

**Determination of some agronomic traits of *Bituminaria bituminosa* accessions collected from Middle Black Sea Region**

Gulumser E., Basaran U., Acar Z., Ayan I., Mut H.

*in*

Porqueddu C. (ed.), Ríos S. (ed.).  
The contributions of grasslands to the conservation of Mediterranean biodiversity

Zaragoza : CIHEAM / CIBIO / FAO / SEEP  
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 92

2010  
pages 105-108

Article available on line / Article disponible en ligne à l'adresse :

<http://om.ciheam.org/article.php?IDPDF=801224>

To cite this article / Pour citer cet article

Gulumser E., Basaran U., Acar Z., Ayan I., Mut H. **Determination of some agronomic traits of *Bituminaria bituminosa* accessions collected from Middle Black Sea Region.** In : Porqueddu C. (ed.), Ríos S. (ed.). *The contributions of grasslands to the conservation of Mediterranean biodiversity.* Zaragoza : CIHEAM / CIBIO / FAO / SEEP, 2010. p. 105-108 (Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 92)



<http://www.ciheam.org/>  
<http://om.ciheam.org/>

# Determination of some agronomic traits of *Bituminaria bituminosa* accessions collected from Middle Black Sea Region

E. Gulumser\*, U. Basaran\*\*, Z. Acar\*\*, I. Ayan\*\* and H. Mut\*

\*Bozok University, Faculty of Agriculture, Field Crops Department, Yozgat (Turkey)

\*\*Ondokuzmayis University, Faculty of Agriculture, Field Crops Department, Samsun (Turkey)

e-mail: erdem6755@hotmail.com

---

**Abstract.** Because dry period has extended in recent years especially in summer, it is necessary to keep forage plants such as *Bituminaria bituminosa* which remains fresh during the summer period and grows in shallow, low fertility ranges. In the present study, some morphological and agricultural features of perennial *Bituminaria bituminosa* (*Psoralea bituminosa*) populations, collected from 7 different locations of Middle Black Sea Region in Turkey, were investigated. Collected seeds were sown in seed trays and obtained seedlings were then transplanted to the field. Some agronomical and morphological traits such as: plant height, flowering period, leaf number/plant, branch number/plant, main stem width, middle leaf length and width, inflorescence (head) number/plant and flower number/inflorescence, seed length, seed width, and germination rate were observed in the establishment year. Certain differences were determined between the populations, for example, plant height ranged between 54 and 128 cm, leaf number per plant between 596 and 50, and main stem diameter between 3.54 and 8.29 mm at 50% flowering stage. Furthermore, flowering period ranged between 94-128 days, number of inflorescences per plant between 3-177, number of flowers per head between 7-25, and seed weight between 2.16-4.20 g.

**Keywords.** *Bituminaria bituminosa* – Accession – Morphological traits – Turkey.

## Détermination de certains des caractères agronomiques des accessions de *Bituminaria bituminosa* collectées dans la moyenne région de la mer Noire

**Résumé.** Étant donné que la période sèche s'est prolongée lors des dernières années surtout en été, il est nécessaire de conserver des plantes fourragères telles que *Bituminaria bituminosa*, fraîche, durant la période estivale dans les parcours à faible fertilité et basse altitude. Dans la présente étude, on a mené des recherches sur certains caractères morphologiques et agricoles de populations pérennes de *Bituminaria bituminosa* (*Psoralea bituminosa*), collectées dans 7 sites différents de la région moyenne de la mer Noire en Turquie. Les semences collectées ont été semées dans des portoirs de semences et les plants obtenus ont été transplantés aux champs. Certains caractères agronomiques et morphologiques tels que la hauteur de la plante, la période de floraison, le nombre de feuilles/plante, le nombre de rameaux/plante, la largeur de la tige principale, la longueur et largeur de la feuille du milieu, le nombre d'inflorescences (têtes)/plante et le nombre de fleurs/inflorescence, la longueur des semences, la largeur des semences, le taux de germination, ont été observés pendant l'année d'établissement. Certaines différences ont été trouvées entre les populations, par exemple, la hauteur de la plante était entre 54 et 128 cm, le nombre de feuilles par plante entre 596 et 50, le diamètre de la tige principale entre 3,54 et 8,29 mm à 50% du stade de floraison. De plus, la période de floraison était entre 94-128 jours, le nombre d'inflorescences par plante entre 3-177, le nombre de fleurs par tête entre 7-25 et le poids des semences entre 2,16-4,20 g.

