475	2,290
2007	5,565	2,254	1,116	6,211,000	2,817
2006	10,014	4,056	1,181	11,829,300	5,366
2005	4,760	1,928	1,178	5,607,975	2,544
2004	1,540	624	652	1,003,738	455
5 Year Average	5,470	2,215	1,032	6,163,003	2,796

MEDIUM LENTILS** Reported as "Regular Lentils" before 2004					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	39,811	16,123	981	39,061,090	17,718
2007	43,795	17,737	972	42,587,853	19,318
2006	48,059	19,464	1,098	52,753,702	23,929
2005	72,039	29,176	918	66,141,917	30,002
2004	79,109	32,039	1,114	88,146,884	39,983
2003	75,671	30,647	855	64,696,436	29,346
6 Year Average	59,747	24,198	990	58,897,980	26,716

YELLOW PEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	10,591	4,289	1,924	20,375,299	9,242
2007	12,200	4,941	1,690	20,621,681	9,354
2006	7,754	3,140	1,417	10,987,560	4,984
2005	13,096	5,304	1,558	20,397,994	9,252
2004	10,122	4,099	1,873	18,954,321	8,598
2003	12,510	5,067	1,406	17,589,934	7,979
6 Year Average	11,046	4,473	1,644	18,154,465	8,235

AUSTRIAN WINTER PEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	3,947	1,599	1,557	6,147,306	2,788
2007	7,720	3,127	1,184	9,139,962	4,146
2006	14,787	5,989	1,054	15,581,200	7,068
2005	7,170	2,904	1,145	8,210,131	3,724
2004	7,754	3,140	2,087	16,183,482	7,341
2003	9,250	3,746	1,256	11,614,468	5,268
6 Year Average	8,430	3,418	1,381	11,146,091	5,056

LARGE CHICKPEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	52,258	21,164	1,270	66,342,176	30,093
2007	79,247	32,095	914	72,462,016	32,869
2006	80,875	32,754	1,039	84,032,326	38,117
2005	58,738	23,789	925	54,332,649	24,645
2004	20,198	8,180	1,277	25,787,441	11,697
2003	17,030	6,897	883	15,040,241	6,822
6 Year Average	51,391	20,813	1,051	52,999,475	24,041

* Pardina, Morton, Eston Varieties
** Brewers, Richlea, Merrit, red Chief Varieties
*** Mason, Pennell, Palouse, VanGard, Laird Varieties

Notes:
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SMALL LENTILS* Reported as "Other Lentils" before 2004					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	44,594	18,061	1,201	53,548,917	24,290
2007	61,501	24,908	1,183	72,780,106	33,013
2006	71,801	29,079	857	61,498,566	27,896
2005	63,808	25,842	934	59,614,078	27,041
2004	72,702	29,444	1,037	75,364,122	34,185
2003	81,623	33,057	964	78,655,425	35,678
6 Year Average	66,005	26,732	1,029	66,910,202	30,351

USADPLC 2008
PRODUCTION REPORT - MIDWEST

REGULAR GREEN PEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	226,905	91,897	1,412	320,436,983	145,349
2007	251,660	101,922	1,874	471,715,300	213,969
2006	292,912	118,629	1,553	454,961,500	206,369
2005	277,005	112,187	1,803	499,440,015	226,545
2004	155,149	62,835	2,849	442,067,918	200,521
2003	119,900	48,560	1,878	225,230,000	102,164
6 Year Average	220,589	89,338	1,895	335,998,453	182,486

LARGE LENTILS***					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	29,691	12,025	812	24,123,192	10,942
2007	32,093	12,998	1,369	43,925,550	19,924
2006	17,880	7,241	1,202	21,492,600	9,749
2005	16,000	39,520	1,153	18,450,000	8,369
4 Year Average	23,916	17,946	1,134	26,997,836	12,246

SMALL CHICKPEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	5,392	2,184	1,758	9,476,560	4,299
2007	9,500	3,848	1,107	10,515,000	4,770
2006	15,737	6,373	980	15,423,019	6,996
2005	6,000	2,430	1,625	9,750,000	4,423
2004	1,889	765	453	855,000	388
5 Year Average	7,704	3,120	1,185	9,203,916	4,175

