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Germination pattern of certain annual legumes in a sub-humid Mediterranean environment of Macedonia, Greece

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Summary - Fresh seeds of certain annual legumes such as *Trifolium scabrum, T. campestre, T. angustifolium, Medicago minima, M. disciformis, Onobrychis aequindentata and O. caput-galli* were collected every month from July to November as well as in March and April of the growing period 1997-1998. The seeds were induced to germination and the germination percentages were recorded. The results showed that all species, except *Onobrychis aequindentata*, did not germinate during summer. Germination percentages were low in the autumn and peaked in different month for each species, possibly owing to different autumn temperatures; spring germination was very low or non-existent. The effect of precipitation was possibly critical for the release of hardseededness, but new research is needed to verify its role.

Key words: dormancy, germination percentage, annual legumes, Mediterranean grassland, Greece

Résumé *- Des tests de germination ont été effectués sur une série de légumineuses annuelles telles que* Trifolium scabrum, T. campestre, T. angustifolium, Medicago minima, M. disciformis, Onobrychis aequindentata *et* O. caput-galli *récoltées chaque mois de juillet à novembre et de mars à avril an 1997-1998. Aucune espèce à part* Onobrychis aequindentata *ne germe en été. Les taux de germination ont été faibles en automne et ont atteint leur maximum à des moments différents selon les espèces. Ils ont été très faibles à nuls au printemps. Le rôle de l'abondance des précipitations dans la levée de la dormance devra être vérifié dans une future recherche.*

Mots-clès: *amélioration pastorale, légumineuse annuelle, pérennité, banque de graines*

Introduction

In the Mediterranean environment, the ability of annual species to survive over summer depends on their level of physiological dormancy, which prevents germination under conditions unsuitable for establishment (Fenner, 1985), such as unseasoned summer rains (Lodge *et al.*, 1990). In legumes, dormancy is mainly ensured by the hard and impermeable seed coat, a characteristic referred to as hardseededness (Russi *et al.*, 1992, Cocks, 1992).

Mature seeds which do not germinate when placed in conditions, normally regarded as favourable to germination, are referred to have primary dormancy. On the other hand seeds which germinate and lose their readiness to germination, are referred to have secondary dormancy. Secondary dormancy is often induced by extremely high or low temperatures (Mayer and Poljacoff - Mayber, 1989).

It is well known that seeds of annual plants have cycles of dormancy and non-dormancy depending on the weather conditions (Baskin and Baskin, 1989). The annual plants of the Mediterranean - type grasslands germinate after the first significant rain, usually in early autumn.

If the primary dormancy is not broken and, consequently, they do not germinate in the autumn, then their secondary dormancy is broken in the following spring (Young *et .al.*, 1973). The summer weather conditions, mainly the alternating temperatures, are essential for the gradual breakage of dormancy (Tadmor *et al.*, 1966). On the other hand, it is not quite clear how the low winter temperatures affect the dormant seeds so that their germination in early spring is facilitated (Bradbeer, 1988).

Every species has its own germination pattern as the various environmental conditions affect the seeds differently. Young *et al.* (1989) reported that years with rains in early autumn usually favour legumes.

Mediterranean grasslands are rich in annual legumes belonging to several genera such as *Medicago, Trifolium, Onobrychis* etc. It is well known that the level of dormancy of legume species is high (Rice, 1989; Lodge *et al.*, 1990). On the other hand, it is not clear how the length of the afteripening period affect the mature seeds so that they achieve satisfactory germination percentages. In this paper, the germination pattern of certain annual legumes was investigated so that the suitable conditions for the release of primary and secondary dormancies are determined.

Materials and methods

The study area was a typical Mediterranean grassland of northern Greece. It is located on a calcareous substrate at about 120 m altitude. Mean monthly temperature ranges from 3°C in January to a July high of 25°C. Average annual precipitation is 582mm with 75% falling during the growing season. The dry period is from July to September.