**Mots-clés.** *Bituminaria bituminosa* – Accession – Caractères morphologiques – Turquie.

---

## I – Introduction

The species *Psoralea* (Leguminosae) includes over 120 subspecies. *Bituminaria bituminosa*, which is one of them, is a perennial and self pollinating subspecies (Juan *et al.*, 2004) very common in the Mediterranean region (Méndez and Fernández, 1990; Méndez *et al.*, 1991). This

plant can also grow in acidic soils with high ground water level (Méndez, 2000). Cool season plants generally are either dry or dormant during June-August period. *Bituminaria bituminosa*, which is still green in summer, offer very nutritious feed to animals with its fruits and seeds as well (Gutman *et al.*, 2000). Furthermore, as it is a legume, it supplies nitrogen to the soil and protects the soil against erosion and therefore, it significantly enhances the productivity of soil (Yates *et al.*, 2009). In this study, some morphological and agricultural characters of *Bituminaria bituminosa* accessions which naturally grow in Middle Black Sea Region were investigated.

## II – Materials and methods

To generate *Bituminaria bituminosa* accessions, firstly fruits were collected from 14 different locations of Samsun, Sinop and Ordu Provinces located in the Middle Black Sea Region in 2008. After cleaning the seeds, they were dried at 30°C (Walker *et al.*, 2007). But, in order to figure out 1000 seeds weight, seed coats were not removed. As separating the seed coats from seeds of *Bituminaria bituminosa* is very difficult, all fruits were sown without removing seed coats. In a pre-germination test, it was observed that *Bituminaria bituminosa* had hard-seed character and germination dormancy. Therefore, sandpaper was used to increase the germination rate. The fruits were firstly sown into seed trays and then transplanted to outside field in 50 x 50 cm spots in early autumn (Pecetti *et al.*, 2007). Since 7 of 14 accessions were at bolting stage, measurements and observations were done in 7 plant populations. Flowering period, plant height, leaf number, stem number, main stem diameter, width and length of middle folia, head number, flower number per head, and fruit length and width were investigated. These measurements were done on 5 different plants, but fruit characters were figured out on 10 plant samples. While examining the data, locations were evaluated both separately and combined. Average, maximum, minimum and standard errors of the results were figured out as well. In addition, *Bituminaria bituminosa* seeds were also collected from 11 different locations in 2009. They were germinated in the trays and transplanted to field in November 2009. The study has been conducted with a total of 25 populations.

## III – Results and discussion

At the end of the study, the results showed that there were significant differences among the investigated characters both within and among the locations (Table 1). According to results, average plant height was 88.4 cm and it ranged from 58 to 124 cm. Flowering period, as an average of locations, varied between 94 and 128 days. This period is extremely important for *Bituminaria bituminosa*, as animals prefer the plant at this stage more than at other stages. They generally graze the nutritious parts such as the leaves, flowers and seeds. It was observed that all leaves were still green even at the stage of seed maturation, considering all examined genotypes. There was no dry leaf tip on any plant samples. Plants were harvested at the beginning of flowering stage for crude protein. Leaves and flowers were separated from the stem and stems and other parts were analyzed separately. According to results, crude protein content of stem changed between 11.37 and 14.06%, regarding the average of locations. Not surprisingly, leaf + flower samples had higher crude protein content than stem samples (22.35-25.67%). Significant differences were recorded for leaf and inflorescence (head) number within and among locations. Average leaf numbers of the samples taken at flowering stage were figured out as 254, but showed a large variation between 50 and 596. Similarly, inflorescence (head) number per plant showed big variation and counted between 3 and 177. Another measured character of the accessions was 1000 seeds weight and it varied between 25 and 33.5 g. Average, minimum, maximum values, and standard errors of all vegetative and seed traits are presented in Tables 1 and 2. Before sowing the collected fruits in seed trays, germination rates of *Bituminaria bituminosa* accessions were tested and found between 15-30%. Sandpaper was mechanically used to scarify the hard seed coat and eventually to increase the germination rate. Post-germination test results showed that sandpaper treatment significantly increased the germination percentage (around 70%). It is clear that hard seed

dormancy negatively affects the germination of *Bituminaria bituminosa*. With only sandpaper scarification, hard seed coat dormancy can significantly be reduced depending on accessions.

