

# Berseem clover (*Trifolium alexandrinum* L.) in the Mediterranean Basin

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**Abstract:** This review provides basic insight into the current status and production of berseem clover (*Trifolium alexandrinum* L.) in Mediterranean basin countries. From the rainfed crop farming of the Aegean Island to rice based cropping of salt affected soils of Nile Delta, berseem clover has an exceptional role in the sustainable crop-livestock farming systems of the Mediterranean basin. It is generally sown in pure stands or in mixtures with annual graminaceous species for grazing during the winter period, for haying or ensiling in spring. It is adapted to mild climates and neutral to alkaline soils and has the constraints of being prone to frost and to acidic, salty and hydromorphic soils.

**Key words:** annual forage legume, berseem clover, constraints, cultivation, Mediterranean Basin, potential

Berseem or Egyptian clover (*Trifolium alexandrinum* L.) is an annual forage legume species native to western Asia. The origin of berseem clover is not well known but it is considered to be originated from Asia Minor, later migrating southward to Syria, Palestine and Egypt (8). It appears that domestication and genetic improvement of the crop occurred in Egypt and that the varieties that were developed were later distributed worldwide (4). Today, berseem clover is extensively cultivated in the Mediterranean Basin (Table 1), the Indian sub-continent and the southern USA in irrigated and rainfed farming conditions due to its excellent feeding value, high growth rate and good regrowth potential after cutting or grazing. Berseem clover is generally used as a winter annual crop in rotation with summer crops such as rice (*Oryza sativa* L.), maize (*Zea mays* L.), sesame

(*Sesamum indicum* L.), sorghum (*Sorghum bicolor* L.) Moench and cotton (*Gossypium* spp.) and well suited to no-till system especially when direct drilled in standing rice. It is generally seeded in October and can be harvested a few times as forage before it is incorporated into soil as a green manure. Berseem clover is used in mixture with oat (*Avena sativa* L.), triticale ( $\times$  *Triticosecale* Wittm. ex A. Camus.) and rye (*Secale cereale* L.) as winter annual forage/green manure crop and shown to be effective N supplier for the summer crops (15). Mixtures of berseem clover and forage cereals outyielded pure berseem stands and may provide forage with more balanced nutritional quality for ruminants. Depending on the cultivar, region and number of cuts in a season, dry matter production of berseem clover ranged from 6 t ha<sup>-1</sup> to 30 t ha<sup>-1</sup> in multi-cut systems in the Mediterranean region (Table 1).

**Table 1. Berseem clover in northern and southern Mediterranean countries**

Country	Cultivated area (1000 ha)	Average DM production (t DM ha <sup>-1</sup> )	Cropping system and way of use	Reference
Algeria	5-15.6*	8-0	Rainfed or irrigated, in a mixture with <i>Lolium</i> or barley	(1)
Egypt	1175	11-21	Irrigated, in rotation with rice and cotton	(6)
Greece	5	12-30	Pure stands or in mixtures with annual graminaceous species	(14)
Italy	25		Rainfed or irrigated, in mixture with cereal or forage grass	(13)
Morocco	50	8-10	Irrigated or rainfed, in rotation with maize	(1)
Tunisia	4.6-6.6	6-8	Irrigated or rainfed, pure or in a mixture with ryegrass, in rotation with cereals	(3, 5, 12)
Turkey	< 2	12-17	In rotation with maize and cotton	(16)

\*berseem clover + alfalfa

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## Berseem in southern Mediterranean

Berseem clover is well-suited to non-mechanized small farms in the southern Mediterranean and has been widely grown for centuries for fodder and soil fertility maintenance. In Egypt, berseem clover has achieved the distinction of being designated “king of forages” and has been the base of Egyptian crop-livestock farming. It has sustained livestock and crop production for centuries in situations where natural pasture and feed resources are scarce (6). Berseem is a key component of the sustainable cropping system in particular rice and cotton based crop production of the Nile Valley and Delta. It is the main winter forage crop occupying about a third of the total cultivated area in winter but it is currently facing a competition with wheat cropping due to increasing food security concern. Berseem clover is a major seed export crop in Egypt with annual seed exports exceeding 12 thousand tons in 2004 (6). In some Maghreb countries, berseem clover is the main forage legume used as green fodder mainly in cattle farming where the seeds are largely self-produced by farmers. In Algeria, it constitutes excellent forage for dairy due to its easy establishment, production potential and high feeding value (1). In Morocco, berseem is grown in rotation with maize mainly in the irrigated systems but is also grown under rainfed conditions in the north. The current 50,000 ha of land dedicated to berseem clover cultivation in Morocco has an increasing trend (20% increases in the last decade). Average production reaches 8 t DM ha<sup>-1</sup> to 10 t DM ha<sup>-1</sup>, well below the potential yield of 16 t DM ha<sup>-1</sup> (2). The area under berseem clover production in Tunisia varied between 4600 ha and 6600 ha during the last decade (5) representing 7% of the total winter forage cultivation area (12). An average of 350 kg ha<sup>-1</sup> of seeds is produced each year on less than 60 ha. Research activities on berseem clover in Tunisia included inventory of cultivars and evaluation, parasitism with *Orobanche crenata* Forssk., feeding value for dairy cows, physiology and agronomic and fertilizer management aspects (7). Intercropping with berseem clover reduced infection by *O. crenata* in food legumes (7).

