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SAINFOIN .. A New Legume for North Dakota?

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Sainfoin (**Onobrychis viciaefolia** Scop.) is a perennial legume which has long been grown as a hay and pasture crop in Europe, Iran, Turkey and western Russia.

Trials with this species conducted by the North Dakota Agricultural Experiment Station about 20 years ago indicated that the types and strains available for evaluation at that time were not adapted to North Dakota conditions[1]. Recently, however, interest in this crop has been revived because of the development of the variety Eski by the Montana Agricultural Experiment Station. Eski was derived from seed obtained from the Eskisehir Dryland Experiment Station at Eskisehir, Turkey. Winter-hardy selections were made from this source and the variety Eski evolved. Eski appears to have the drouth resistance and winter hardiness that other strains of sainfoin have lacked, and in addition has several of the other characteristics which an ideal legume should have.

The ideal legume for North Dakota should be high yielding, palatable, nutritious, non-bloating, long-lived, drouth resistant, winter-hardy, insect and disease resistant, and competitive.

Sainfoin grows three to four feet high and possesses a hollow stem which arises from a branched crown. The leaves are pinnately compound with varying number of leaflets, as shown in Figure 1. Rose-colored flowers are contained on an erect, raceme-type inflorescence. Both flower and pod maturation begins at the base of the inflorescence and proceeds upward. The yellow to dark brown seed is produced in a one-seeded, bean-shaped, netted pod that shatters readily when mature. Pods containing seed weigh 23 grams per 1,000, whereas seed with pod removed weigh 15 grams per 1,000 (6). Alfalfa seed, in comparison, weighs two grams per 1,000 (4).

Sainfoin has yielded well in limited trials at Williston and Dickinson, but has been a poor producer at Fargo. It is reported to be a palatable and nutritious forage. Generally, it is similar to alfalfa in ether extract, higher in nitrogen-free extract, and lower in protein, crude fiber and total ash at similar stages of growth[2]. Leaflets are retained on the sainfoin plant better than on alfalfa with advancing maturity. Sainfoin matures slightly earlier than does alfalfa.

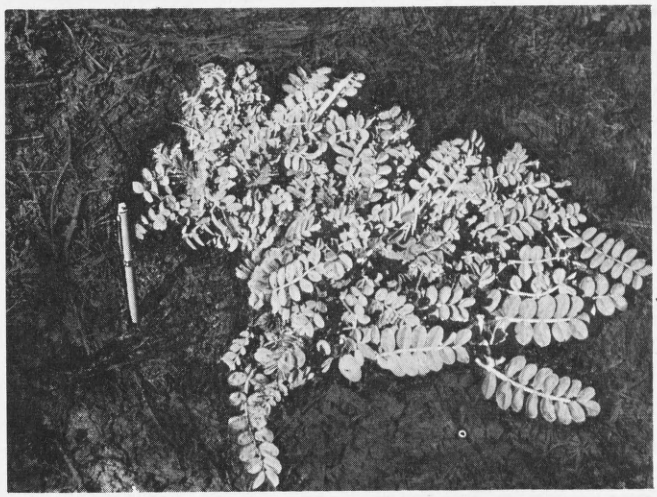

Fig. 1. Early stage of growth of sainfoin. Note pencil for relative size of plant.

Sainfoin has never been known to cause bloat in livestock. Foam tests used to indicate the bloat potential of plants have shown it to be very low in this property (3). In areas where adapted, sainfoin is long-lived. How long-lived it will be in North Dakota will depend to a great extent on how drouth resistant and winter hardy it is. Tests by the Montana Agricultural Experiment Station indicate it is both drouth resistant and winter hardy, although contradictory results have been obtained. It has a deep, penetrating root system and appears to be well adapted to calcareous soils (5). Presently, it is reported to be resistant to many insects, including the alfalfa weevil (1). However, its insect and disease resistance in the Northern Great Plains environment will not be severely tested until it is grown on large acreages in this region.

Sainfoin appears to be a poor competitor with weeds. Eski sainfoin has generally had little or no regrowth after first harvest, and weeds have been a very serious problem in both seedling and established stands.

[1]Dr. J. F. Carter, professor and chairman, Department of Agronomy, personal communication.

Schneiter was assistant agronomist, Williston Branch Station; Dr. Whitman is professor and chairman, Department of Botany; and Dr. Larson is associate professor, Department of Agronomy.

