

## PLANT MATERIALS TECHNICAL NOTE

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### **SAINFOIN** *Onobrychis viciifolia* Scop.

#### **An Introduced Legume for Conservation Use in Montana and Wyoming**

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#### **General Description**

Sainfoin has been grown in parts of Europe and Asia for over 450 years. Various strains have been introduced into North America since about 1900. These cultivars were generally low-yielding and poorly adapted to North American soils and climatic conditions. More recent introductions, however, when combined with plant-breeding efforts, have resulted in increased multi-cut forage yields, improved nodulation and nitrogen fixation, and resistance to diseases and insect pests.

Sainfoin grows from a root crown on a deeply penetrating tap root early in the spring and flowers one to two weeks earlier than alfalfa, which makes it an early season flowering species for pollinator habitat plantings. The stem is hollow, reddish-brown with straight hairs, and grows to a height of about 3 feet or more. The leaves are pinnately compound with 11 to 29 leaflets. The leaflets are longer than wide and taper abruptly to small sharp points. Condensed tannins in the leaves reduce the risk of bloat in ruminant livestock and reduce nematode parasitism in sheep. The small (about 1/3-inch long), fragrant flowers are pink to lavender with reddish-purple lines, have wing petals, and are borne on a spike-like stem called a raceme. The fruit is a one-seeded pod about 1/4-inch long.



A sainfoin flower

### **Adaptation or Range**

Sainfoin is adapted to much of the northern Rocky Mountains, Great Plains, and Great Basin up to elevations of 6,000 feet. It yields best on deep, well-drained soils with a pH of 7.0 to 8.0, and mean annual precipitation of 13 or more inches. It is frost and drought tolerant, resistant to bacterial wilt, and a good forage legume for sites with calcareous soils, late spring frosts, and plentiful spring and early summer precipitation. In areas where dryland hay production is limited to one cutting, or when there is a shortage of irrigation water, it may prove a good substitute for alfalfa (*Medicago sativa*).

### **Uses**

*Hay Production:* Sainfoin has a feed value similar to alfalfa, but is preferred over alfalfa by cattle, sheep, deer, and elk. It is well suited to mechanical harvesting as it grows upright and is easily cut. Since growth occurs up to full bloom, the first cutting can be taken at about the half- to full-bloom stage. Unlike alfalfa, sainfoin does not drop its lower leaves, and stems remain succulent as the plant matures. As a result, forage quality does not decrease as rapidly after the 10% bloom stage. Avoid cutting or grazing sainfoin too closely as it does not store carbohydrates during the summer and relies on photosynthesis by existing leaves to provide the necessary energy for re-growth. Allow six weeks of grazing rest before the first killing frost in the fall to facilitate the carbohydrate root storage needed for winter survival. Cutting a hay crop or grazing sainfoin after dormancy is recommended.

*Irrigated Pasture:* Sainfoin has premium forage quality and palatability making it an excellent choice for pasture. Although its productive lifespan may be less than other species, grazing sainfoin in the bud or early bloom stage and keeping the grazing height above 8 inches, lengthens the productive life from two or three years to six years. Sainfoin yields more when planted with either birdsfoot trefoil (*Lotus corniculatus* L.) or black medic (*Medicago lupulina* L.).

During the 1970's, a high-quality irrigated pasture mix intended to minimize alfalfa-caused bloat in cattle and for fall and winter stockpile grazing instead of haying, was developed by the late USDA-Agricultural Research Service (ARS) scientist, C. Scott Cooper, at the Range and Livestock Research Laboratory near Miles City, Montana. This "Cooper Mix" can be used for swath-stockpiling or direct grazing. It utilizes sainfoin as the main seed base with proportions of meadow brome (*Bromus biebersteinii*), birdsfoot trefoil, orchard grass (*Dactylis glomerata* L.) and spreading alfalfa added. By seeding the spreading alfalfa at only one-quarter pound per acre in the mixture, the danger of bloat is minimized. The producer may 1) graze and rotate the entire season or, 2)

green chop and graze the second cutting and/or, 3) graze early spring, hay mid-summer, and then stockpile re-growth for winter grazing.

*Dryland Pasture:* Sainfoin is adapted to dryland pastures and grows satisfactorily in mixtures with bunchgrasses such as Russian wildrye (*Psathyrostachys juncea*) and crested wheatgrass (*Agropyron desertorum*). The alternate-row planting method (sainfoin-Russian wildrye-sainfoin-Russian wildrye) is the recommended practice for mixes with Russian wildrye. Sainfoin forage yields, however, are slightly higher when it is grown alone.

