RELEASE NOTICE
OF
'SHOSHONE' SAINFOIN

(*Onobrychis viciifolia)*

WYOMING AGRICULTURAL EXPERIMENT STATION

September 2004

Introduction: Sainfoin appears to be native to regions around the Mediterranean, Black and Caspian Seas and north to Russia. Plant introductions have been collected from Iran, Turkey, Greece, Yugoslavia, Italy, Bulgaria, Spain, Switzerland, Germany, Soviet Union, Poland, Norway and the United Kingdom. It has been cultivated in Europe for at least 450 years. Sainfoin was introduced into the northern Great Plains of the U.S. from Turkey. Improved varieties which have been developed in North America include; 'Eski' and 'Remont' from Montana, 'Renumex' from New Mexico, and 'Melrose' and 'Nova' from Canada.

Description: Sainfoin, *Onobrychis viciifolia* Scop. (holy grass, holy hay) is a member of the Fabaceae family. It is a perennial, non-bloating, forage legume. It was introduced into Montana and North Dakota in the early 1950s from Eurasia (Turkey) and can be used as a hay or pasture crop. It is a deep-rooted species with stout, erect stems arising from a crown. Leaves are oddly pinnate with 13-21 leaflets per leaf. Flowers are borne on an erect raceme and are pink to rose in color. A single seed is produced in a bean-shaped pod. Seed are kidney-shaped and weigh about 15 g/1000 seed. As seeds mature, they are susceptible to shattering from the pod. Use of pollinators (honey or leaf cutter bees) will increase seed yields. The seed crop should be wind-rowed when the seed is at about 40% moisture. Seed is dried in the windrow before threshing and is stored at 12% moisture. Important diseases in the U.S. include root, crown and stem rots. Probably the worst insect pest is the lygus bug. However, it is resistant to the alfalfa weevil. From experiments conducted in Wyoming, sainfoin is resistant to the alfalfa stem nematode, but susceptible to Verticillium wilt. It is also susceptible to seedling blight caused by *Phytophthora megasperma*, but appears to be immune to the root rot phase, which is a problem in alfalfa. In greenhouse studies conducted by the author, 'Apron'® (metalaxyl) seed treatment was shown to offer good protection against Phytophthora seedling blight.

Uses: Sainfoin is an extremely palatable and nutritious forage for all classes of livestock and wild life. It is a preferred forage for cattle, sheep, deer, elk and rabbits. Sainfoin tends to mature earlier than alfalfa providing early spring forage. At similar stages of maturity, sainfoin has been lower in crude protein (CP) and higher in digestible nutrients (ADF) than alfalfa. Like other legumes, sainfoin fixes atmospheric nitrogen and provides extra nitrogen for non-leguminous forage species which may be planted in a forage mixture. A select strain of *Rhizobium* spp. is available for sainfoin which will assure adequate nodulation. Sainfoin can be used for wildlife habitat restoration, for wildlife enhancement as a component with other forage species for 'Food Plots,' or as a legume component under the conservation reserve program. Although its flower attracts a variety of pollinating insects, use of honey or leaf cutter bees will increase seed production. Beekeepers indicate honey yields with sainfoin are much greater than with alfalfa.

Area of Adaptation: Sainfoin is well adapted to much of the northern Rocky Mountains, northern Great Plains, and the inland Pacific Northwest. It has been successfully grown from Montana to Arizona. In Wyoming, the variety Remont yielded similar to Ladak alfalfa over a four-year period in the Laramie Valley.

Environmental Considerations: Sainfoin can be used either for pasture or hay in areas receiving 330 mm (13 inches) or more annual precipitation. It thrives on calcareous soils (pH 7.0 to 8.0) which are too dry for clover or alfalfa. It is long-lived on dryland, but short-lived on irrigated land. It grows well on soils low in phosphorus but results in reduced nitrogen fixation.

