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Breeding system of *Medicago arborea* in open pollinated and in caged conditions

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Summary

The research was carried out in a representative area of the semi-arid Sicilian inland; its aim was to study the evolution of the reproductive process in *Medicago arborea* in open pollinated and in caged conditions.

On the basis of two groups of 4 plants each, eight years old and with a 4 x 4 layout of planting, 4 reference units were selected for each plant; as the first raceme appeared, on each reference unit every two weeks until maturity the number of racemes, of flowers and of pods/raceme were observed, as also the number of seeds/pod at ripening.

The results pointed out:

- the plants in open pollinated conditions produced on the whole meanly 80000 flowers with a growing formation trend until the maximum value (1800 flowers/d) was reached during the third decade of April; moreover a mean fertility of 33 % was observed (similar to that of some herbaceous legumes in the same area);
- in caged conditions the flowering period was 25 days longer, flower production higher by 40000 flowers, and a mean selfing quota of 6 % was observed; height and diameter were also greater than in open pollinated conditions.

Introduction

Studies on *Medicago arborea* have up to now been concentrated on bio-agronomical, productive and qualitative aspects whereas information on floral structure, reproductive process and pollen vectors is lacking.

It seemed necessary to study the breeding system because of the increasing interest towards this species, particularly in the mediterranean environments with at least 400 mm of rainfall, and because breeding plants under way aim at obtaining improved populations (Stringi *et al.*, 1990;

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The Authors equally contributed to this paper.

Corleto *et al.*, 1990; Stringi *et al.*, 1991; Mastroilli *et al.*, 1992; Martiniello *et al.* 1992).

The objective of this study, in fact, is to obtain fundamental information in order to allow a more adequate development of breeding plans. The study regarded only the observation of the evolution of the reproductive process and represents the starting point for a more complex program aimed at better understanding the breeding system and all of its conditioning factors (degree of selfing, incompatibility systems, pollen vectors, etc.).

Materials and methods

The research was carried out in a representative environment of the semi-arid Sicilian inland (Pietranera farm - S. Stefano Quisquina - AG).

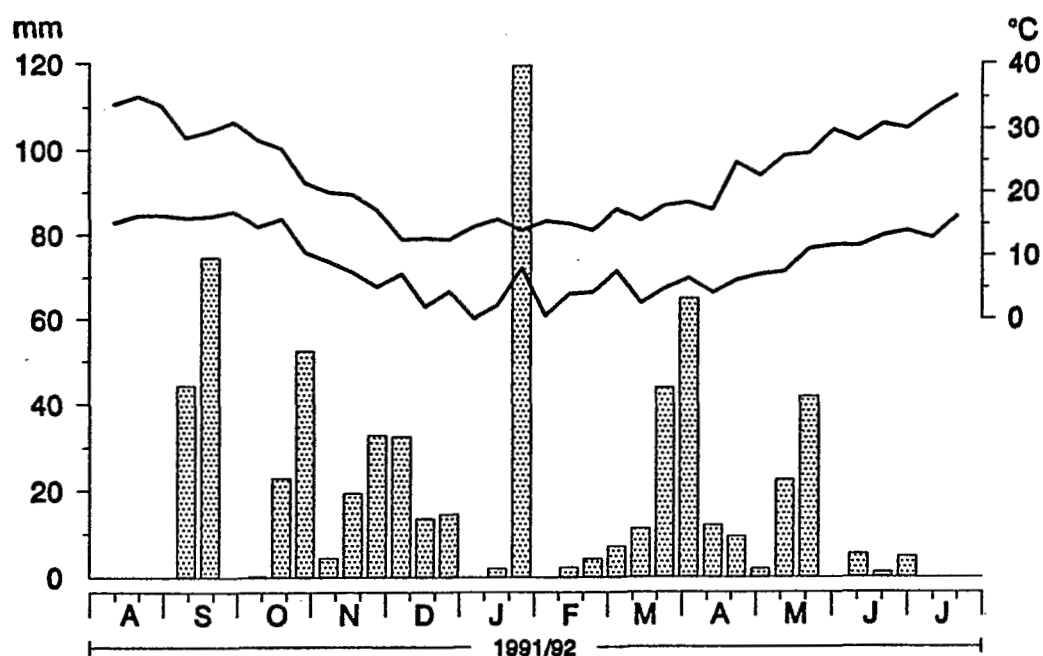


Fig. 1 - Ten-day temperatures and rainfall of the trial period

Observations were carried out on eight-year-old plants with a quincunx layout of planting of 4 x 4 m.