MEDIUM LENTILS** Reported as "Regular Lentils" before 2004					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	103,236	41,811	987	101,918,548	46,230
2007	142,840	57,850	1,392	198,794,000	90,172
2006	247,450	100,217	1,189	294,160,695	133,430
2005	231,004	93,557	1,376	317,948,212	144,220
2004	180,489	73,098	1,225	221,093,814	100,287
2003	1,000	405	1,300	1,300,000	590
6 Year Average	151,003	61,156	1,245	189,202,545	85,822

YELLOW PEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	517,498	209,587	1,272	658,256,513	298,583
2007	536,400	217,242	1,961	1,051,880,935	477,130
2006	573,330	232,199	1,435	822,468,500	373,069
2005	390,666	158,220	1,958	764,924,028	346,967
2004	216,261	87,586	1,698	367,293,766	166,603
2003	60,070	24,328	1,870	112,322,500	50,949
6 Year Average	382,371	154,863	1,699	629,524,374	285,550

AUSTRIAN WINTER PEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	7,557	3,061	1,121	8,474,565	3,844
2007	17,500	7,088	1,284	22,466,565	10,191
2006	34,138	13,826	866	29,547,250	13,403
2005	12,000	4,860	1,050	12,600,000	5,715
2004	9,732	3,941	1,148	11,174,220	5,069
2003	9,400	3,807	1,305	12,265,000	5,563
6 Year Average	15,055	6,097	1,129	16,087,933	7,298

LARGE CHICKPEAS					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	7,129	2,887	1,570	11,192,780	5,077
2007	29,750	12,049	1,001	29,780,000	13,508
2006	19,876	8,050	874	17,379,820	7,883
2005	17,000	6,885	1,106	18,802,000	8,529
2004	5,128	2,077	1,020	5,228,600	2,372
2003	11,516	4,664	1,057	12,169,200	5,520
6 Year Average	15,065	6,102	1,104	15,758,733	7,148

SMALL LENTILS*					
Year	Acreage	Hectares	lbs/acre	Pounds	Metric Ton
2008	28,162	11,406	935	26,054,271	11,818
2007	29,667	12,015	1,324	39,267,100	17,811
2006	33,185	13,440	1,152	38,239,200	17,345
2005	5,000	2,025	1,265	6,325,000	2,869
2004	0	0	0	0	0
2003	77,360	31,331	1,276	98,688,000	44,765
6 Year Average	28,896	44,108	992	34,762,262	15,768

- * Pardina, Morton, Eston Varieties
** Brewers, Richlea, Merrit, red Chief Varieties
*** Mason, Pennell, Palouse, VanGard, Laird Varieties

Notes:
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2008 USADPLC PRODUCTION REPORT:
STATE BY STATE COMPARISON

ACREAGE											
State/ Year	Green Peas	Small Sieve	Yellow Peas	AWP	Large Chickpeas	Small Chickpeas	Large Lentils	Medium Lentils	Small Lentils	Red Lentils	Total Pulse Acres
ID 08	29,360	1,364	2,919	1,841	23,641	1,669	1,316	7,141	22,052	1,635	92,938
ID 07	19,550	1,378	2,680	4,600	37,905	4,215	1,700	11,335	28,272		11,635
WA 08	51,549	1,275	7,474	1,147	28,617	1,337	1,315	25,089	22,542	5,196	145,541
WA 07	58,907	1,288	9,320	1,220	38,542	1,350	1,505	31,710	33,229		177,071
OR 08	615	0	198	959	0	0	0	750	0	0	5,522
OR 07	1,130	0	200	1,900	2,800	0	0	750	0		6,780
CA 08	0	0	0	0	5,940	0	0	0	0	0	5,940
CA 07	0	0	0	0	7,000	0	0	0	0		7,000
MT 08	43,890	0	209,608	4,590	4,038	1,900	9,504	39,798	11,138	8,841	333,306
MT 07	49,500	0	209,000	15,000	12,250	1,500	12,000	57,000	14,000		370,250
ND 08	183,015	0	307,890	0	3,092	3,492	20,187	44,429	17,025	9,176	588,307
ND 07	190,960	0	320,000	0	13,500	6,000	20,093	78,640	15,667		644,860
SD,NE MN 07	3,083	0	4,535	2,967	3,610	1,805	0	5,926	971	992	23,889
SD, NE MN 07	11,200	0	7,400	2,500	4,000	2,000	0	7,200	0		34,300