Development of Shoshone Sainfoin: The origin of Shoshone sainfoin came from an intercross of 176 surviving plants in a sainfoin variety trial at the University of Wyoming, Agricultural Research and Extension Center located in Torrington, Wyoming (Table 1). The trial was planted on 26 April 1981 and severe stand decline occurred the following summer. Roots of stunted plants were found to be heavily parasitized by the northern root-knot nematode, *M. hapla* Chitwood. Overall stand reduction in the sainfoin entries by the spring of 1983 was 91.5%. Entries in the test and percent stand reductions in 1983 are given in **Table 1**. All six entries appear to be equally susceptible. After the stunted chlorotic plants were removed, the remaining 176 selected plants were allowed to intercross with native pollinators. Before seed could be obtained, a fence had to be constructed to prevent deer predation. Sainfoin entries and their percent contribution to the intercross in August of 1984 are listed in **Table 1**. Surviving plants of the sainfoin variety Bozeman, Creston, Eski, Melrose, Remont and W-40 are the parental lines of Shoshone. A relatively small amount (800 g = 1.76 lbs) of seed was obtained in the fall of 1984 and designated as 'WY-PX1-84.' This seed was used to conduct experiments in the greenhouse, growth chamber and the one field study. Some of this seed was saved and planted in a 20-ft by 20-ft enclosure for an increase at Torrington. This seed was then used to establish an 0.8 A seed block in the spring of 1994 at the Archer Experiment Station under dryland conditions. Seed was planted on 36-inch rows with a seeding rate of 5 lbs/A. From this seed block, 227 lbs of unshelled, clean seed with a germination of 60% was obtained in 1995 and designated 'WY-PX2-94.' Portions of this seed were used to obtain information on forage yield and stand persistence in trials at Archer and Powell, Wyoming, and at Bridger and Bozeman, Montana.

Greenhouse, Growth Chamber and Field Studies - Shoshone was compared to Remont which has excellent yield and stand persistence in Montana and Wyoming. Since interplantings with forage grass species are commonly used, experiments included solid seedings and intercropping. Studies were conducted under both irrigated and dryland conditions.

Greenhouse and Growth Chamber Studies - Studies conducted at the University of Wyoming showed Shoshone to express tolerance to the northern root-knot nematode. This was expressed by increased shoot and root weight (**Tables 2a, 2b, 3 and 4**).

Inoculum used in these studies was originally obtained from sainfoin roots in Torrington and cultured on alfalfa in the greenhouse. However, inoculum levels in the experiments exceeded field populations and appeared to overwhelm sainfoin plants.

Field Studies - Field plot studies have been conducted at six different locations from 1990 to 2003 (**Table 5**). These include; The University of Wyoming Experiment Stations at Archer (dryland) and Powell (irrigated); USDA-Plant Materials Center, Bridger, Montana (irrigated and dryland); and University of Montana Agricultural Research Station, Bozeman, Montana (dryland and irrigated).

Wyoming

1. Archer (**dryland**) - (1996-2001) - Forage yields of Shoshone and Remont under dryland conditions in southeastern Wyoming, were similar over a five-year (1997-2001) period (**Table 6**). Rainfall was sufficient for the year of establishment and for the first production year. This was followed by severe drought during the last four years of the study, resulting in severe yield reduction by 2001. Total yield over the five harvest years was 5.51 tons/A for Shoshone compared to 5.54 tons/A for Remont.

2. Powell (**irrigated**) - (1996-2001) - Forage yield was taken in 1997, 1999 and 2001 (**Table 7**). Yields and plant stands for Shoshone in 2001 were slightly better than Remont. Total yield for the three harvest years was 11.13 tons/A for Shoshone compared to 10.44 tons/A for Remont. Total four-year yield for Shoshone was 123.4 lbs/plot fresh weight compared to 121.0 lbs/plot fresh weight for Remont.

Montana

1. Bridger **(irrigated)** - Shoshone forage yield was higher than that of Remont in the irrigated test. Total yield for four years for Shoshone was 10.9 tons/A compared to 9.36 tons/A for Remont (**Table 8**). Shoshone also yielded higher than Remont in the intercropped treatments with Manska wheatgrass. Yields for Shoshone were 5.21 tons/A versus 4.76 tons/A for Remont.

2. Bridger **(dryland)** - Shoshone forage yield was slightly higher than that of Remont under dryland conditions at Bridger. Total four-year yields for Shoshone were 4.76 tons/A compared to 4.35 for Remont (**Table 8**). Shoshone also yielded slightly higher than Remont in the intercropping with Bozoisky. Yields for Shoshone were 3.76 tons/A compared to 3.64 tons/A for Remont.

3. Bozeman Sainfoin yield trial **(dryland)** - Shoshone forage yield was slightly higher in the dryland test than Remont. Total four-year yields for Shoshone were 123.4 lbs/plot compared to 121.0 lbs/plot for Remont (**Table 9**).

