Preliminary results of some forage legume populations cultivated in three different Sardinian environments

Vargiu M., Spanu E., Loche F., Salis L.

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Preliminary results of some forage legume populations cultivated in three different Sardinian environments

M. Vargiu, E. Spanu, F. Loche, L. Salis
Centro Regionale Agrario Sperimentale, Cagliari, Italy - Email crass@tin.it

Summary - After several years of characterization and evaluation of numerous annual legume populations collected in different areas in Sardinia, further studies in different environments were necessary to confirm the preliminary results obtained in the experimental farm of Ussana. Ten populations of *Trifolium subterraneum* and *Medicago* spp. annual legumes were tested in field plots and in three different environments characterized by different soil-types and altitude. Preliminary data about adaptability, forage and seed production in the first year are given in this paper. Conclusions can not be drawn and other studies are necessary to confirm the agronomic value of the tested populations.

Key-words: annual legume populations, adaptability, forage yield, seed production

Résumé *- Aprés avoir caractérisé et évalué pendant quelques années de nombreuses populations de légumineuses annuelles spontanées en Sardaigne, il a été nécessaire de conduire d'autres essais en différents milieux pour confirmer les résultats obtenus précédemment dans l'exploitation expérimentale d'Ussana. Dix populations de légumineuses annuelles appartenant à l'espèce* Trifolium subterraneum *et au genre* Medicago *spp., ont été testés dans trois milieux différents, avec différentes caractéristiques pédologiques et altimétriques. Ce travail présente les données de la première année d'essais sur l'adaptation et la production de fourrage et de semences. Les premières données ne permettent pas de tirer de conclusions définitives, et demandent donc des études supplémentaires pour confirmer la validité agronomique des populations testées.*

Mots-clés: *légumineuses annuelles, adaptation, production fourragère, production de semences*

Introduction

The importance of forage legumes for animal feed and agropastoral sustainability is well known and documented (Osman *et al.*, 1990).
Owing to summer drought, annual species (Sarno *et al.*, 1989) are the more common legumes in Sardinian pastures; their frequency varies according to the autumn rainfalls (Arangino *et al.*, 1984,) and animal grazing. To improve the pasture quality a common practice is to cultivate legume crops (in pure stand or in mixture) using imported seeds some of which have a scarce adaptability (Arangino *et al.*, 1992, Spanu *et al.*, 1996).

In 1993 a research project aimed at identifying and evaluating the spontaneous flora of Sardinian pastures was undertaken characterising those populations useful for forage purposes. The populations mostly collected belong to the families of *Graminaceae* and *Leguminosae*. They were observed for 4 years on benches and in open fields at the Ussana experimental farm. The evaluations concerned the biological cycle, disease susceptibility, herbage growth during the year and seed production (Vargiu *et al.*, 1999). The preliminary observations confirmed, in the legumes, the better performance of *Trifolium subterraneum* species and of some annual species of *Medicago*.

This experiment took place at three locations in Sardinia, characterised by different soil and climatic conditions, employing the more interesting populations to verify their adaptability.

Materials and methods

The trials were carried out in the Cagliari province at Ussana (150 m a.s.l., 39° Lat. N, typic palexeralf soil) and San Nicolò Gerrei (500 m a.s.l., 39° Lat. N, vertic xerochrept soil), and Mamoiada in the Nuoro province (600 m a.s.l., 40° Lat. N, typic xerochrept soil).

Randomised block experimental design with 4 replications and 10 m^2 plots was adopted at all locations. Ten populations, four of *Trifolium subterraneum* subsp. *brachycalycinum* and six of *Medicago* (*M. polymorpha*, *M. arabica*, *M. orbicularis*), were sown during the last week of October 1998.

The soil was dressed with P-fertiliser (100 kg ha^{-1} of P_2O_5) after the ploughing; the sowing-bed was prepared with a harrowing and a light rolling. The sowing was realised in 15 cm spaced rows with a plot-sowing machine.

The forage yield was evaluated weighting the herbage harvested in each plot and drying completely each 500 g sub-sample in an oven-dryer at the temperature of 65 °C.

Seed production was evaluated in two 0.1 m^2 sampling quadrates inside each plot, evaluating the number of pods, seed number and seed weight; the seeds of *Trifolium subterraneum* populations were separately picked up under and above the soil to determine the burial ability. Data were statistically processed with ANOVA model.

Results and discussion

The weather was unfavourable in all locations (figure 1).