**Table 1. Morphological traits of *Bituminaria bituminosa* accessions (n = 5 for each accession)**

Feature†		Location							Mean
		1	2	3	4	5	6	7	
FP	Mean	99.8	101	109	94	107	109	98	102
	Minimum	94	94	94	94	94	109	94	94
	Maximum	109	109	123	94	128	109	114	128
	Std. error	3.55	3.4	6.30	0	7.11	0	4	1.75
PH	Mean	81.6	104.7	87	74.6	102	93	75.9	88.4
	Minimum	62	94	61	54	75	76	60.5	54
	Maximum	105	117	103	88	128	116	100	128
	Std. error	8.21	4.17	7.7	6.24	10.56	7.30	8	3.25
LBN	Mean	10.6	7	7.4	10	8.4	8	5.8	8.12
	Minimum	7	5	4	5	6	5	2	2
	Maximum	14	9	9	16	10	10	10	16
	Std. error	1.2	0.84	1.03	1.79	0.81	1.04	1.43	0.49
UBN	Mean	6.6	7.4	7	3.8	5	7.8	4.8	6.05
	Minimum	4	1	4	1	4	5	3	1
	Maximum	11	13	13	7	6	11	6	13
	Std. error	1.2	1.94	1.58	1.02	0.45	1.01	0.58	0.48
MBT	Mean	5.76	5.72	5.8	4.6	5.9	6.22	4.27	5.5
	Minimum	4.33	4.13	4.8	3.6	5.22	4.37	3.54	3.54
	Maximum	7.28	6.83	8.30	5.3	7.92	8.29	5.61	8.3
	Std. error	0.58	0.48	0.63	0.27	0.506	0.65	0.35	0.21
LN	Mean	308	258	283.2	214	312.2	243.2	158	254
	Minimum	177	98	128	118	149	198	50	50
	Maximum	393	500	452	280	596	301	212	596
	Std. error	36.9	66.7	62	30	78	18.9	28.38	19.35
IN	Mean	27	88.4	72	47	120	63.4	35	64.7
	Minimum	12	31	6	3	79	26	7	3
	Maximum	65	151	177	97	175	77	54	177
	Std. error	9.6	19.2	31.4	19	17.8	9.5	9.4	8
FN/I	Mean	9	19.2	9.6	10	10.6	16	8.2	11.8
	Minimum	7	12	7	8	7	14	7	7
	Maximum	10	25	13	12	14	18	11	25
	Std. error	0.63	2.76	1.02	0.63	1.47	0.70	0.8	0.80
LW	Mean	2.02	2.26	2.44	2.3	2.04	1.84	1.94	2.12
	Minimum	1.60	2	2	1.8	1.8	1.4	1.4	1.4
	Maximum	2.40	2.6	3	2.6	2.2	2.2	2.6	3
	Std. error	0.14	0.14	0.196	0.14	0.068	0.136	0.194	0.062
LL	Mean	4.74	4.40	5.02	4.80	4.26	4.08	4.08	4.48
	Minimum	4	3.9	4.6	4	4	3.4	3.8	3.4
	Maximum	5.2	5.1	5.4	5.4	4.6	4.7	4.4	5.4
	Std. error	0.230	0.209	0.128	0.228	0.107	0.206	0.102	0.086

†FP: flowering period (day); PH: plant height (cm); LBN: lower branch number; UBN: upper branch number; MBT: main branch thickness (mm); LN: leaf number; IN: inflorescence number; FN/I: flower number/inflorescence; LW: leaflet width (cm); LL: leaflet length (cm).