4. Bozeman Sainfoin yield trial **(irrigated)** - Irrigated forage yield for Remont was higher than Shoshone; 369.7 lbs/plot fresh weight for Remont compared to 317.8 lbs/plot fresh weight for Shoshone (**Table 9**).

5. Bozeman miscellaneous legume trial **(irrigated)** - Forage yield for Shoshone was significantly higher than Remont (**Table 10**). Total three-year yields for Shoshone were 21.96 tons DM/A versus 20.15 tons for Remont. Of the 16 entries in the trial, Shoshone ranked no. 2.

Summary: Shoshone is the progeny of an intercross of 176 plants from five separate varieties selected for persistence in the presence of the northern root-knot nematode. No further selection was made for forage or seed yield. Overall results of these studies have shown Shoshone to be equal to or slightly better than Remont for forage production under both dryland and irrigated sites in Wyoming and Montana. Tolerance to the northern root-knot nematode was indicated in growth chamber and greenhouse studies by higher shoot and root biomass and plant survival in the presence of the root-knot nematode. However, tolerance usually results in greater root galling and higher nematode population in response to larger roots. This root parasite occurs throughout the northwestern U.S. and Canada.

Although Shoshone should express tolerance to this nematode, it does not have true resistance (no nematode reproduction on roots) and therefore should not be planted in fields known to have a high population of *M. hapla*. This statement applies to any sainfoin variety. Research conducted by the author to determine if true resistance could be found in the world collection of *O. viciifolia*, as well as in other species of the genus, was negative. Shoshone appears to be well-adapted to both dryland and irrigated test sites in both states**.** Apron® seed treatment should be used when planting sainfoin in irrigated sites for protection against Phytophthora seedling blight.

Variety Development:

Torrington - In 1990, a 20-ft by 20-ft block was planted with remaining seed from the WY-PX1-82 intercross of the original selected plants. Seedlings, established in the greenhouse, were transplanted in rows and seed harvested in 1991 and 1992, resulting in approximately 5 lbs of breeder seed.

Archer - Seed from the Torrington crossing block was used to plant an 0.8 acre seed block at the Archer research station in 1994. In 1995, approximately 250 lbs of foundation seed was harvested and designated WY-PX2-94 (Shoshone). This resulted in 227 lbs of clean, unshelled seed. Domestic bees were not used for either of the seed increases. This seed was used to establish all the forage yield trials.

Powell – A 0.5 acre field located on the University of Wyoming, Agricultural Research and Extension Station in Powell, WY was planted with second generation Breeder Class seed (WY-PX2-94) of Shoshone sainfoin in the spring of 2004. Seed harvested from this new planting will be designated as Foundation Class seed.

Increase and Distribution:

Three generations, Foundation, Registered, and Certified, are recognized. Foundation seed will be maintained by the Wyoming Seed Certification Service, Powell, Wyoming. Foundation seedstock should be available in 2005.

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Published materials with information on diseases of Remont sainfoin and reaction of Shoshone sainfoin to the northern root-knot nematode:

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6. Mathre, D. 1968. Diseases of Sainfoin. pp. 65-66. In, Sainfoin Symposium at Montana State University, Montana Ag. Exp. Sta. Bulletin 627.
7. Shigaki, T. 1991. Control of the northern root-knot nematode in sainfoin by intercropping with meadow bromegrass. M.S. Thesis, 55 pp. University of Wyoming Science Library, Laramie, Wyoming.

8. Shigaki, T., F. A. Gray, R. H. Delaney and D. W. Koch. 1998. Evaluation of host resistance and intercropping for management of northern root-knot nematode in sainfoin, *Onobrychis viciifolia*. Journal of Sustainable Agriculture 12:23-39.
9. Wofford, D. S., F. A. Gray and J. W. Eckert. 1987. Evaluation of cultivars, experimental lines and plant introduction collection of sainfoin for resistance to the northern root-knot nematode. J. Nematology 19:30-37.
10. Wofford, D. S., F. A. Gray and J. W. Eckert. 1989. Pathogenicity of two population of *Meloidogyne hapla* Chitwood on alfalfa and sainfoin. J. Nematology 21:87-91.

Note: Other general information on sainfoin can be obtained by searching the Internet for "sainfoin."