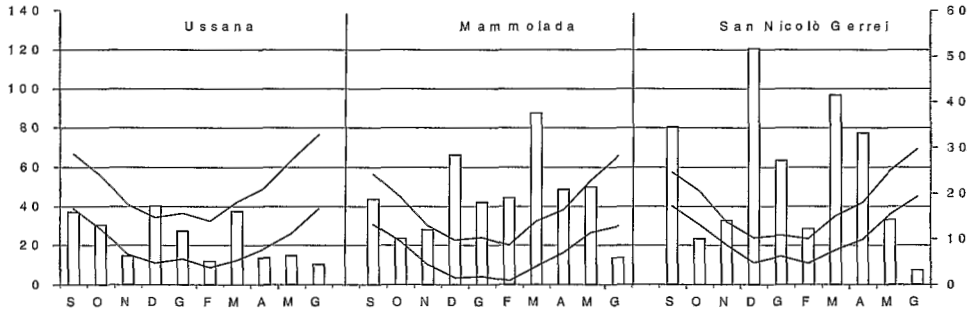

Figure 1 – Weather recording in the three locations.

The registered annual rainfall was 238 mm in Ussana, 447 mm in Mamoiada, 563 mm in San Nicolò Gerrei, which is below the long-term average in every location. After autumn sowing, no useful rain was recorded. Winter was severe, particularly in January and February when some snowfall occurred in Mamoiada and San Nicolò Gerrei and some sleet in Ussana.

In Ussana, one month after sowing, it was decided to irrigate with 20 mm due to drought conditions. This avoided the failure of the trial at this location.

Lack of autumn rainfalls delayed emergence; in all locations emergence became well evident in mid-December, two months after sowing.

The higher forage production (see table 1) was obtained in San Nicolò Gerrei, with yield data between 2 t ha^{-1} of *Medicago orbicularis* (population 157) and 5 t ha^{-1} of *Medicago polymorpha* (population 86; 24% higher than in Ussana and 87% than in Mamoiada).

The first cut was done in Ussana on 15th March 1999 for *Medicago polymorpha* populations. In this location, the dry spring weather induced the early interruption of the vegetative activity, so that, at the beginning of April, the last utilisation of medics was one month in advance compared to the other two locations. In Ussana *Trifolium subterraneum*

populations were cut until the first day of May, but the last production was scarce and very parched, with a dry matter percentage of about 33%.

In all locations the most productive species was *Medicago polymorpha*, particularly the population 74 in Ussana and the population 86 in Mamoiada and San Nicolò Gerrei. The most productive populations of *Trifolium subterraneum* were 61 in Ussana and 121 in Mamoiada and San Nicolò Gerrei.

Table 1 – Dry matter yield (t ha^{-1}) at the different cutting dates.

Location		Ussana				
Annual medics	Population	Site of collection	15 march 99	1 april 99	9 april 99	Total
M. polymorpha	2	Ussana	1.65 AB	-	1.03 B	2.67 AB
M. polymorpha	74	Pratosardo	1.42 B	-	1.90 A	3.32 A
M. polymorpha	86	Ussana	2.03 A	-	1.08 B	3.11 A
M. arabica	63	S. Lucia (OR)	-	3.02	-	3.02 A
M. arabica	93	Domusnovas	-	2.89	-	2.89 AB
M. orbicularis	157	Olbia	-	2.57	-	2.57 AB
Trifolium subterraneum	Population	Site of collection	22 march 99	7 may 99		
Trif. Subterraneum	60	Zeddiani	2.13	0.20		2.34 AB
Trif. Subterraneum	61	S.Lucia	2.28	0.50		2.79 AB
Trif. Subterraneum	62	S.Lucia	2.41	0.29		2.70 AB
Trif. Subterraneum	121	Macomer	1.50	0.34		1.84 B

Location		Mamoiada			San Nicolò Gerrei		
Annual legumes	Population	21 april 99	12 may 99	Total	27 april 99	17 may 99	total
M. polymorpha	2	0.11	0.48 A	0.60 AB	2.47 AB	1.73 A	4.20 A-C
M. polymorpha	74	0.08	0.47 A	0.55 AB	3.06 A	1.65 A	4.71 AB
M. polymorpha	86	0.40	0.44 AB	0.85 A	2.94 A	2.05 A	4.99 A
M. arabica	63	-	0.17 CD	0.17 BC	1.42 BC	1.58 AB	3.00 C-E
M. arabica	93	-	0.21 B-D	0.21 BC	1.98 AB	0.81 CD	2.79 DE
M. orbicularis	157	-	0.04 D	0.04 C	0.23 C	1.72 A	1.96 E
Trifolium subterraneum	60	0.09	0.21 B-D	0.30 BC	2.14 AB	1.44 A-C	3.58 B-D
Trifolium subterraneum	61	0.19	0.36 A-C	0.55 AB	2.12 AB	0.96 B-D	3.08 C-E
Trifolium subterraneum	62	0.24	0.30 A-C	0.54 AB	2.95 A	0.57 D	3.53 B-D
Trifolium subterraneum	121	0.36	0.44 A-B	0.80 A	3.22 A	0.65 D	3.87 A-D

Means with the same letters are not significantly different at P=0.01

The highest seed yield, shown in table 2, was obtained in San Nicolò Gerrei, where it ranged between 0.6 t ha^{-1} in *Medicago arabica* 93 e 0.2 t ha^{-1} in *Trifolium subterraneum* 121.