*Seed Production:* Bulk seed yields of over 1,000 pounds per acre have been obtained under irrigation, with dryland yields substantially lower at 100 to 200 pounds per acre. The crop can be swathed when seed moisture is below 40% or when the seed begins to shatter. The stems and leaves may still be green at this stage. After two to five days of good drying weather, the crop may be combined with little loss.



Sainfoin seed with pods and a single, pod-less (naked) seed

Sainfoin seed production fields are susceptible to damage from lygus bugs (*Lygus* spp.) and resistant to alfalfa weevils (*Hypera postica*). Scout blooming fields frequently to determine the optimum time for insecticide application. Consider early morning or evening applications, when temperatures are cooler, in order to minimize negative impacts to beneficial pollinators.

At the Bridger Plant Materials Center, irrigated fields have been harvested early as a hay crop and then allowed to regrow and successfully produce a seed crop. Late growing season grazing by deer is less than in the spring, and lygus bug populations are reduced, resulting in less damage to the seed crop.

*Wildlife:* Since sainfoin is a preferred food source for many wildlife species, including sage grouse, it may prove valuable as a legume component in Conservation Reserve Program. In addition, sainfoin yields more, higher-quality honey than alfalfa.

### **Stand Establishment**

There are approximately 30,240 seeds (without pods) per pound and 18,500 seeds (with pods) per pound. Seeds with pods are normally sold by seed dealers in Montana and Wyoming. Sainfoin is easy to establish, provided the planting depth is no deeper than ¾-inch, and the seed is planted into a firm, weed-free seedbed. First year weed control is critical for optimum stand establishment. Plant sainfoin after a cereal grain or other crop where broadleaf weed control has been obtained, but no residual herbicide activity remains. Sainfoin can be planted with the pod intact, which

accounts for a much higher seeding rate when compared to alfalfa. For root nodule formation and nitrogen fixation, the seed must be inoculated with sainfoin-specific *Rhizobium* bacteria just prior to planting. Sainfoin can be planted in the fall, but spring plantings have the best emergence.

Plant dryland sainfoin with pods in 21- to 30-inch wide rows at 20 to 14 pounds, respectively, of pure live seed (PLS) per acre (see Plant Materials Technical Note, MT-46, current revision). To attain this spacing, block off drill openings with duct tape until the desired spacing is achieved. If a grass is included in the planting, reduce the seeding rate to 10 to 13 PLS pounds of sainfoin with pods per acre. Planting in alternate rows (sainfoin-grass-sainfoin-grass) is a one-pass, establishment method. The sainfoin should be placed in the large drill box and the grass in the small seed box. For planting in a pastureland mix, use 2 to 5 pounds PLS of sainfoin with pods per acre.

For irrigated production, sainfoin can be planted in a 7- to 12-inch wide row spacing at 25 to 34 PLS pounds of seed with pods per acre. If a grass variety is included in a seeding mixture, reduce the rate to 17 to 20 PLS pounds per acre. To increase stand longevity: 1) select disease resistant varieties, 2) do not clip or graze the stand the year of establishment, 3) allow established plants to produce seed, graze up to 50% utilization, and let livestock trample some of the seed into the soil. The last practice has been shown to increase sainfoin in the stand up to 35% (Mowrey and Matches 1991).

After sainfoin has become established, there are several herbicides labeled for application during the November to March dormant season (see Weed Management Handbook 2006 – 2007). Grassy weeds can also be controlled by swathing before seedhead formation or with labeled herbicides during the growing season.

### **Limitations**

Sainfoin has poor tolerance to close or frequent grazing and animal trampling. Its slow growth makes it best suited for rotational grazing systems. The productive life of sainfoin is related to such factors as clipping height, competition from other forages and weeds, and frequency of irrigation. *Irrigating sainfoin in the same manner as alfalfa will cause rapid stand decline.* Sainfoin typically requires about 50% of the irrigation water needed by alfalfa. Since sainfoin is readily browsed by deer and elk, new plantings may need protective fencing in areas where large herds reside. In addition, it should not be planted next to unprotected shelterbelts because trees and shrubs may suffer collateral damage.