Table 1. Stand loss caused by the northern root-knot nematode, *Meloidogyne hapla*, in a sainfoin variety trial. Surviving plants were intercrossed to produce Shoshone sainfoin.[a] (Torrington, WY, Res. & Ext. Center)

Sainfoin entry	Stand loss[b] on 23 May 1982 (%)	Survival of plants selected for tolerance to *M. hapla*				
		Selected 15 May 1983		Intercrossed 10 Aug 1984		
		Total	Mean[c]	Total	%	Mean[c]
Bozeman	93.2 a	28	7.0 a	17	9.6	4.3 e
Creston	85.0 a	40	10.0 a	36	20.4	9.0 a
Eski	93.2 a	40	10.0 a	33	19.0	8.3 ab
Melrose	95.0 a	35	8.8 a	28	15.9	7.0 a-e
Remont	94.5 a	30	7.5 a	30	17.0	7.5 a-d
W-40	88.3 a	34	8.5 a	32	18.1	8.0 a-c
Total		207		176		

[a] Values in each column followed by the same letter are not different at $P < 0.05$ as determined by Duncan's multiple-range test.
[b] Plots were established 26 April 1981 at the University of Wyoming, Research and Extension Center. Values are means of four replications.
[c] Values are the mean number of plants selected for tolerance to the root-knot nematode from four replicate plots.

Table 2a. Effect of *Meloidogyne hapla* on dry shoot and root weight and plant mortality of (WY-PX1-84) Shoshone (**greenhouse study**) **Experiment I.** University of Wyoming, Department of Plant Sciences (1990).

Entry	Treatment: Inoculated with *M. hapla*	Treatment: Uninoculated	Percent reduction due to *M. hapla*
	Shoot weight (g)		
WY-PX1-84	**0.507 c**	**1.057 c**	**52.0**
Remont	0.035 c	0.613 cd	94.3
Regar bromegrass	2.973 b	3.760 b	20.9
WY-PX1-84 +	0.007 c	0.173 d	96.0
Regar bromegrass	5.830 a	8.020 a	27.3
	5.837	8.193	
Remont +	0.000 c	0.123 d	100.0
Regar bromegrass	5.210 a	8.210 a	36.5
	5.210	8.333	
LSD value	0.637	0.817	
	Root weight (g)		
WY-PX1-84	**1.838 c**	**1.988 b**	**7.5**
Remont	0.108 c	0.800 b	86.5
Regar bromegrass	36.155 b	31.833 a	+ 13.6
WY-PX1-84 +	0.000 c	0.460 b	100.0
Regar bromegrass	76.617 a	43.810 a	+ 74.9
	76.617	44.270	
Remont +	0.000 c	0.513 b	100.0
Regar bromegrass	70.253 a	37.590 a	+ 86.9
LSD .005	11.377	12.991	

Values of shoot weight are in grams and are the mean of five replicate plots.

Table 2b. Effect of *Meloidogyne hapla* on dry shoot and root weight of (WY-PX1-84) Shoshone. **Experiment II, (growth chamber study)** University of Wyoming, Department of Plant Sciences, Plant Pathology/Nematology Laboratory, 1990.

Entry	Treatment: Inoculated with *M. hapla*	Treatment: Uninoculated	Percent reduction due to *M. hapla*
	Shoot weight (g)		
WY-PX1-84	**0.128 d**	**1.329 ab**	**90.4**
Remont	0.038 d	1.321 ab	97.1
Regar bromegrass	0.948 c	0.948 b	0.0
WY-PX1-84 +	0.008 d	1.183 b	99.3
Regar bromegrass	2.138 a	1.580 a	+ 35.3
	2.146	2.763	
Remont +	0.000 d	1.117 b	100.0
Regar bromegrass	1.588 b	1.647 a	3.6
	1.588	2.764	
LSD 0.05	0.351	0.395	
	Root weight (g)		
WY-PX1-84	**0.117 c**	**2.575 b**	**95.5**
Remont	0.019 c	2.338 b	99.2
Regar bromegrass	3.531 b	3.678 b	4.5
WY-PX1-84 +	0.008 c	1.413 b	99.5
Regar bromegrass	17.292 a	7.722 b	+ 122.0
Remont +	0.000 c	1.722 b	100.0
Regar bromegrass	5.900 b	7.122 b	
LSD .005	2.776	2.645	