The vegetation of the grassland is dominated by annuals such as *Avena spp.*, *Trifolium scabrum, T. campestre, Medicago minima, and Onobrychis aequindentata* as well as the perennial grass *Dichanthium ischaemum.*

Fresh seeds of each of the legume species *Trifolium scabrum, T. campestre, T. angustifolium, Medicago minima, M. disciformis, Onobrychis caput-galli and O. aequindentata* were randomly collected and placed in a net which was hanged 5-10 cm above the ground. The seeds were affected by the outdoor weather conditions but were unable to germinate. Every month, from July to November of 1997 and March and April 1998, four lots of 100 seeds each, were taken from the net and placed for germination in a growth chamber, in alternating conditions of temperature and light (25°C, 16 hours light and 16°C, 8 hours light) but with a constant and sufficient moisture level. The germinated seeds were recorded and removed once a week. The seeds remained in the growth chamber for four weeks. The results (germination percentages) were transformed to square root values before their analysis of variance and test of means (Steele and Toree, 1960).

Results and discussion

The weather conditions of the study period are shown on Figure 1. The precipitation of summer months was quite high; the August precipitation was almost equal to the October one and higher than the November precipitation. On the other hand, April precipitation was almost zero. Nevertheless, the seed germination of all the species in the summer was almost zero except of *O. aequindentata*, which showed a relatively low germination percentage in August. This suggests that the mature seeds of all the species had primary dormancy and required the influence of the summer weather conditions in order to break it. This result is reinforced from a

previous research (data not shown), in which scarified and stratified seeds, collected in June, did not germinate.

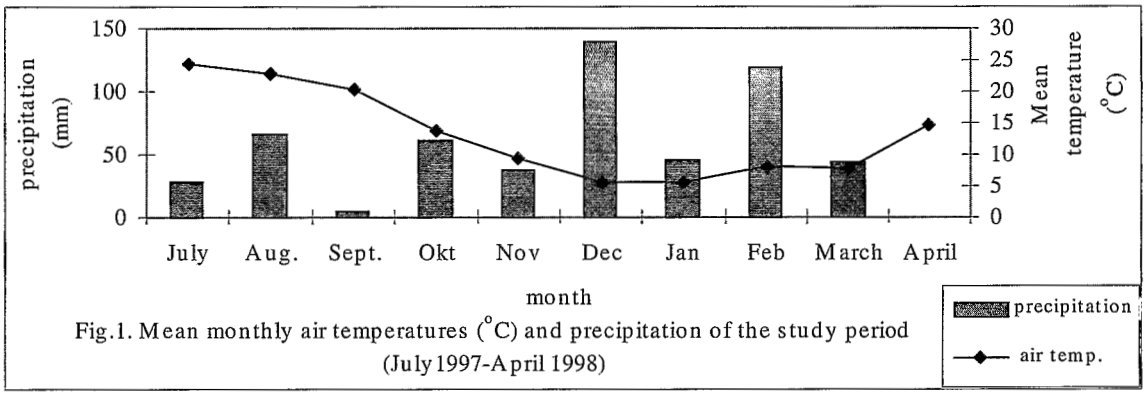

Fig.1. Mean monthly air temperatures (°C) and precipitation of the study period (July 1997-April 1998)

The test produced very low germination percentages for all the species. The maximum germination percentage of every species appeared in different months (Table 1). In general, there was an increasing trend from September to October. In November, most of the species showed relatively high percentages, except of *M. minima* that displayed a drastic decrease and O. aequindentata which gave its maximum germination percentage.

The germination percentages of the legume species clearly showed the different reaction of each species to temperature. Some species such *as M. minima* and *O. caput-galli* had satisfactory germination percentages in September or October, when the temperatures were still high, while others such as *O. aequindentata* peaked their germination in the lower temperatures of November. It is possible that the hardseededness was released in different time for each species as a result of autumn temperatures. The analysis of variance showed significant statistical differences between the germination percentages of the different months (Table 1).

Table 1. Germination percentages of certain annual legumes during the growing season 1997-98.

