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in

Genier G. (ed.), Prosperi J.M. (ed.).
The Genus Medicago in the Mediterranean region: Current situation and prospects in research

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 18

1996
pages 133-141

IMPROVEMENT STUDIES OF *MEDICAGO* SP. FOR THE MEDITERRANEAN CLIMATIC CONDITIONS OF AEGEAN REGION

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ABSTRACT

Turkish research workers encounter many times different problems of agriculture in different regions of Turkey which has diversity of climatic conditions throughout Anatolian peninsula. Coastal part of Aegean region with an extreme Mediterranean climate is one of these agricultural regions and the shortage of hay and quality feed production is among the main obstacles existing in the animal husbandry sector of agriculture in the area.

Main objective of the Pasture and Forage Crop Section of Field Crop Department, Agriculture Faculty, Aegean University is to develop research projects on the promotion of forage crop production and pasture management in this part of the country. Recent studies have been focused on the alfalfa improvement programs and on annual medics to be used for the marginal land renovations.

Some basic results of alfalfa variety evaluation, single crop selection and annual medic comparison studies were discussed in this article.

Key words: *Medicago*, Turkey, breeding objectives, agronomical traits, annual medics

1 INTRODUCTION

It is difficult to say that human nutrition in Turkey is sufficient and well balanced in terms of protein consumption, although the country is known as a self-sufficient one (Avcioglu, 1975).

The yields of our farm animals are very low because of the shortage of forage sources and the low yields of oriental breeds. These breeds comprise 96% of the sheep and 62% of the cattle sources of the country, but the total numbers of these animals are very high, i.e. 70 millions of heads. As an example, the average meat and milk yield per cow is 300 kg and 5,000 kg in EC countries whereas it is only 150 kg meat and 1,200 kg milk per cow in Turkey.

The acreage of forage crops is quite limited, 2.7% of the whole cultivated area although it is the most important feed source following natural pastures and meadows in the country. However, in the developed countries of Europe these forage crop cultivation area are generally 20-25% of the total.

In addition to some other factors (social, cultural and economical obstacles), the shortage of forage crops seed production and the low quality standards of the material are among the reasons limiting forage crop production.

Considering the importance of the matter, we would like to emphasize the impact of the seed production programs of the Ministry of Agriculture. According to the newly established program only about 1,000 tons of alfalfa seed will be distributed to the farmers in countrywide in 1995. This case is a typical example of shortage of high quality forage production in the country.

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Remembering the limited forage crop production and unproductive structure of animal husbandry sector, it is very easy and reasonable to stress that alfalfa cultivation is one of the solution measures for the problem. After the development of programs for the extension of alfalfa cropping systems, it is obvious that it will be necessary to have suitable cultivars for the different regions of Turkey, particularly for Mediterranean climatic parts. Our first project aims to test many cultivars and to select proper material for our Aegean region and to develop material for further breeding programs.

It should also be emphasised that the region has marginal lands with many agricultural problems. These lands are composed of mainly natural pastures and some woody and shrubby areas, stony or rocky wastelands. Since these pastures occupy a significant part of the marginal lands and constitute the essential feed source of the grazing animals in the region, some improvement measures should also be imposed on the vegetation. It is quite obvious that annual medics are most beneficial crops to introduce to these poor plant canopies, additionally they are the natives of those environments. Considering these peculiarities of the agricultural structure of region we established another project on annual medics to test the local populations and some introductions.

2. ALFALFA IMPROVEMENT STUDIES

1.1 Variety evaluation

Material and Method: Many varieties of alfalfa originating from different ecosystems were chosen for the first step of our alfalfa improvement program started in 1986. Mesa-Sirsa, Peruvian, Moapa, Uinta, Sonora, Scout, Washoe, WL-202, Wernal, Apex, Caliverde, Lahontan, Cody, local ecotype Bayindir, Cardinal, WL-522, Zia, Ranger, and Ladak were the varieties tested in yield experiment and some of these varieties in addition to Diabloverde, Chilean, B-12 and Matador were the material tested in single crop selections.