## Berseem in northern Mediterranean

In Greece, forage production is mainly based on alfalfa (*Medicago sativa* L.), common vetch (*Vicia sativa* L.) and berseem clover (14). It is usually grown in central and southern Greece and the Aegean islands, being used for forage production mainly in fields that cannot be irrigated during summer. With three to six cuttings, fodder yield of berseem clover ranges from 12 t DM ha<sup>-1</sup> to 30 t DM ha<sup>-1</sup>. Despite the demand, which reaches a modest 400 t year<sup>-1</sup> - 600 t year<sup>-1</sup>, its value as fodder crop and soil improving properties, berseem clover is a poor competitor of alfalfa which offers higher income to Greek farmers. Researches in Greece showed that some varieties of berseem clover (cvs. Lito, Kastalia and Pinias) have some frost tolerance, down to -7°C (9). In Turkey, Berseem is widely underutilized despite the region is the origin and the antiquity of its cultivation. Cropping of berseem clover is limited to only less than 2,000 ha. Dry matter production ranges from 1.5 t ha<sup>-1</sup> to 9 t ha<sup>-1</sup> in single cut system and from 12.4 t ha<sup>-1</sup> to 16.4 t ha<sup>-1</sup> in multi-cut system in Mediterranean region of Turkey. In Italy, berseem clover was introduced as a forage crop in the early 1900s and today, it is the best adapted and most cultivated clover in large areas of central, southern and insular regions of the country (13). It is grown in pure stand on about 25,000 ha, mostly in the central and southern regions, but it is also widely used in mixtures with grasses or other legumes. It is the fourth forage species in Italy in terms of amount of produced certified seed. In recent years, several varieties have been released, but only nine of them contributed to 80% of the certified seed in 2010. 

## References

- (1) Abdelguerfi A, Laouar M (2002) Les espèces pastorales et fourragères, leurs utilisations au Maghreb (Algérie, Maroc, Tunisie). Food and Agriculture Organization of United Nations, Rome
- (2) Ameziane TE (1975) Contribution à l'étude de la production de bersim irrigué dans le Gharb. Mémoire de 3ème cycle. IAV Hassan II, Rabat
- (3) AVFA (2014) Agence de la Vulgarisation et de la Formation Agricole, Ministère de l'Agriculture, Tunis
- (4) Badr A, El-Shazly HH, Watson LE (2008) Origin and ancestry of Egyptian clover (*Trifolium alexandrinum* L.) as revealed by AFLP markers. Genet Resour Crop Evol 55:21-31
- (5) DGPA (2014) Direction Générale de la Production Agricole, Ministère de l'Agriculture, Tunis
- (6) Dost M, Misri B, El-Nahrawy M, Khan S, Serkan S (2014) Egyptian Clover (*Trifolium alexandrinum*) King of Forage Crops. Regional Office for the Near East and North Africa, Food and Agriculture Organization of the United Nations, Cairo
- (7) Fernández-Aparicio M, Emeran AA, Rubiales D (2010) Inter-cropping with berseem clover (*Trifolium alexandrinum*) reduces infection by *Orobanche crenata* in legumes. Crop Prot 29:867-871
- (8) Genckan MS (1983) Yembitkileri Tanımı. Ege Üniversitesi Ziraat Fakültesi Yayın 467
- (9) Kotsiotou H (1984) Forage plants. *Trifolium alexandrinum*. Athens
- (10) Kotsiotou H (1990) Annual *Trifolium* species in low input natural pastures improvement and in wheat rotation. Proceedings, 6th Meeting on Mediterranean Pasture and Fodder Crops, Bari, Italy, 17-19 October 1990
- (11) Mezni M, Haffani S, Khamassi N, Albouchi A (2013) Effects of the defoliation height on the growth, mineral uptake and soluble carbohydrate contents in berseem clover (*Trifolium alexandrinum* L.) var. Khadhraoui. IOSR J Agric Vet Sci 5:78-91
- (12) OEP (2014) Office de l'Élevage et des Pâturages, Ministère de l'Agriculture, Tunis
- (13) Pecetti L, Usai R, Romani M, Fraschini P, Salis M (2012) Evaluation of berseem clover (*Trifolium alexandrinum* L.) germplasm in Sardinia, Italy. Ital J Agron 28:202-205
- (14) Papastylianou PT, Bilalis D (2011) Flowering in Sulla (*Hedysarum coronarium* L. cv. Carmen) and Persian clover (*Trifolium resupinatum* L. cv. Laser) as affected by sowing date in a Mediterranean environment. Austr J Crop Sci 10:1298-1312
- (15) Ulger AC, Anlarsal AE, Gok M, Cakir B, Yuçel C, Onac I, Atici O (1999) The effect of green manure crops of legumes on grain yield and some agronomical characters of maize grown on different nitrogen doses. Turk J Agric For 23:193-200
- (16) Yolcu H, Tan M (2008) General view to Turkey forage crops cultivation. J Agric Sci 14:303-312