	Final plant counts						Percent mortality due to
	Inoculated			Uninoculated			
Entry	Initial	Final	Mortality	Initial	Final	Mortality	*M. hapla*
WY-PX1-84	**12.0**	**3.5**	**70.8 c**	**12.0**	**11.3**	**5.8**	**65.0**
Remont	12.0	1.0	91.7 d	12.0	11.8	1.7	90.0
Regar bromegrass	12.0	10.0	16.7 b	12.0	12.0	0.0	16.7
WY-PX-84 +	6.0	0.5	91.7 d	6.0	5.8	3.3	88.4
Regar bromegrass	6.0	6.0	0.0 a	6.0	6.0	0.0	0.0
Remont +	6.0	0.0	100.0 d	6.0	5.3	11.7	98.3
Regar bromegrass	6.0	6.0	0.0 a	6.0	5.5	8.3	0.0
LSD .05			12.3			NS	

Values are the mean of four replicates. Data were collected after 6 months.
Toshiro Shigaki, M.S. Thesis, 1991.

Table 3. Evaluation of sainfoin for reaction of the northern root-knot nematode **(1990 greenhouse flat study)**.[a]

Sainfoin entry[b]	Plant biomass (dry wt/plant in grams)				Root galling[c]		Final plant count (plants/row)[d]		Plant survival of inoculated plants (%)
	Shoot		Root						
	Inoculated with *M. hapla*	Uninoculated	Inoculated with *M. hapla*	Uninoculated	Inoculated with *M. hapla*	Uninoculated	Inoculated with *M. hapla*	Uninoculated	
Plant #2	0.11 a	0.50 a	0.06 a	0.35 a	2.4 ab	1.0 a	1.8 a	16.0 a	11.3
Plant #3	0.05 a	0.72 a	0.01 a	0.40 a	2.0 b	1.0 a	0.3 a	13.0 b	2.3
Remont	0.00 a	0.44 a	0.00 a	0.31 a	0.0 c	1.0 a	0.0 a	16.0 a	0.0
Shoshone (WY-PX1-84)	**0.04 a**	**0.37 a**	**0.09 a**	**0.32 a**	**3.0 a**	**1.0 a**	**1.0 a**	**16.0 a**	**6.1**

[a] Means over four replicates, one row (20 seeds) per replicate. Values in each column followed by the same letter are not different at $P \leq 0.10$ as determined by Duncan's multiple range test.

[b] Plants #2 and #3 are full-sib families from single plant selections of the sainfoin variety Nova and Remont, respectively, for tolerance to *M. hapla*.

[c] Roots were rated for galling on a scale of 1-4; 1 = no galls, 2 = 1-10 galls, 3 = 11-100 galls, 4 = >100 galls.

[d] Flats were seeded and inoculated on 7/16/89. Final stand counts were made 9 months later on 2/7/90.

Table 4. Evaluation of sainfoin for reaction to the northern root-knot nematode **(1989 greenhouse pot study)**.[a]

Entry[b]	Plant biomass (dry wt/plant in grams) Shoot 9/19/89	Shoot 1/4/90	Root 1/4/90	Root galling[c] (1-4)	Nematode reproduction (eggs/root system)	Plant survival (%)
Sainfoin						
Plant #2	7.1 a	3.5 ab	5.9 ab	3.5 ab	109,003 b	60 ab
Plant #3	7.2 a	4.4 a	12.0 a	3.5 ab	70,592 b	80 a
Remont	6.2 a	1.5 b	2.2 b	3.0 b	115,431 b	40 b
Shoshone	**7.4 a**	**2.9 ab**	**4.6 ab**	**3.8 a**	**331,115 a**	**60 ab**
Alfalfa						
Ladak	7.8	7.5	26.3	3.3	505,861	100

[a] Means of 10 replicates, one plant/replicate. Pots were seeded on 5/20/89 and inoculated on 7/10/89. Values in each column followed by the same letter are not different at $P \leq 0.10$ as determine by Duncan's multiple range test.
[b] Plants #2 and #3 are full-sib families from single plant selections of sainfoin Nova and Remont, respectively for tolerance to *M. hapla*.
[c] Roots were rated for galling on a scale of 1-4; 1 = no galls, 2 = 1-10 galls, 3 = 11-100 galls, 4 = >100 galls.
[d] Plants were inoculated at 2 months of age with 5,000 *M. hapla* eggs on 7/10/89 and reproduction determined after 9 months on 1/4/90. All plants were inoculated.