19 Alfalfa varieties were compared in a randomised complete block design with three replications. The plot size was 2.0 x 5.0 = 10.0 m^2; having 10 rows in each plot. The total of first four cuts as green matter yield, dry matter rate and yield, crude protein rate and yield were used as criteria for the comparisons.

Results and Suggestions

Green and Dry Matter Rates and Yields: The total green and dry matter yields of 4 cuts of cultivars are shown in Table 1. As it is seen in this Table, Mesa-Sirsa, Moapa, Peruvian, Uinta and Sonora had the highest yields and the second group Scout, Washoe, XL-202 and Wernal followed these high yielders. The variation in dry matter percentage and yield figures were also very different from green matter yields. As it is shown in the same Table 1, Ranger, Cody and Lahontan had the highest dry matter percentages and Ladak, Scout, Wernal and Caliverde followed this group. When the data were tested in terms of dry matter yield characteristics, results indicated the superiority of the cultivars of Uinta, Mesa-Sirsa, Peruvian, Moapa, Sonora and Scout where Washoe, WL-202, and Wernal were in the following second group.

Crude Protein Rates and Yields: The data related to the crude protein contents indicated the high variation among the cultivars (Table 2). Some cultivars like Moapa, Peruvian, Sonora, Mesa-Sirsa, Bayindir (local population), WL-202, Apex, Uinta, Caliverde, Washoe and WL-522 were the most successful material with regard to the crude protein content whereas Cardinal, Ladak, Wernal, Lahontan and Cody were at the end of the group with the lowest crude protein content. On the contrary of the dry matter characteristics, crude protein percentage and yield data showed a very consistent variation and the cultivars ranked in the same line in terms of yield performances as in the percentages. For instance, Peruvian, Moapa, Mesa-Sirsa, Uinta, Sonora and Scout were again most successful cultivars in relation to crude protein yields. But Zia, Cardinal and Ladak had the lowest crude protein yielding capacity.

Table 1. Green matter yields, dry matter percentage and yields of some alfalfa cultivars grown under the mediterranean climatic conditions of Izmir

Green matter yields (kg/ha)		Dry matter percentage (%)		Dry matter yields (kg/ha)	
Cultivars	Mean	Cultivars	Mean	Cultivars	Mean
Mesa-Sirsa	8797.6 A	Ranger	29.00 A	Uinta	2066.00 A
Peruvian	8466.0 AB	Cody	28.67 AB	Mesa-Sirsa	2038.67 AB
Moapa	8450.0 AB	Lahantan	27.67 ABC	Peruvian	2031.33 AB
Uinta	8380.0 AB	Ladak	27.33 BC	Moapa	1997.67 AB
Sonora	8354.0 AB	Scout	26.67 CD	Sonora	1975.67 AB
Scout	7285.3 BC	Wernal	26.97 CD	Scout	1946.67 ABC
Washoe	6939.0 CD	Caliverde	26.67 CD	Washoe	1703.00 BCD
WL-202	6520.0 CDE	Zia	25.67 DE	WL-202	1630.00 CDE
Wernal	6140.0 CDEF	Cardinal	25.33 DEF	Wernal	1628.00 CDE
APEX	5964.0 DEFG	WL-202	25.00 EFG	Cody	1556.33 DEF
Caliverde	5770.0 DEFG	WL-522	25.00 EFG	Caliverde	1539.67 DEFG
Lahantan	5479.0 EFGH	Washoe	24.67 EFGH	Lahantan	1519.67 DEFGH
Cody	5427.0 EFGH	Uinta	24.67 EFGH	Apex	1449.33 DEFGH
Bayindir	5239.0 EFGH	Apex	24.33 EFGH	Ranger	1357.33 EFGH
Cardinal	4862.0 FGH	Peruvian	24.00 FGH	Bayindir	1242.33 FGH
WL-522	4808.0 GH	Moapa	23.67 GH	Cardinal	1224.67 FGH
Zia	4757.0 GH	Bayindir	23.67 GH	ZIA	1219.67 FGH
RANGER	4696.0 GH	Sonora	23.67 GH	WL-522	1207.00 GH
Ladak	4371.0 H	Mesa-Sirsa	23.33 H	Ladak	1182.67 H

