

Possible New Annual Leguminous Forages for Arizona

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Alfalfa, the major forage crop in Arizona, is a member of a plant family whose members are collectively referred to as "legumes". Alfalfa is also a perennial plant, with individual plants typically surviving for three to five or more years. Many species of annual legumes, which complete their entire life cycle in one year, are used as forages in arid areas of the world. Low-growing, reseeding, annual legumes that are closely related to alfalfa (in the genus *Medicago*) and commonly called "medics," are important forage plants in dry areas of North Africa, the Middle East and Australia. Medics in these areas are "winter annuals" growing in the relatively cool periods of fall, winter and early spring. Seed produced in late spring remains dormant in summer and germinates with the onset of winter rains.

In 1986, we began to explore the possibility of using annual medics as alternative forages at low elevations in Arizona--either in irrigated pasture or on improved rangeland. With irrigation, total forage production is the primary criterion by which entries have judged. Under dryland conditions, the ability to germinate and establish with fall rains and to rapidly flower and set large amounts seed are the most important characteristics studied. This report describes some of our early results and conclusions.

PHASE I - INITIAL SCREENING, 1986-88

In both 1986-87 and 1987-88 we conducted large irrigated screening trials at Tucson. A total of 498 accessions of medics from 22 different species were evaluated for such characteristics as seedling vigor, earliness of flowering, seed production, and drought survival. From these trials, we identified 16 accessions that had sufficient forage production potential to be evaluated under conditions similar to that of an irrigated pasture. An additional 10 introductions, which were early flowering and appeared to have good drought survival, were selected for a dryland establishment and seed production trial.

PHASE II - EVALUATION OF SELECTED MEDICS UNDER IRRIGATION, 1987-89

Sixteen selected medic accessions were grown in replicated 1 X 1 meter broadcast-seeded plots with flood irrigation at Tucson during 1987-89. Alfalfa and berseem clover were also grown in these trials as checks. Harvests were conducted at approximately 10% bloom during the late winter and spring. Four of the medics and 'Multicut' berseem clover outyielded alfalfa ('Lew') in the 1987-88 trial despite being harvested only twice compared to four harvests for alfalfa (Table 1). The seven highest yielding entries in this trial were included in a second trial in 1988-89. Surprisingly, none of the medics or berseem were able to produce even half as much forage as alfalfa in the 1988-89 trial.

Table 1. Number of harvests and total forage yield (expressed as percent of the alfalfa variety Lew) for 16 annual medic accessions 'Lew' and 'Multicut' *berseem* clover during 1987-88 and 1988-89 seasons at Tucson.

Medicago species name	Entry	1987 - 88		1988 - 89	
		No. harvests	Yield ⁺	No. harvests	Yield ⁺
<i>aculata</i>	13 H/S	2	130	2	46
<i>blancheana</i>	7384	1	33	-	-
<i>ciliaris</i>	1472	2	113	2	46
<i>granidensis</i>	2389	1	32	-	-
<i>intertexta</i>	2362	2	112	1	27
<i>nurex</i>	4029	1	44	-	-
<i>polymorpha</i>	Circle Val.	2	129	2	50
	5564	2	67	-	-
	Serena	-	-	2	48
<i>rigidula</i>	1402	1	50	-	-
<i>rotata</i>	1855	1	22	-	-
<i>rugosa</i>	2086	1	24	-	-
<i>sativa</i> (alfalfa)	Lew	4	100	4	100
<i>scutellata</i>	Robinson	2	66	-	-
	2681	2	97	2	29
<i>truncatula</i>	1450	2	72	-	-
	Paraggio	2	82	-	-
<i>tubinata</i>	7840	2	90	-	-
(<i>Berseem clover</i>)	Multicut	4	125	3	65

⁺ As percent of Lew.