Table 5. Forage yield trials in Wyoming and Montana established to evaluate the performance of the Shoshone sainfoin.

Location	Dryland/irrigated	Establishment year	Harvest / location years	
			Including establishment year	Excluding establishment year
Wyoming				
1. Archer	dryland	June 1996	5	4
2. Powell	irrigated	June 1996	3	3
Montana				
1. Bridger	irrigated	May 1996	4	3
2. Bridger	dryland	May 1996	4	3
3. Bozeman	irrigated	June 1998	4	3
4. Bozeman	dryland	June 1998	4	3
Total			24	19

Table 6. Forage yields of Shoshone and Remont sainfoin at the University of Wyoming **dryland** station at **Archer**.

Entry		Forage yield (T/A, 12 % moisture)					
		1997 (2 cuts)	1998 (1 cut)	1999 (1 cut)	2000 (1 cut)	2001 (1 cut)	Total (6 cuts)
Shoshone		**2.88**	**1.65**	**0.48**	**0.42**	**0.08**	**5.51**
Remont		2.68	1.54	0.52	0.53	0.27	5.54
Shoshone + Bozoisky		1.83	0.85	0.37	0.30	0.02	3.37
Remont + Bozoisky		1.94	0.83	0.56	0.27	0.01	3.61
Precipitation (inches)	1996	1997	1998	1999	2000	2001	
	18.34	25.87	13.49	14.32	11.75	13.47	

Plots were established on 6 June 1996. Each plot was 20 x 20 ft with 12 rows planted 16 inches apart. Seeding rate was 20.5 lbs/A. There were five replicates in a randomized complete block design.

Table 7. Yield trials of Shoshone and Remont sainfoin at the University of Wyoming Research & Extension Center at **Powell**, (**irrigated**).[a]

Entry	Yield (T/A) (dry matter) 1997 (2 cuts)	1999 (2 cuts)	2001 (2 cuts)	**Total yield** (T/A) (6 cuts)	**Plants/ sq ft** (2001)	Forage quality[b] (1999) **CP**	ADF	NDF
Shoshone	**2.09**	**4.14**	**4.90**	**11.13**	**1.38**	**17.48**	**30.13**	**38.20**
Remont	1.74	3.78	4.92	10.44	1.24	16.45	33.20	42.08
Shoshone + Manska	2.24	4.13	5.50	11.87	1.03	16.30	31.53	46.33
Remont + Manska	2.24	4.10	5.64	11.98	0.95	15.60	32.65	46.20
Average	2.08	3.98	5.24	11.30	1.15	17.03	31.78	42.17
LSD (0.10)		NS				2.33	NS	6.37
CV (%)		15.10				10.90	9.00	12.00

[a] Plots were established in the spring of 1996. Values are the mean of four replicates.
[b] CP = Crude Protein, ADF = Acid Detergent Fiber, NDF = Neutral Detergent Fiber.

Table 8. Evaluation of Shoshone sainfoin under both irrigated and dryland conditions at the USDA **Bridger Plant Materials Center,** Bridger, Montana.

Entry	Yield (kg/ha) dry wt. 1996	1997	1998	1999	4-year total (kg/ha)	T/A
IRRIGATED TRIAL						
Shoshone	**2962**	**6751**	**6496**	**6411**	**22620**	**10.09**
Remont	2681	6113	6293	5908	20995	9.36
Manska	5743	10917	7668	4668	29072	12.97
Shoshone +	**1288**	**2683**	**2987**	**4711**	**11669**	**5.21**
Manska	3130	6229	4604	2715	16678	7.43
	4418	8912	7591	7426	28847	12.64
Remont +	1090	2602	3526	4375	11593	5.17
Manska	3344	7489	5961	2673	19467	8.68
	4434	10091	9487	7048	31060	13.85
DRYLAND TRIAL						
Shoshone	**1179**	**5510**	**2230**	**1765**	**10645**	**4.76**
Remont	1117	5117	1834	1690	9758	4.35
Bozoisky	507	2901	1242	527	4367	1.94
Shoshone +	**851**	**4547**	**1749**	**1303**	**8450**	**3.76**
Bozoisky	159	648	351	342	1500	0.67
	1010	5195	2100	1645	9950	4.43
Remont +	747	4522	1699	1204	8172	3.64
Bozoisky	139	448	261	326	1174	0.52
	886	4970	1960	1530	9346	4.16

Yields are dry weights and are the mean of four replicate plots. The 1996 yields are of one harvest while the 1997-1999 are of two harvests. Manska is a forage wheatgrass while Bozoisky is a forage Russian wildrye grass.
Dr. Mark Majerus, USDA Agronomist.