Table 2. Crude protein rates and yields, crude ash rates and yields of some alfalfa cultivars grown under the mediterranean climatic conditions of Izmir

Crude protein percentages (%)		Crude protein yields (kg/ha)		Crude ash percentages (%)		Crude ash yields (kg/ha)	
Cultivars	Mean	Cultivars	Mean	Cultivars	Mean yields	Cultivars	Mean
Moapa	25.17 A	Peruvian	510.67 A	Wernal	9.00 A	Peruvian	175.67 A
Peruvian	25.17 A	Moapa	502.33 A	Lahontan	8.98 A	Moapa	173.33 AB
Sonora	24.83 AB	Mesa-Sirsa	502.33 A	Ranger	8.97 AB	Mesa-Sirsa	169.33 ABC
Mesa-Sirsa	24.63 AB	Uinta	493.00 A	Caliverde	8.86 AB	Uinta	165.33 ABC
Bayindir	24.13 ABC	Sonora	490.33 A	Moapa	8.73 ABC	Scout	164.67 ABC
WL-202	23.93 ABC	Scout	438.67 AB	Peruvian	8.66 ABCD	Sonora	159.00 ABCD
Apex	23.93 ABC	Washoe	400.33 BC	Scout	8.47 ABCDE	Wernal	146.00 BCDE
Uinta	23.87 ABC	WL-202	387.67 BCD	Washoe	8.45 ABCDE	Washoe	144.00 CDE
Caliverde	23.67 ABCD	Caliverde	360.33 BCDE	Cody	8.45 ABCDE	Caliverde	136.00 DEF
Washoe	23.50 ABCDE	Wernal	347.67 CDEF	Mesa-Sirsa	8.38 BCDE	Lahontan	134.67 DEF
WL-522	23.40 ABCDE	Apex	346.00 CDEF	Zia	8.37 BCDE	Cody	131.00 DEF
Scout	22.77 BCDEF	Cody	329.00 CDEFG	Cardinal	8.22 CDEF	WL-202	129.00 EFG
Zia	22.70 BCDEF	Lahontan	319.00 DEFG	Ladak	8.13 DEF	Ranger	125.00 EFGH
Ranger	22.50 BCDEF	Ranger	304.00 EFG	Sonora	8.08 DEF	Apex	115.00 FGHI
Cardinal	22.53 CDEF	Bayindir	300.67 EFG	Uinta	8.04 EF	Zia	101.67 GHI
Ladak	21.47 DEF	WL-522	280.33 EFG	Apex	7.98 EF	Cardinal	100.00 HI
Wernal	21.40 DEF	Zia	276.67 FG	WL-202	7.93 FG	Ladak	95.33 HI
Lahantan	21.20 EF	Cardinal	272.67 FG	WL-522	7.63 G	WL-512	91.67 I
Cody	21.03 F	Ladak	254.67 G	Bayindir	7.12 H	Bayindir	89.33 I

Crude Ash Rates and Yields: As it is indicated in the Table 2, there were again high variation among the cultivars tested. Vernal, Lahontan, Ranger, Caliverde, Moapa, Peruvian and Scout contained highest crude ash rates whereas Uinta, Apex, WL-202, WL-512 and Bayindir had the lowest rates. When we compare the cultivars in terms of crude ash yield the results showed a very different distribution from the percentage values. Crude ash yields were highest in Peruvian, Moapa, Mesa-Sirsa, Uinta, Scout and Sonora cultivars respectively. The same values in Ranger, Apex, Zia, Cardinal, Ladak, WL-512 and Bayindir were lowest.