Sainfoin requires good drainage and has a low tolerance to excessive soil moisture, flooding, water logging, or even a high water table. It is also shade intolerant and performs poorly on acidic or saline soils. Depending on adaptability to a given site, it may yield well for one or more production years. Sainfoin seedlings compete poorly in mixtures with tall, aggressive grasses, such as intermediate wheatgrass (*Thinopyrum intermedium*) or smooth brome (*Bromus inermis*). Although total yield is usually not affected in these stands, the proportion of sainfoin rapidly decreases. Older sainfoin varieties are short-lived where root and crown rots are a problem.

### **Releases**

Releases (year and location) of sainfoin include 'Delaney' (2007, Wyoming), 'Shoshone' (2005, Wyoming), 'Nova' (1980, Canada), 'Renumex' (1977, New Mexico), 'Remont' (1971, Montana), 'Melrose' (1969, Canada) and 'Eski' (1964, Montana). *Only the following releases are considered well adapted to Montana and Wyoming* because of their selection from lines adapted to our northern, semi-arid climate and subsequent forage trial results at various sites in these two states (see Table 1 for yield data at three test sites in Montana).

**Delaney** sainfoin was released as a multi-cut variety to replace Remont. Under irrigation, Delaney had higher yields than Shoshone, Remont, and Eski sainfoin, as well as cultivars of birdsfoot trefoil and cicer milkvetch (*Astragalus cicer* L.). The re-growth potential of Delaney was also improved, and under irrigation, third cutting yields were higher than Remont, Eski, and Shoshone. Under dryland conditions, Delaney proved superior to Eski but similar to Remont.

**Shoshone** sainfoin was selected for its tolerance of northern root-knot nematode. It has good drought tolerance, winter hardiness, and is also resistant to alfalfa stem nematode. Shoshone is the preferred variety when sugar beets or other root crops are included in an irrigated crop rotation.

**Remont** sainfoin was selected for rapid re-growth potential. It begins spring growth earlier than Eski, and therefore has a higher yield potential during a long growing season.

**Eski** sainfoin was selected for winter hardiness in trials at Sidney, Montana. Eski is recommended for dryland areas receiving at least 13 inches of annual precipitation and irrigated land yielding only one or two cuttings.

Table 1. Summary of Delaney Sainfoin Yields (Tons Dry Matter/Acre/Year) in Montana Trials, 1998-2006

Location:	Bozeman.	Bozeman	Bozeman.	Kalispell	Moccasin	Bozeman.	Moccasin	Bozeman.
Production Type:	Irrigated	Dryland	Irrigated	Irrigated	Dryland	Irrigated	Dryland	Irrigated
Year Seeded:	1998	1998	1999	1999	1999	2000	2000	2004
Years Harvested:	1998-2001	1998-2001	2000-2001	1999-2002	2000-2002	2001-2003	2001-2002	2005-2006
No. Harvests:	11	7	6	11	3	10	2	6
	tons/A	tons/A	tons/A	tons/A	tons/A	tons/A	tons/A	tons/A
Delaney sainfoin	<b>4.89</b>	<b>1.77</b>	<b>4.26</b>	<b>6.45</b>	0.38	<b>5.74</b>	0.89	<b>6.32</b>
Shoshone sainfoin	4.33	<b>1.68</b>	<b>4.11</b>	5.75	0.40	<b>5.43</b>	0.94	5.58
Remont sainfoin	<b>5.03</b>	<b>1.65</b>	<b>3.96</b>	<b>5.81</b>	0.33	5.04	0.85	5.46
97MT-1 sainfoin	<b>4.82</b>	1.49	<b>4.24</b>	<b>5.83</b>	0.42	-	-	-
Nova sainfoin	-	-	-	-	-	5.00	0.92	-
Eski sainfoin	4.30	1.58	3.27	2.75	0.28	4.90	0.81	5.59
Ladak 65 alfalfa	-	-	-	5.03	<b>0.81</b>	4.70	<b>1.33</b>	-
Shaw alfalfa	-	-	-	-	-	4.78	<b>1.40</b>	-
L-2 Syn1 birdsfoot trefoil	-	-	-	3.03	0.36	3.21	0.31	-
Windsor cicer milkvetch	-	-	-	4.23	0.20	2.29	0.47	-
Lutana cicer milkvetch	-	-	-	3.93	0.28	2.45	0.33	-
Tretana birdsfoot trefoil	-	-	-	2.26	0.28	3.16	0.19	-
Monarch cicer milkvetch	-	-	-	3.94	0.26	2.07	0.30	-
AC Grazeland alfalfa	-	-	-	5.19	<b>0.81</b>	-	-	-

**Bold** values within a column denote values not significantly different from the highest yield.

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