Table 9. Sainfoin yield trial, **Bozeman,** Montana, (established June 1998).

Irrigation/ Entry	Harvest year 1998 (1 cut)	1999 (2 cuts)	2000 (1 cut)	2001 (2 cuts)	**Total** (6 cuts)
Dryland					
Remont	21.8	72.7	16.8	9.7	121.0
Eski	7.4	79.7	19.1	9.8	116.1
97MTSain-1	18.3	64.6	17.3	9.0	109.1
Shoshone	**13.4**	**79.2**	**20.1**	**10.7**	**123.4**
SF-Laramie-73	19.1	76.3	21.5	12.8	129.7
Mean	16.0	74.5	19.0	10.4	119.9
LSD .05	**4.9**	**7.6**	**2.8**	**2.2**	**12.2**
CV %	20.0	6.7	9.6	13.4	6.6
Irrigated					
Remont	49.0	127.5	109.3	84.0	369.7
Eski	33.5	110.1	95.1	77.5	316.2
97MTSain-1	45.5	120.5	108.2	79.7	353.9
Shoshone	**39.8**	**107.2**	**97.0**	**73.8**	**317.8**
SF-Laramie-73	42.9	119.5	110.0	86.7	359.1
Mean	42.12	116.96	103.92	80.34	343.33
LSD .05	**4.7**	**14.8**	**19.8**	**14.8**	**31.3**
CV %	7.3	8.2	12.4	11.9	5.9

Values are the mean of five replicate plots and are the fresh weight in lbs/plot.
Dr. Dennis Cash, Agronomist, MSU.

Table 10. Miscellaneous legume trial (**irrigated**), **Bozeman,** Montana, (established April 21, 2000).

Entry	Harvest year 2000 (1 cut)	2001 (2 cuts)	2002 (3 cuts)	2003 (2 cuts)	**Total** (8 cuts)
SF-Laramie-73	4.22	8.77	5.62	4.36	22.96
Shoshone	**4.17**	**8.24**	**4.86**	**4.43**	**21.96**
Remont sainfoin	3.24	7.88	4.70	4.32	20.15
Nova sainfoin	4.15	7.38	4.11	4.35	19.99
Eski sainfoin	3.22	7.82	4.87	3.70	19.61
Shaw alfalfa	2.82	6.60	5.45	4.25	19.11
Forager alfalfa	2.98	6.50	5.55	4.05	19.08
Ladak 65 alfalfa	3.02	6.48	5.04	4.26	18.80
Empire birdsfoot trefoil	2.29	4.27	3.47	3.23	13.24
L2 Syn-1 birdsfoot trefoil	2.37	3.93	3.48	3.04	12.82
Tretana birdsfoot trefoil	2.39	3.70	3.64	2.89	12.62
Viking birdsfoot trefoil	2.08	4.06	3.70	2.73	12.57
Leo birdsfoot trefoil	2.24	3.87	2.67	2.48	11.26
Lutana cicer milkvetch	0.98	3.07	2.63	3.10	9.78
Windsor cicer milkvetch	0.75	3.07	2.50	2.83	9.15
Monarch cicer mikvetch	0.43	2.44	2.52	2.88	8.28
Mean	2.58	5.50	4.05	3.56	15.70
LSD .05	**0.37**	**0.56**	**0.63**	**0.66**	**1.64**
CV %	10.1	7.0	10.8	12.86	7.29
Sainfoin mean	**3.80**	**8.02**	**4.83**	**4.23**	**20.88**
Alfalfa mean	2.94	6.53	5.35	4.19	19.00
Birdsfoot trefoil mean	2.27	3.96	3.39	2.87	12.50
Cicer milkvetch mean	0.72	2.86	2.55	2.94	9.07

Values are the mean of five replicate plots and are in tons DM/A.
Dr. Dennis Cash, Agronomist, MSU.