DRY PEA PRODUCTION IN THE U.S.

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U.S. dry pea production is concentrated in the Palouse region of eastern Washington and northern Idaho where an estimated 95% of the U.S. crop is grown. The major production area is located 46° to 47° N, 117° to 118° W and at elevations of 600 to 800 meters. The crop is produced in rotation with winter wheat in the rolling hills of this region that is commonly referred to as the "Palouse". Although dry pea production is centered in the Palouse region, other areas such as Oregon, Minnesota and North Dakota have produced the crop. Whether or not these states will produce dry peas in the future will depend the relative profitability of dry peas compared with alternative crops.

In the Palouse, dry peas are included in rotations with cereals for a number of reasons, namely: (a) the benefit of a legume in crop rotations in terms of soil erosion control (the legume replaces summer fallow, a practice known to increase the probability of severe soil erosion); (b) less severe disease infestations in cereals because the legume is not an alternate host for most cereal pathogens; (c) better control of grassy weeds compared with cropping systems with only cereals in the rotation; (d) diversification to exploit the symbiotic association with *Rhizobium* and so to decrease applications of expensive inorganic fertilizers, although in many instances residual soil N is so high that effective symbiosis is inhibited; and (e) broader market opportunities because of demands in domestic and foreign markets.

The area sown to dry peas (excluding both wrinkled seed peas and 'Austrian' winter peas) has remained relatively constant from 1974 to 1983 at about 65,000 ha, although the area sown was as low as 45,000 ha in 1981. Average seed yields over the past 10 years have been about 1760 kg ha^{-1} with a low of 700 kg ha^{-1} in 1977 to a high of 1900 kg ha^{-1} in 1980. The low yields in 1977 were caused by a rare occurrence of severe drought, whereas the high yields of 1980 were associated with the cool-moist season that followed the volcanic eruption of Mt. St. Helens in the spring of that year.

Peas were introduced into the Palouse near the turn of this century. Commercial production began during the 1920's and it seems probable that the substantial increase in area sown was due to the introduction of the Alaska type cultivars that are typically rapid emerging, early flowering, and early maturing. 'Alaska' originated in New York State prior to 1880 where it was used primarily as a canning pea.

About 78 percent of the peas produced in Washington and Idaho are green (cotyledon) types, while about 22 percent are yellow (cotyledon) types (Table 1). Green pea cultivars used in the Palouse include 'Alaska', 'Garfield', 'Latah', 'Tracer', and numerous commercial Alaska type strains. A strain locally known as 'Columbia' is a popular commercial type because of its high yield and uniform dark green color. Yellow pea cultivars include 'Latah', 'First and Best*, and to a limited extent, 'Paloma'.

Alaska types have large smooth round green seeds and bloom in about the 10th node. The vine type is tall and weakly upright, indeterminate and usually non-branching. Alaska peas typically reach maturity approximately **95** days after sowing.

Garfield, a green dry pea cultivar released to growers in 1977 is larger seeded, higher yielding and has a longer vine habit when compared with Alaska (Muehlbauer et al., 1977). The greater plant height of Garfield, when compared to Alaska, improves harvesting ease, especially on ridges where poor vine growth has been a chronic problem. Garfield does not differ from Alaska in resistance to seed bleaching but, because of its longer growth period, it often bleaches to a greater extent than Alaska if cool-wet weather persists after dry seed maturity but prior to harvest. Garfield flowers at the 14th node, has tolerance to pea root rot (F. solani), and resistance to common wilt (F. oxysporum race 1). The later blooming of Garfield and its resistance to root rot are two factors that contribute to the approximate one week delay in maturity when compared to Alaska. This maturity delay is a disadvantage and can result in lowered seed quality due to adverse weather after dry seed maturity.