[2]**Holden, L. J.** 1963. Agronomic potential of sainfoin (**Onobrychis viciaefolia**) for Montana. M.S. thesis, Montana State University, Bozeman. 48p.

Research at Dickinson

An observation and yield trial of sainfoin and alfalfa seeded alone and in mixture with bromegrass and crested wheatgrass was planted at Dickinson in 1966. This seeding mainly was to determine the adaptability of sainfoin to western North Dakota, especially as related to drouth resistance and winter hardiness, and to determine its ability to compete when seeded in mixture with bromegrass and with crested wheatgrass. These grasses are the two major species used for pasture and hay in this area.

The per cent of each legume and grass in 1967, the first year of harvest, and average yields for 1967 and 1968 are given in Table 1. Much additional work will be needed before the value of this species for western North Dakota is determined.

Table 1. Per cent and yields of Eski sainfoin and alfalfa seeded with bromegrass and with crested wheatgrass in 1966 at Dickinson, 1967-68.

	Per cent in mixture*		Tons/acre @ 12% moisture		
Legume of mixture	Grass	Legume	1967	1968	2-yr. average
Sainfoin	—	100	2.69	1.30	2.00
Alfalfa	—	100	.68	1.25	.97
Brome and alfalfa	63	37	1.20	1.32	1.26
Crested and alfalfa	61	39	1.45	1.39	1.42
Brome and sainfoin	47	53	2.12	1.27	1.70
Brome and sainfoin	51	49	1.96	1.00	1.48

*Per cent grass and legume determined in 1967.

Research at Williston

Personnel at the Williston Experiment Station have observed and conducted trials with Eski sainfoin since 1965. Eski is extremely early and appears to be winter hardy and frost resistant. No winter kill of Eski has been observed at the station since the first trial was established in 1965. In the seedling year, some plants were still blooming as late as November 12. Prior to this date the temperature had dropped to 32°F or below 32 times, with a lowest temperature of 15°F.

Eski appears to be drouth hardy. It has remained green and has exhibited more growth through periods of low amounts of available moisture than other grasses and legumes, including alfalfa.

In the past two years the plants at Williston have developed definite signs of nitrogen deficiency. This same condition has been observed in other areas where sainfoin has been established (2). This is a very unusual condition for a legume and apparently indicates that the strain of nitrogen-fixing bacteria presently available may not be efficient in nitrogen fixation or is short-lived.

Forage and seed production of Eski sainfoin for the past three years has been good in spite of below normal rainfall (Table 2).

Table 2. Forage and seed production of Eski sainfoin and rainfall at Williston, 1966-68.

			Rainfall in inches*	
Year	Tons/acre @ 12% moisture	Lbs/acre seed	Total	Deviation from normal
1966	3.69**	494	10.41	−4.01
1967	1.29	379	11.76	−2.66
1968	.49	250	10.27	−4.15
Average	1.82	374	10.81	−3.61

*Rainfall from July 1 the year before harvest to June 30 the year of harvest.
**Planted on fallow.

Rainfall in each year was below normal. The forage and seed protein for the three-year period averaged 12.9 and 26.1 per cent, respectively. Two cuttings were made in 1966 and one each in 1967 and 1968. The mean date for forage harvest was June 15 (10-30 per cent bloom) and for seed harvest was July 16.

Inoculated seed was sown at 25 pounds per acre on summer fallow. Weeds were controlled by hoeing the first season in the trial.

One of the more serious problems encountered has been the poor competitiveness of sainfoin with weeds. Eski has generally produced little or no regrowth after harvest and as a result weeds have become a problem. In newly established fields, weeds such as Russian thistle (**Salsola kali**) and yellow foxtail or pigeon grass (**Setaria lutescens**) have been a very serious problem. Herbicide trials using both pre-plant and post-emergence herbicides have been conducted at the station. Trifluralin at ¾ pound per acre was the most effective pre-plant spray tested, giving good control of both of these weeds without injury to sainfoin. Post-emergence herbicide, 2,4-DB applied at one pound per acre has given good control of Russian thistle without injury to the sainfoin, providing the application was made when the weeds were extremely small.

Some of the trials presently being conducted with Eski sainfoin at the Williston Station include rate of seeding, fertility studies, and a trial comparing Eski with various alfalfa varieties.

Research at Fargo

Sainfoin was seeded alone in a small observational plot at Fargo on May 10, 1965. The plants were allowed to grow undisturbed throughout the summer and fall of 1965. Weeds were controlled by hoeing.