When we consider the green matter and dry matter yields of cultivars, results reflected the superiority of none-hardy group of alfalfa cultivars characteristics including no dormancy period. These crops had a very long vegetation period and by means of this characteristics they could produce more biomass. Under the climatic conditions of Izmir-Turkey with a typical Mediterranean climate all none-hardy cultivars had also a very fast growth and higher number of clippings. On the contrary of the none-hardy group alfalfas, hardy types like Ranger, Ladak and Vernal were not high yielding cultivars because of the hot and dry weather conditions. This situation changed in the dry matter contents and hardy types had higher dry matter rates in relation to their morphological structures and leaf/stem ratios. But, since the green matter yields were higher in the none-hardy group, dry matter yield pattern among the cultivars were different from dry matter percentages and none-hardy cultivars were again more successful than hardy types in terms of dry matter yield. Similar results were observed in the crude ash contents of all alfalfa cultivars.

Based on the results of the experiment it could be concluded that none-hardy alfalfa cultivars were far more successful than hardy types. Hence, some cultivars in addition to the new ones were chosen to test in single crop nurseries.

1.2 Single crop selections

Material and Method: In this experiment conducted under the greenhouses and field conditions of Field Crop Dept. in Bornova/Izmir, individual plants of promising 13 cultivars were observed in relation to some characteristics such as earlyness, plant height, tillering, mid-leaf length and width, leafiness and some others.

Resultats and suggestions

First growth of alfalfa crops in spring: The climatic data of experimental area shows the mild structure of the Mediterranean winter conditions and if one can achieve a cultivar with fast growing habit and earliness in spring it seems quite feasible to breed a high yielding synthetic with a fast regrowth characteristic enabling more cuttings in a given period of time.

Data related to the observations of first growths indicated that Diabloverde was the earliest type and Moapa, Messa-Sirsa, Sonora followed this cultivar (Table 3).

Plant height of alfalfa crops in spring: As an indication of higher yields and suiting to cutting practices, Chilean, Peruvian, Sonora and Apex had the highest mean plant height values among the cultivars tested.

Rate of tillering: There were also significant differences among the cultivars in terms of tillering capacity which is an important component of yield characteristics. According to the results of scoring, Uinta, B-12, WL-202 and Diabloverde were at the top of the rank (Table 3).

Mid-leaflet length and width and leafiness of alfalfa crops: As it is always known that leaf/stem ratio is an important factor in hay quality. The measurements indicated the superiority of Moapa, Diabloverde, Zia and Chilean respectively. As another indication of leaf/steam ratio, leafiness scores were also given in Table 4. These observations indicated that B-12 and Uinta were the most successful crops with higher leaf/steam ratios.

The result of the measurements and observations of the many single plants from 13 different cultivars indicated that some single crops had higher yielding capacity. Considering the earlyness,

plant height, tillering, mid-leaf length and width, leafiness and other characteristics, different number of single crops have been selected for further studies. 36 crops of Moapa, 25 crops of Mesa-Sirsa, 25 crops of Peruvian, 25 crops of Diabloverde, 28 crops of Sonora, 15 crops of Zia, 17 crops of WL-202 and 14 crops of B-12 were among the plants selected.