**Table 2. Seed traits of *Bituminaria bituminosa* accessions (n = 10 for each accession)**

Feature†		Location							
		1	3	4	5	8	9	16	Mean
BSL	Mean	16.33	13.62	15.6	14.21	13.53	14.073	14.12	14.50
	Minimum	11.82	11.01	13.14	12.77	10.6	11.9	12	10.60
	Maximum	19.14	15.23	17	16.11	15.97	16.06	16.30	19.14
	Std. error	0.662	0.498	0.332	0.332	0.552	0.517	0.46	0.213
SL	Mean	5.73	5.28	5.66	6.11	5.76	5.55	5.96	5.72
	Minimum	4.53	4.90	5.01	5.45	5.29	4.70	5.09	4.53
	Maximum	7.20	5.64	6.66	6.87	6.48	6.49	6.62	7.20
	Std. error	0.250	0.080	0.180	0.137	0.113	0.184	0.172	0.067
SW	Mean	3.35	3.10	3.23	3.54	3.31	2.96	3.31	3.26
	Minimum	2.16	2.75	2.88	2.77	2.73	2.17	2.93	2.16
	Maximum	3.82	3.37	3.67	4.10	3.76	3.35	3.91	4.10
	Std. error	0.144	0.062	0.073	0.116	0.113	0.108	0.080	0.042
TSW	Mean	29.6	29.2	30	33.5	27.7	25	31.5	29.5

†BSL: seed length with beak (mm); SL: beakless seed length (mm); SW: seed width (mm); TSW: 1000 seed weight (g).

### III – Conclusions

One of the most specific characters of Mediterranean climate is high temperature and severe drought in summer. Almost all plant vegetation is dry during most of the summer and animals can graze only few plant species in rangelands. *Bituminaria bituminosa* is one of the rare plant species which can stay green in summer and offer plentiful roughage high in quality. It is also possible to cultivate this plant as forage with its abundant vegetative parts and high protein content. However, intense breeding studies need to be done to fulfill the purpose. In this study, extremely high variation was revealed and all this material can be used in further breeding studies.

### References

- Gutman M., Perevolotsky A. and Sternberg M., 2000.** Grazing effects on a perennial legume, *Bituminaria bituminosa* (L.) Stirton, in a Mediterranean rangeland. In: *Options Méditerranéennes, Series Cahiers*, 45, p. 299-303.
- Juan A., Monino I., Correal E., Méndez P. and Crespo M.B., 2004.** Comparación de las tasas de fructificación de *Bituminaria bituminosa* (Leguminosae) bajo condiciones de cultivo en canarias y la península Ibérica. In: Criado B.G., Cuidad A.G., de Aldana B.R.V. and Zabalgoeazcoa I. (eds). *Pastos y Ganadería Extensiva*, p. 111-115.
- Méndez P., (2000).** El heno de tедера (*Bituminaria bituminosa*): Un forraje apetecible para el caprino. In: 3 *Reunión Ibérica de Pastos y Forrajes*, Galicia (Spain), p. 412-414.
- Méndez P. and Fernández M., 1990.** Interés forrajero de las variedades de *Bituminaria bituminosa* (L.) Stirton ("tedera") de Canarias. In: *XXX Reunión Científica de la Sociedad Española para el Estudio de los Pastos*, San Sebastián (Spain), p. 264-272.
- Méndez P., Fernández M. and Santos A., 1991.** Variedades de *Bituminaria bituminosa* (L.) Stirton (Leguminosae) en el archipiélago canario. In: *Pastos*, 20, p. 157-166.
- Pecetti L., Tava A., Pagnotta M.A. and Russi L., 2007.** Variation in forage quality and chemical composition among Italian accessions of *Bituminaria bituminosa* (L.) Stirt. In: *J. Sci. Food Agric.*, 87, p. 985-991.
- Walker D.J., Bernal M.P. and Correal E., 2007.** The influence of heavy metals and mineral nutrient supply on *Bituminaria bituminosa*. In: *Water Air Soil Pollut.*, 184, p. 335-345.
- Yates R.J., Real D., Revell C. and Howieson J.G., 2009.** Developing inoculant quality root-nodule bacteria for *Bituminaria bituminosa*: a perennial pasture legume with potential for dryland agriculture. In: *The 16th International Congress on Nitrogen Fixation*, Montana (USA).