Tracer, a green dry pea cultivar released in 1977, is a small sieve Alaska type with good yield potential when compared to other small sieved Alaska strains (Muehlbauer et al., 1977). Tracer has uniform seed size, shape and color, greater plant height, lower susceptibility to seed bleaching when compared to other small sieve Alaska cultivars, and resistance to common wilt (F. oxysporum race 1). The taller plant height improves harvestability in areas where poor vine growth has contributed to harvesting problems. Tracer sets triple pods at one or more reproductive nodes and is somewhat later maturing when compared to other small-sieve Alaska strains.

Small sieve Alaska types are used less extensively and are characterized by slightly smaller seed size and earlier maturity (90 days from sowing) when compared to regular Alaska types, and they tend to be slightly dimpled and more susceptible to seed bleaching. It is impossible to distinguish between small sieve Alaska strains and regular Alaska strains based on seed appearance or plant stature (Muehlbauer, 1982). An improved regular Alaska cultivar (designated as 'Alaska 81') that is immune to pea seedborne mosaic virus and resists seed bleaching will soon be available to growers. Alaska 81 has also been significantly higher yielding when compared to other Alaska cultivars.

Latah a large yellow dry pea cultivar selected from the old 'First and Best' cultivar was released in 1972 (Wilson, 1977). Latah has a long vine habit, blooms in the 14th node, and is relatively high yielding. Maturity is comparable to Garfield (Muehlbauer, 1982).

The Palouse dry pea crop is normally sown in mid to late April after danger of severe frost and matures within 95 to 120 days. Nearly all of the current production area is rain-fed (although the potential for irrigated pea crops in this area and nearby drier areas, is not precluded) and includes crop land that has slopes that range from 8 to 30 percent (Papendick and Miller, 1977).

Dry pea crops in the Palouse produce highest economic yields when grown on well drained soils on south and east facing slopes. Crops grown in draws and on flats can yield well, but those areas often remain wet until late spring, and sowing is delayed, crop duration is restricted, and for current cultivars yields are reduced. Crops seeded in low lying areas often produce excessive vegetative growth and are prone to various foliar diseases such as downy mildew, sclerotinia white mold, and powdery mildew.

The common practice used for seedbed preparation is to plow or disk fields intended for peas in the fall or early spring to incorporate previous crop residues (Reisenauer et al., 1965). In spring, when soils are sufficiently dry, fields are cultivated and firmed with a harrow although some growers prefer to use a rod weeder. Deep tillage is avoided to prevent excessive moisture loss.

Growers use the same grain drills to plant dry peas that are used for wheat and barley. The drills have either 15 or 18 cm row spacings. For optimal yields, peas should be planted as early as possible in the spring and when soil temperatures are above 4°C (Murray, 1982). Plant populations of about 740,000 plants per hectare have been optimal for Alaska peas in the Palouse region (Muehlbauer and Dudley, 1974).

Molybdenum is known to be deficient in the soils of the Palouse and as a result dry pea crops can be severely affected. Symptoms of affected crops include yellowing, reduced growth rate, earlier flowering, poor pod and seed development, and reduced yields. The deficiency is routinely corrected by applying sodium molybdate to the seeds at the rate of 35 g ha^{-1}. It is important to distribute sodium molybdate uniformly over the seed and to insure adherence to the seeds with a "sticker". Ammonium molybdate $(NH_4)_6Mo_7O_4$) at the rate of 1.1 kg ha^{-1} applied broadcast to the soil in combination with gypsum has also been used successfully to correct molybdenum deficiencies. Also, fertilization with molybdenum as $NaMoO_4$ at the rate of 0.5 kg ha^{-1} has generally been sufficient to prevent deficiencies.

The common practices for broadleaf weed control in dry peas include preemergence applications of Dinoseb amine or metribuzin after all tillage and seeding operations are completed, or to apply dinoseb amine post emergence when the weeds are small and when wax is present on the pea foliage. Grass type weeds (wild oats, downy brome, etc.) are usually controlled with shallow incorporation of trillate during the final tillage operations or by shallow incorporation of the chemical after seeding.