The plants were sampled for nitrogen determinations during several stages of growth in 1966. Tops and roots were separated at a point 1½ inches

above the cotyledonary node. Roots existing four inches below the node were discarded. The tops and retained roots were dried at 100°C for one hour to a constant weight at 70°C.

The top and root tissue was analyzed for nitrogen by the Kjeldahl method. Date of sampling, stage of growth, per cent Kjeldahl nitrogen in the roots and per cent crude protein in the tops are shown in Table 3. As the plants matured, per cent nitrogen and protein in the roots and tops, respectively, decreased.

Table 3. Per cent nitrogen and protein in the roots and tops of Eski sainfoin, respectively, at several stages of growth at Fargo, 1966.

Date	Stage	Height-inches	% N roots	% Protein tops
May 18	Rosette	3	2.4	34.2
June 7	80% bud	21	1.6	20.0
June 22	50% bloom	31	1.5	10.6
July 5	Full bloom	32	1.1	10.5
July 26	Pod	31	1.4	8.1
August 15	Pods falling	24	1.4	9.3
September 27	—	—	2.0	9.3

Seed was inoculated with the specific nitrogen-fixing bacteria prior to seeding. Good nodulation was observed on the roots when the plants were harvested on May 18, 1966. The plants were approximately three inches tall and in a rosette stage of growth with 12-15 leaves present.

Eski was compared with several alfalfa varieties seeded at Fargo on May 20, 1966 and May 25, 1967. The inoculated seed was seeded at a rate of 30 pounds per acre. Seed cost was 85 cents per pound. This cost may decline as seed becomes more available. Forage yields obtained from sainfoin and the three recommended varieties of alfalfa for North Dakota and per cent stand are shown in Tables 4 and 5. The results show that Eski possesses poor recovery growth, as was observed at the other stations in North Dakota.

Table 4. Tons dry matter per acre of Eski sainfoin and three alfalfa varieties seeded in 1966 and harvested during 1967-68 at Fargo.

		Tons dry matter per acre						
	% stand	1967				1968			
Variety	6-25-68	6-20	7-21	9-1	Total	6-25	7-23	8-28	Total
Eski	72	.79	.20	0	.99	.88	.09	.06	1.03
Vernal	91	1.43	1.00	.50	2.93	1.16	.78	.34	2.28
Ranger	96	1.42	1.06	.60	3.08	1.15	.90	.44	2.49
Ladak	99	1.67	1.10	.43	3.20	1.45	.99	.46	2.90

Table 5. Tons dry matter per acre of Eski sainfoin and three alfalfa varieties seeded in 1967 and harvested during 1968 at Fargo.

	% Stand	Tons dry matter per acre			
Variety	6-10-68	6-18	7-22	9-3	Total
Eski	80	2.11	.34	0	2.45
Vernal	98	2.49	1.59	.65	4.73
Ranger	99	2.28	1.78	1.06	5.12
Ladak	98	2.54	1.43	.61	4.58

A trial was initiated at Fargo in 1968 on a one year old stand of Eski to study whether management of stubble height might be used to induce a more rapid recovery growth. Two stubble heights of two and five inches were imposed on plants at harvest on June 19, 1968. Plants were allowed to recover until they were harvested again on August 28, 1968 at the selected heights of two and five inches. Yields obtained from the two treatments are shown in Table 6.

Table 6. Tons dry matter per acre of Eski sainfoin harvested at 2- and 5-inch stubbles at Fargo, 1968.

	Tons dry matter per acre		
Treatment	6-19	8-28	Total
2-inch	3.31	.44	3.75
5-inch	2.28	.18	2.46

The one year's data suggest that leaving an additional three inches of stem does not provide for more rapid recovery. The recovery growth originated from the crown of the plant regardless of stubble height. This study will be continued during 1969.

SUMMARY

Observations and investigations to date suggest that farmers who have successfully grown alfalfa before and who are not afraid of bloat should continue to use alfalfa as the principal forage legume. The main advantage of sainfoin is its nonbloating characteristic, although this has not been verified in North Dakota trials to date. Results from Montana indicate sainfoin possesses this desirable characteristic.

Eski appears to be satisfactory with respect to yield in western North Dakota and to adaptability throughout the state. Recovery ability and competitiveness of Eski have been poor in North Dakota trials. Trials at Dickinson and Williston have shown a decline in productivity after the first harvest year.

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