Among the annual medics, in Ussana the populations of *Medicago polymorpha* showed the highest seed yield. In Mamoiada *Medicago polymorpha* 2 e *Medicago arabica* 93 were the most productive, whereas in San Nicolò Gerrei the most productive were the populations of *M. arabica* and *M. orbicularis* and *Medicago polymorpha* 74.

Amongst the medics the 1000 seed weight changed notably with location; it generally was lower in Ussana because of the extreme drought in the spring season during the reproductive phase.

Table 2 – Seed production at the three locations. The percentages of buried seeds are reported in brackets.

		Ussana			Mamoiada			San Nicolò Gerrei		
Annual legumes	n°population	Seed n° 0.1 m^{-2}	1000 seed weight (g)	seed yield (t ha^{-1})	seed n° 0.1 m^{-2}	1000 seed weight (g)	seed yield (t ha^{-1})	Seed n° 0.1 m^{-2}	1000 seed weight (g)	Seed yield (t ha^{-1})
M. polymorpha	2	1546 A	3.44 A	0.53 A	670 AB	5.03 A	0.33 A	832 C	4.03	0.33 C
M. polymorpha	74	1129 AB	3.27 A	0.36 A	497 B	4.29 B	0.21 BC	1143 C	3.83	0.44 A-C
M. polymorpha	86	1445 A	3.61 A	0.53 A	406 B	5.13 A	0.21 BC	778 C	4.66	0.36 BC
M. arabica	63	906 AB	1.87 B	0.17 B	524 B	2.31 C	0.13 C	1799 B	2.53	0.45 A-C
M. arabica	93	579 B	1.79 B	0.10 B	1044 A	2.35 C	0.25 AB	2605 A	2.40	0.62 A
M. orbicularis	157	529 B	2.19 B	0.13 B	526 B	3.87 B	0.21 BC	1339 BC	4.22	0.57 AB
Trif. subterraneum	60	582 (30)	5.03 B	0.29	327 (58)	4.98	0.16	719 (54)	5.24	0.38
Trif. subterraneum	61	570 (28)	5.46 AB	0.31	265 (20)	4.79	0.12	657 (52)	5.58	0.37
Trif. subterraneum	62	547 (27)	5.44 AB	0.30	254 (47)	5.02	0.13	573 (53)	5.96	0.35
Trif. subterraneum	121	346 (27)	5.94 A	0.20	224 (35)	5.10	0.11	439 (46)	5.68	0.25

Data of *medic* and *trifolium* populations have been elaborated separately.

As regards the *Trifolium subterraneum* populations, the seed yield was higher in San Nicolò Gerrei, whereas the 1000 seed weight didn't showed differences among populations in the three locations. In Ussana this species revealed the lowest percentage of buried seeds, in San Nicolò Gerrei the highest percentage, whereas in Mamoiada the burial capacity were diversified among populations.

Conclusions

The environmental conditions, mainly rainfalls, appeared determinant for the performance of the examined populations.

In San Nicolò Gerrei, compared with the other two locations, the good soil characteristics and the rainfalls determined the highest forage yield. In Mamoiada the low soil fertility, the prolonged drought conditions and the severe winter temperature reduced the forage yield.

The seed yield appeared sufficient to ensure the self-reseeding in the following autumn.

The examined data confirm that at higher altitudes in the first year, annual legume growth is limited to late spring (Spanu *et al.*). Indeed, the importance of self-reseeding plants is mainly related to early growth that can be obtained the following autumn and the cost saving from not having to re-sow.

One indication regards the need to irrigate in dry environments such as Ussana: this may be necessary at least in the critical periods (sowing, flowering, reproduction), in order to avoid the failure of the sowing and to obtain seed production with good characteristics.

The results of the first year are not sufficient to select the more adapted populations for the examined environment. Moreover, it is necessary to study their behaviour under grazing conditions (Cocks, 1988) and to make a comparison with the available cultivars in the market, in order to select suitable populations from which commercial adaptable varieties can be obtained.

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