Species	July	August	Sept.	Oct.	Nov.	March	April
Trifolium scabrum	0.0a*	1.0a	10.0b	17.5c	17.0c	0.0a	7.5b
Trifolium. Campestre	0.0a	0.25a	7.0b	15.5c	14.0c	0.5a	0.5a
Trifolium angustifolium	0.0a	0.25a	4.0b	10.0bc	13.0c	8.5bc	0.0a
Medicago minima	0.0a	0.0a	2.0ab	15.0ab	5.5c	0.5ab	3.5bc
Medicago disciformis	0.0a	0.25a	3.5b	10.0c	9.0c	0.0a	1.0a
Onobrychis caput-galli	0.0a	0.0a	11.5c	5.0b	8.5bc	0.5a	0.5a
Onobrychis aequindentata	1.0ab	3.25b	8.0c	12.0c	18.0d	0.0a	0.0a

*Means with the same letter in each row are not significantly different (P< 0.05).

In the spring, the germination of legume species was very poor. Only *T.angustifolium* in March and *T.scabrum* in April gave a relatively significant germination percentage. From our data is not obvious why the secondary dormancy of the majority of the species was not broken. It seems that the increase of temperature was not enough and other factors, which can not be determined from the present research, were required to be met in order for the secondary dormancy to be broken.

For the effect of precipitation on the germination percentages of the studied species, no strong comment can be made since the tests were performed with the presence of the necessary water. The fact, however, that all the species germinated in September, when no precipitation occurred, suggests that the relatively high August precipitation was effective in soaking the seeds, thus facilitating their subsequent germination. In the following months, the precipitation did not seems to be the critical factor but new research is needed so that moisture is also tested for its effect on seed germination on legumes.

Conclusions

1. All legume species showed primary dormancy, but it was broken in different time for each of them during the autumn period.
2. The germination percentages were quite low in the autumn and extremely low in the spring if not zero.
3. It is possible that precipitation played an important role in seed germination of each species but new research is needed to verify its role.

References

Baskin, C.C., Baskin, J.M. (1988). Germination ecophysiology of herbaceous plant species in a temperate region. *Amer. J. Bot.*, 75, 2, 286-305.

Bradbeer, W.J. (1988). *Seed dormancy and germination.* Blackie academic and professional, 146.

Cocks, P.S. (1992). Changes in the size and composition of the seed bank of medic pasture grown in rotation with wheat in North Syria. *Aust.J.Agric.Res.*, 43, 1571-1581.

Fenner, M. (1985). *Seed ecology*. Chapman and Hall, 145.

Lodge, G.M., Murison, R.D., Heap, E.W. (1990). The effect of Temperature on the hardseed content of some annual legumes grown on the northern slopes of New Wales. *Austr. J. Agric. Res.*, 41, 941-955.

Mayer, A.M., Poljacoff-Mayber, A. (1989). *The germination of seeds*. Pergamon Press, 265.

Rice, K. (1989). Impacts of seedbanks on grassland community structure and population dynamics. *Ecology of soil seed bank.* Academic press, 212-229.

Russi, L., Cocks, P.S., Roberts E.H. (1992).Seed bank dynamics in a Mediterranean grassland. *J. of Applied Ecology*, 29, 763-771.

Steele, R.,Torrie, H. (1960). *Principles and procedures of statistics*. McGraw-Hill International editions, 233-237.

Tadmor, N.H., Cohen, Y., Harpaz, Y. (1966). Interactive effects of temperature and osmotic potential on the germination of range plants. *Crop Science*, 9, 771-774.

Young, J.A., Evans, R.A., Kay, B.L. (1973). Temperature requirements for seed germination in an annual-type rangeland community. *Agronomy journal*, 65, 656-659.

Young, J.A., Young, C.G. (1989). Seed production and germination dynamics in California annual grasslands. *Grassland structure and function in California annual grassland*. Edited by L.F. Huenneke and H.A. Mooney. Kluwer Academic Publishers, 39- 46.