



Austrian Winter Peas for Dryland Green Manure

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The winter wheat-fallow cropping system is a common practice in the western Great Plains. The primary objective of the fallow interval is to store water in the soil profile. Unfortunately, the system is difficult to sustain if conventional fallowing techniques leave insufficient surface residue, which, in turn, may expose soil to wind and water erosion and organic matter loss. The fallow period has been found to be a rather inefficient means of storing water. Conservation tillage methods have been studied to decrease erosion and increase soil-moisture storage in the Great Plains. However, producers' acceptance of conservation tillage alternatives in Wyoming has been low. Use of a legume crop incorporated as green manure to partially replace fallow is another alternative in the Great Plains. Agronomic studies to investigate the potential benefits, growth culture, and effects on wheat yields of green manures have been evaluated since 1991 in southeastern Wyoming. To date, Austrian winter field peas (*Pisum sativus* subsp. *arvense*) have the greatest potential as a green manure in the winter wheat-fallow cropping system. The benefits,

culture, varieties, and effects of Austrian winter field peas on wheat yield are summarized in the information that follows.

Potential Benefits of Green Manure

1. Nutrient source: The legume crop will provide nitrogen for subsequent wheat crops.
2. Soil organic matter: The summer fallow-winter wheat cropping system drastically reduces soil organic matter. Conversely, green manure increases the soil organic matter that improves soil water-holding capacity, soil nutrient levels, soil structure, and beneficial soil microorganisms.
3. Soil erosion: The stand 14-month fallow period subjects soil to intense wind and water erosion, especially when associated with conventional tillage. Peas can provide soil cover for 10 to 11 of the 14 months.
4. Field water-use efficiency: Summer fallow only saves 20 to 40 percent of precipitation with potential nutrient leaching beyond the wheat root zone (Greb et al. 1967; Sooby,

1994). Peas, when terminated early enough, will use water otherwise lost to runoff, soil evaporation, and movement beyond the root zone. In studies at the University of Wyoming Research and Extension Center in Archer, conventional fallow lost eight inches of soil water between May and September while the pea green manure crop used only nine inches. Dalrymple et al. (1993) found that neither chemical, chemical plus tillage, or conventional fallow stored any additional soil water between July 1 and early September.

Peas are easy to grow

Pea culture

1. Pea seed must be inoculated with the proper rhizobium species (*Rhizobium leguminosarum*) prior to planting to ensure proper symbiotic nitrogen fixation and plant growth.
2. Winter pea seeding rate (pounds per acre) depends on seed size, intended use of the crop, plant growth habit, and available soil water during the growing season. In Archer, 70 to 80 pounds per acre planted in the fall have established stands of four to six plants per square foot in the spring, which appears to be adequate for this environment. Optimum seeding-rate evaluations are currently underway.
3. Peas require fertility levels of phosphorous (P) and potassium (K) similar to annual cereals and are very sensitive to salt, requiring proper fertilizer placement (Cash et al., 1995). Fertilizer application rates should be based on soil tests.
4. Several Austrian winter pea varieties are available on the market with a wide range

in price depending on the seed source and variety. Melrose, Fenn, and common seed have expressed excellent winter hardiness and growth in Archer (Table 1). Additional variety performance evaluations are being conducted in Wyoming and Nebraska.

5. Planting date and procedures: Direct seeding of peas into wheat stubble at a depth of 2 to 2½ inches in late August and early September has been very successful in Archer. The snow-catching ability of wheat stubble appears to protect the peas from winterkill. A deep furrow drill can also assist in winter survival. Excessive winter kill has occasionally been observed when peas have been planted in tilled soil at some locations in southeast Wyoming. Winter survivability of peas planted directly after July wheat harvest is being investigated. April and May planting have been successful, but fall planting has several advantages such as increased growth in spring and early summer, nitrogen fixation beginning in the fall, greater time to increase beneficial soil microorganisms associated with the legume, and an earlier obtaining of the desired quantity of biomass.
6. Weed control: The need for chemical weed control varies depending on weed population levels and weather.

In general, our experience in Archer has shown that no herbicide is required in fall planting, a nonselective herbicide may be required before fall or spring no-till planting if downy brome (*Bromus tectorum* L.) has established before planting peas, and a selective herbicide should be applied in the spring if temperature and moisture conditions have favored weed growth more than pea growth.

Managing a green manure crop

1. The time at which a green manure crop should be terminated depends on several factors including the producer's goals. Some producers may want to:
 - a. **Provide 50 pounds per acre of soil nitrogen.** This requires about 1,500 pounds per acre of above-the-ground biomass dry matter. A limited number of studies indicate that this yield level occurs by early June with fall seedings and by the second to third week in July with spring seedings. A fall seeding may exceed 3,000 pounds per acre of biomass dry matter by the end of June (Table 1), with an expected nitrogen contribution of about 80 pounds per acre to the subsequent crops.
 - b. **Conduct a September planting of winter wheat following the pea green manure.** Terminating growth of the green manure by July 1 can conserve sufficient moisture to decrease the potential for diminished wheat yields. This conclusion is based primarily on spring-planted peas; fall-planted green manure studies are under evaluation. Production of 1,500 pounds per acre of green manure peas will typically deplete the root profile of available soil moisture. Average total precipitation for July, August, and September in Archer is 4.5 inches. If the green manure crop is terminated by July 1 in Archer, July, August, and September precipitation will be soil stored rather than lost beyond the root zone or runoff with associated soil erosion.
 - c. **Prevent volunteer peas in the wheat crop.** Volunteer peas are avoided by

terminating the green manure crop no later than at the initial appearance of seed pods.

2. The method used to terminate the green manure crop is important and should rapidly stop pea growth to conserve water if winter wheat is being planted in September.

The tillage method used will be influenced by soil moisture. Disking has been successful with or without significant soil moisture. When pea growth is left on the soil surface after growth termination with undercutting or an herbicide, water runoff and wind erosion should be decreased when compared to using soil inversion techniques. Evaporation from the soil will be reduced when at least 2,300 pounds per acre of crop residue are left on the soil surface (Dalrymple et al., 1993).

Wheat yield and quality

Compared to conventional fallowing practices, spring-planted peas decreased the yield of a subsequent winter wheat crop when a green manure crop was allowed to grow later than July 1 in Archer. Wheat yield decreased 3.3 percent for each week of pea growth allowed after July 1. Three years after the green manure was produced, however, positive yield effects were observed from the second wheat crop when pea growth was allowed to continue through the middle of August.

The wheat-seed protein of the two crops following a green manure crop increased 0.5 to 1.5 percentage points. Because of the relatively dry and cool soils, the mineralization of organic matter to available nitrogen is thought to be slowed and to occur over several years following a green manure crop.

Table 1: Mean winter survival and green manure or forage yield of fall-planted Austrian winter pea varieties during 1995 and 1996 at Archer, Wyoming. ¹¹

Variety	Winter survival	Green manure/forage yield
	—%—	—pounds dry matter/acre—
Fenn	85	3752 a*
Common	77	3293 a
Melrose	86	2764 bc
Glacier	68	2227 c

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