Medics are very sensitive to low temperatures during mid-winter when secondary branches are beginning growth. January 1989 had 23 days with temperatures of 0° C or below, while only five days with freezing temperatures were experienced in January 1988. The mean temperatures in January and February 1989 (9.9° and 14.6°) were also lower than those recorded in 1988 (11.7° and 15.2°). However, mean temperatures in November and December of 1988 (15.1° and 10.7°) were slightly higher than those recorded in 1987 (14.9° and 10.2°). The relatively low temperatures experienced in 1989 caused the first harvest to be delayed until March 2, whereas in 1988 this harvest was made on February 8. This effectively shortened the 130- to 140-day production season (February to mid-June) by nearly 20%. Alfalfa was less affected by low temperatures, with yields in 1989 only 24% lower than those produced in 1988. Declines in yield between the two seasons similar to those recorded for the medics were also observed for berseem clover. Seed production was generally good on all medics in both years.

PHASE III - ESTABLISHMENT AND SEED PRODUCTION OF SELECTED MEDICS UNDER DRYLAND CONDITIONS, 1988-89

Early-flowering medics that were identified in screening nurseries were planted in replicated 1 meter rows in a non-irrigated plot at Tucson in October, 1988. A total of 100 seeds were sown in the bottom of 10 centimeter-deep furrows and lightly covered. Approximately 12 mm of water was applied to the plot with a sprinkler in mid-November; no other irrigation water was applied. Precipitation during the November to May period totaled 53 mm, 48% of normal. Plant numbers were recorded in March, and pods were harvested in mid-May for each entry.

Little difference in plant numbers (stand) or vigor were noted among the medic accessions, although all medics appeared more vigorous than alfalfa (Table 2). Seed production was highest for accessions from *M. laciniata* and *M. littoralis*, which suggests that these materials could persist on dryland sites. Additional information on reestablishment from dryland-produced seed will be needed before large-scale planting is attempted.

Table 2. Agronomic and reproductive characteristics of annual medic accessions and alfalfa grown under dryland conditions during 1988-89 at Tucson.

Medicago species name	Entry	Days to first flower	Number plants per meter	Vigor score [†]	Seeds per plant
<i>laciniata</i>	PI 498847	87	4.0 ~ 2.2	2.5 ~ 1.2	617 ~ 768
	PI 498877	88	4.8 ~ 5.0	2.5 ~ 1.5	262 ~ 155
	PI 498891	89	5.0 ~ 2.1	2.6 ~ 0.5	623 ~ 368
	PI 498910	89	8.8 ~ 4.9	3.0 ~ 1.4	286 ~ 253
<i>littoralis</i>	SA 21128	100	8.3 ~ 4.2	3.5 ~ 1.9	282 ~ 237
<i>polymorpha</i>	Circle Val.	100	4.8 ~ 4.4	2.5 ~ 1.3	45 ~ 27
	SA 4236	87	17.0 ~ 3.9	4.3 ~ 0.7	40 ~ 24
	Serena	85	10.5 ~ 2.7	2.9 ~ 0.5	8 ~ 4
<i>sativa</i>	AZ-crecp.-rt.	-	8.0 ~ 4.7	1.5 ~ 0.6	0
<i>truncatula</i>	Cyprus	84	9.3 ~ 3.2	3.3 ~ 0.3	104 ~ 24
	Ghor	84	10.0 ~ 2.7	3.8 ~ 0.3	111 ~ 38

[†] Scored: 1 = poor, 5 = excellent.

CONCLUSIONS

Our data indicate that considerable variation in yield would be associated with medics grown in pure stands under irrigation in areas of Arizona with winter weather similar to that at Tucson. Given the relative stability of alfalfa yields, it would appear that this crop still represents the best forage legume for irrigated winter pastures at low elevations in the state, even if grown as an annual. However, seed produced in a single year in an annual medic pasture may germinate over many years. In a multiple-species pasture, medic seedlings could be available to exploit favorable environmental conditions similar to those experienced in 1987-88 and, under those circumstances, lead to higher forage production. Additional field trials under Arizona conditions will be needed to define the conditions under which annual medics would make a positive contribution to pasture production.

Findings from our dryland trial were generally more encouraging, especially since winter rainfall was meager in 1988-89. Significant seedling establishment and seed production were observed for most of the medics evaluated. Very few legumes have been hardy enough to establish and persist on improved southwestern rangeland in the past. Further trials like the one described, but conducted at different sites, are planned to confirm whether early flowering medics may be suitable for this purpose.