Table 3. Data related to the different characteristics of single crops of cultivars

First growth of alfalfa crops in spring

Cultiva	Date	Cultivar	Date
Moapa	07.03.1989	Apex	15.03.1989
Messa-Sirsa	07.03.1989	Zia	15.03.1989
Peruvian	10.03.1989	WL-202	15.03.1989
Diabloverde	28.02.1989	B-12	15.03.1989
Sonora	07.03.1989	Uinta	15.03.1989
Bayindir	10.03.1989	Matador	10.03.1989
Chilean	10.03.1989		

Plant height of alfalfa crops in spring

Cultivar	Number of crops	Mean	Standard deviation	Sd. Dev. of mean	Coefficient of variation
Moapa	234	97.22	13.45	0.85	0.13
Messa-Sirsa	185	104.73	13.49	0.99	0.13
Peruvian	342	114.59	15.56	0.84	0.13
Diabloverde	88	111.90	13.54	1.44	0.12
Sonora	347	114.51	16.14	0.87	0.14
Bayindir	289	107.74	12.18	0.78	0.11
Chilean	117	115.58	18.18	1.68	0.15
Apex	306	97.78	16.15	0.92	0.16
Zia	327	113.82	18.13	1.00	0.15
WL-202	73	92.26	17.20	20.1	0.18
B-12	77	99.09	15.30	1.74	0.15
Uinta	96	95.29	18.04	1.84	0.18
Matador	40	108.25	17.23	2.72	0.15

Rate of tillering (abundance of new tillers) of alfalfa crops

Cultivar	Number of crops	Max.	Mean	Min.	Standard deviation	Sd. dev. of mean	Coefficient of variation
Moapa	239	5	3.74	2	0.51	0.030	0.13
Messa-Sirsa	188	5	3.79	2	0.51	0.037	0.13
Peruvian	342	5	3.62	2	0.53	0.028	0.14
Diabloverde	86	5	3.83	2	0.52	0.057	0.13
Sonora	350	5	3.73	2	0.54	0.029	0.16
Bayindir	295	5	3.27	2	0.53	0.030	0.16
Chilean	118	5	3.60	2	0.65	0.059	0.18
Apex	304	5	3.38	2	0.62	0.035	0.18
Zia	324	5	3.55	2	0.62	0.034	0.17
WL-202	71	5	3.97	2	0.47	0.056	0.11
B-12	75	5	4.16	3	0.77	0.089	0.18
Uinta	96	5	4.29	3	0.85	0.080	0.19
Matador	40	5	3.70	3	0.64	0.100	0.17

Table 4. Mid-leaflet length and width and leafiness of alfalfa crops

Cultivar		Number of crops	Mean (cm)	Standard deviation	Sd. Dev. of mean	Coefficient variation
Moapa	Width	238	10.48	2.52	0.16	0.24
	Length	238	23.56	5.85	0.38	0.24
Messa-Sirsa	Width	190	8.86	2.26	0.16	0.25
	Length	190	21.88	5.03	0.36	0.22
Peruvian	Width	337	7.70	2.49	0.13	0.32
	Length	337	21.70	5.71	0.31	0.26
Diabloverde	Width	85	8.10	3.56	0.38	0.43
	Length	85	23.10	6.76	0.72	0.29
Sonora	Width	345	6.98	3.28	0.17	0.46
	Length	345	20.95	6.64	0.35	0.31
Bayindir	Width	290	7.32	2.93	0.17	0.40
	Length	290	20.75	5.64	0.33	0.27
Chilean	Width	115	8.01	3.02	0.28	0.37
	Length	115	22.35	7.30	0.67	0.32
Apex	Width	307	6.20	2.84	0.16	0.45
	Length	307	18.99	5.03	0.28	0.26
Zia	Width	328	8.96	3.63	0.20	0.40
	Length	328	22.33	6.04	0.33	0.27
WL-202	Width	74	5.74	2.36	0.27	0.41
	Length	74	16.88	4.46	0.53	0.26
B-12	Width	75	6.67	2.69	0.30	0.40
	Length	75	17.83	5.04	0.57	0.28
Uinta	Width	94	7.84	2.50	0.25	0.31
	Length	94	18.61	4.52	0.46	0.24
Matador	Width	40	5.70	1.93	0.30	0.33
	Length	40	15.70	4.46	0.70	0.28