Pea crops in the Palouse are severely affected by pea root rot. Other diseases are important and include Fusarium wilt races 1 and 2, powdery mildew, Sclerotinia white mold, and various viruses transmitted by aphids. Pea root rot caused by Fusarium solani (Mart.) Sacc. f. sp. pisi (Jones) Snyd. & Hans, can severely damage most Alaska strains, particularly when the seedbed is heavily compacted. Because Alaska peas are early maturing, they usually escape powdery mildew (Erysiphe polygoni DC.). Most Alaska strains are resistant to wilt caused by Fusarium oxysporum Race 1, but some small sieve strains are susceptible. Yields of Alaska peas are variable due to weather, diseases, and other stress factors and somewhat lower than the released cultivars, Garfield and Tracer.

Important insect pests of the dry pea crop include the pea leaf weevil (Sitona lineatus), pea weevil (Bruchus pisorum L.) and aphids. The pea leaf weevil feeds on the foliage of the pea plants soon after emergence and has caused serious economic losses when not controlled. The insect was inadvertently introduced from Europe to the Pacific Northwest via Vancouver Island, British Columbia. Control is through use of insecticides; however, various types of biological control have had some success. Host plant resistance has revealed levels of tolerance, but good resistance has not been found.

One of the most important of the insect pests, the pea weevil enters pea fields at about bloom and feeds on nectar and pollen. After a feeding period, the females begin to lay eggs on the surface of developing pods. Upon hatching, the larva eats its way directly from the egg through the pod and into the developing pea ovule. A small dark spot or "sting" marks the point of entry on the seed coat. The larvae then feed inside the seeds until pupae form and later, usually in storage, the pupae transform to adults. The pea weevil completes one cycle per season and they do not damage sound seeds in storage. After leaving infested seeds, adult pea weevils overwinter in debris, fence rows, and the bark of pine trees, among other places. Host plant resistance is being studied and progress has been made, however, the level of resistance found does not appear sufficient to preclude the use of insecticides for control.

Dry pea crops are harvested as soon as possible after dry seed maturity. Growers in the Palouse use pick up attachments on the combines (otherwise known as a pea bar) to lift the pea vines from the soil surface and into the cutter bar. The lifters help avoid a great deal of shattering that would otherwise take place.

Palouse dry pea crops are inspected and graded according to U.S. standards as established by the U.S. Department of Agriculture, Federal Grain Inspection Service. The standards consider the prevalence of damaged and defective seeds and contamination by foreign materials in determining grades.

Improve standing ability. Progress has been made in developing populations and germplasm with combined resistance to Fusarium wilt, Fusarium root rot, powdery mildew and pea seedborne mosaic virus.

Dry peas produced in the Palouse are used in numerous ways that include whole peas, split peas, reconstituted peas, pea powder, noodles and various snack, items. Splitting is accomplished by first steaming the peas to loosen the seedcoats, followed by the use of centrifugal force to split the peas.

A more comprehensive treatment of the dry pea crop in the Palouse and elsewhere is contained in a recent review by F. J. Muehlbauer, R. W. Short, and J. M. Kraft entitled "Description and Culture of Dry Peas", 1984. Copies are available on request.

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Table 1. Average annual dry pea production and export in the United States by state and dry pea type from 1967 to 1978 (modified from Smith, 1980)

State/National	Dry pea type	Average annual production	Volume exported
		1000 t	percent
Production			
Washington	Green	51.8	42
	Yellow	17.4	14
	Total	69.2	56
Idaho	Green	44.2	36
	Yellow	5.3	4
	Total	49.5	40
Other[1]	Green	0.4	1
	Yellow	4.5	4
	Total	4.9	4
United States	Green	96.4	78
	Yellow	27.2	22
	Total	123.6	100
Export[2]			
United States	Green	49.8	40
	Yellow	15.9	13
	Total	65.7	53

[1]Oregon, Minnesota and North Dakota

[2]For period 1967 through 1977