PRODUCTION											
State/ Year	Green Peas	Small Sieve	Yellow Peas	AWP	Large Chickpeas	Small Chickpeas	Large Lentils	Medium Lentils	Small Lentils	Red Lentils	Total Production
ID 08	48,628,212	2,810,293	5,618,151	3,314,520	28,960,652	2,804,155	1,217,115	7,141,050	26,480,234	1,635,480	128,609,862
ID 07	32,816,502	2,828,871	4,349,681	6,114,962	36,019,996	6,211,000	1,102,292	13,916,537	30,325,875		133,683,716
WA 08	84,798,599	2,626,747	14,386,888	2,065,338	37,381,524	2,245,320	1,216,717	25,088,952	27,068,683	5,195,608	202,074,376
WA 07	89,269,879	1,737,050	15,902,000	630,000	35,874,020	0	890,155	28,021,316	42,318,481	NR	214,642,902
OR 08	984,456	0	370,260	767,448	0	0	0	0	0	0	2,122,164
OR 07	1,864,500	0	370,000	2,395,000	566,000	0	0	650,000	135,750		5,963,250
CA 08	0	0	0	0	13,662,000	0	0	0	0	0	13,662,000
CA 07	0	0	0	0	11,760,000	0	0	0	0	NR	11,760,000
MT 08	39,501,000	0	188,647,200	5,508,000	3,230,000	1,805,000	5,702,400	35,818,200	8,910,000	6,630,525	295,752,325
MT 07	84,122,500	0	323,256,327	19,500,000	12,250,000	1,575,000	16,800,000	82,650,000	18,900,000	NR	559,053,827
ND 08	277,853,365	0	465,074,583	0	4,352,780	5,866,560	18,420,792	49,760,383	16,173,675	8,717,461	846,219,599
ND 07	368,552,800	0	715,674,608	0	13,770,000	6,540,000	27,125,550	110,096,000	20,367,100		1,262,126,058
SD, NE MN 08	3,082,618	0	4,534,730	2,966,565	3,610,000	1,805,000	0	0	970,596	991,979	17,961,489
SD, NE MN 07	19,040,000	0	12,950,000	3,875,000	3,760,000	2,400,000	0	6,048,000	0		48,073,000

2008 STATE PRODUCTION SUMMARY TABLE (lbs)					
	Green Peas	Yellow Peas	AWP	Lentils	Chickpeas
Idaho	51,438,505	5,618,151	3,314,520	36,473,879	31,764,807
Washington	87,425,346	14,386,888	2,065,338	58,569,960	39,626,844
Oregon	984,456	370,260	767,448	0	0
California	0	0	0	0	13,662,000
North Dakota	277,853,365	323,256,327	0	93,072,310	10,219,340
Montana	39,501,000	188,647,200	5,508,000	57,061,125	5,035,000
Others	3,082,618	4,534,730	2,966,565	1,962,575	5,415,000
Total	460,285,290	536,813,556	14,621,871	247,139,850	105,722,991

Small Lentils - Pardina, Morton, Eston Varieties
Medium Lentils - Brewers, Richlea, Merrit, Varieties
Large Lentils - Mason, Pennell, Palouse, VanGard, Laird Varieties
Red Lentils - Red Chief, Red Robin, Crimson, Morton

Notes:
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4
CHAPTER

Processing Methods for Dry Peas,
Lentils & Chickpeas



USA DRY PEA &
LENTIL COUNCIL