Leafiness of alfalfa crops

Cultivar	Number of crops	Max.	Mean	Min.	Standard deviation	Sd. dev. of mean	Coefficient of variation
Moapa	232	90	87.25	75	5.81	0.40	0.066
Messa-Sirsa	187	90	86.95	75	6.05	0.44	0.069
Peruvian	338	90	82.01	60	7.75	0.42	0.090
Diabloverde	89	90	76.51	60	5.07	0.53	0.066
Sonora	346	90	78.20	60	8.62	0.46	0.110
Bayindir	290	90	75.79	75	7.50	0.44	0.098
Chilean	118	90	78.68	75	6.48	0.59	0.080
Apex	313	90	80.70	75	7.29	0.41	0.090
Zia	330	90	77.96	60	6.71	0.36	0.080
WL-202	73	90	89.38	75	2.99	0.35	0.033
B-12	78	90	90.00	90	0.00	0.00	0.000
Uinta	96	90	89.62	75	2.15	0.21	0.023
Matador	41	90	89.26	75	3.27	0.51	0.030

3. STUDIES ON ANNUAL MEDICS

As it is mentioned before we believe that in the arid and semi-arid parts of the Aegean Region, soils should be kept covered with crops so as to maximise the production per unit area per unit time and to minimise the erosion.

In the Mediterranean region, most observers believe that a cereal-medic rotation is the best suited to the zone receiving 350-500 mm of rain annually. The coldest monthly average minimum

temperature acceptable for medic growing is about 2°C. The cold tolerance of medics become critical within the 350 to 500 mm rainfall zone at high elevations (Anonymous, 1975). For this reason, to decide what type of cereal-legume rotation to introduce the environment the constraints imposed by climate.

In Turkey, there are very much wide differences in climatic conditions, rainfall distribution in the country being very different from one part to the other. For instance, there is a corner at the Black Sea Coast which receives about 2,000 mm of rainfall annually, while there is another point in the Central Plateau which has only 250mm of annual rainfall. The other regions have annual rainfalls between these two extremes. In the eastern part of the country snow covers the soil for more than six months of the year, while in the west and south there is no snow at all.

The medics originate from around the Mediterranean Basin, where some 30 species are found growing as motive plants. Some medic species are now country-wide in distribution. Eraç (1982), Karagöz (1985) and Kurt *et al.* (1985) investigated some agronomic characteristics of medic species consist of local and introduced material. In a new experiment some local collections and two introductions of medics were compared under the Mediterranean climatic conditions of Bornova/Izmir. *Medicago blancheana, Medicago tuberculata, Medicago globosa, Medicago scutellata* represented the local material and *Medicago trunculata var. jemalong* and *Medicago littoralis var. harbinger* were introductions. The preliminary results of the experiment indicated that *Medicago scutellata* and *Medicago trunculata* were promising species for further studies (Table 5).

Our newly established projects aimed to enlarge the research material and to focus on the selection and breeding studies of medics suitable to the environmental conditions of region.

Table 5. Some yield characteristics of annual medics (*Medicago* sp.) under Bornova conditions

Medics	Green matter (g/plant)	Dry matter (g/plant)	Medics	Root weight (g/plant)	Medics	Leaf area (cm^2)
M. scutellata	53.31 A	11.00 A	*M. scutellata*	2.92 A	*M. scutellata*	7.69 A
M. globosa	22.70 B	3.71 B	*M. truncatula*	0.47 B	*M. truncatula*	3.38 B
M. blancheana	17.90 C	3.70 B	*M. blancheana*	0.39 BC	*M. tuberculata*	2.99 B
M. truncatula	14.95 C	3.58 B	*M. globosa*	0.25 CD	*M. blancheana*	2.75 B
M. tuberculata	7.51 D	1.39 C	*M. tuberculata*	0.12 D	*M. globosa*	2.75 B
M. littoralis	3.60 D	0.62 C	*M. littoralis*	0.10 D	*M. littoralis*	0.64 C

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