Two homogeneous groups of five plants each were selected; before flowering one group was put into metal cages of 2.5 x 2 x 2 m and isolated with an insect-proof net.

On each plant of the two groups, four reference units (representative

main branches) were selected and as soon as the first racemes appeared the following observations were made once every week until maturity:

- number of racemes;
- number of flowers and pods/raceme.

Moreover at maturity the number of seeds/pod was surveyed.

The total number of racemes, of flowers and of pods/plant was obtained by multiplying the sum of the values of the four reference units by a coefficient calculated on the basis of the total pod production of each single plant divided by the pod production of the four reference units of the same plant.

Furthermore, on each plant of the two groups, some dimensional characters were surveyed at the beginning and at the end of the trial.

Discussion

In open pollinated conditions flowering began around the middle of February and ended around the end of May. On the whole the plants produced meanly 80000 flowers.

		UNCAGED	CAGED
Height (cm)	January 1992	145.2	149.3
Diameter (cm)		154.6	157.1
Height (cm)	August 1992	155.4	177.8
Diameter (cm)		164.8	183.4
Duration of flowering (d)		103	120
Ripening		06/07	28/07

Tab. 1 - Dimensional and phenological characters

During flowering time (103 days) the daily rate of flower formation had an increasing intensity with an almost steady trend until the highest value was reached during the third decade of April (around 1800 flowers/day) and then decreased rapidly.

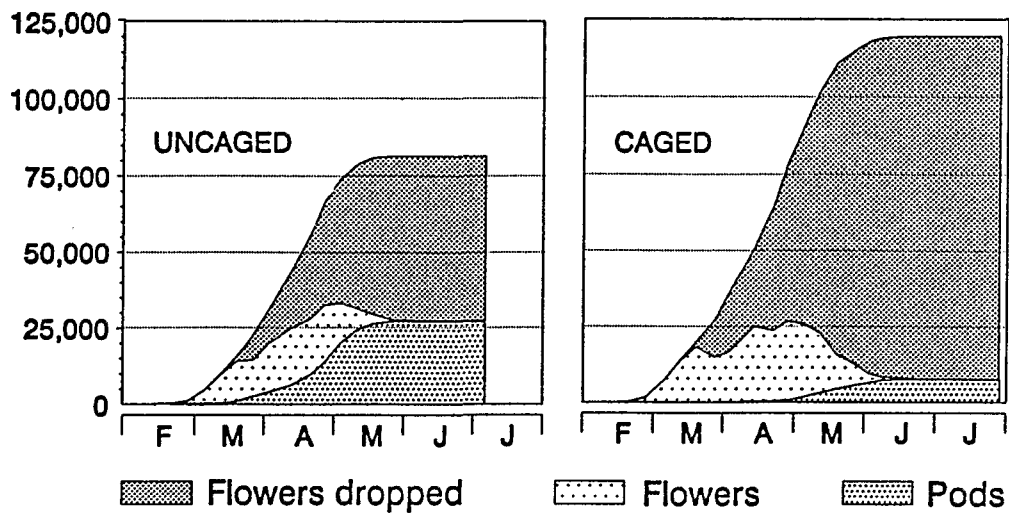


Fig. 2 - Evolution of the reproductive process

Flower drop was observed 25 days after the beginning of flowering; the rate of flower drop showed sudden increments and reached, after approximately two weeks, the same values as flower formation; afterwards, a sudden reduction in the rate of flower drop was observed in occurrence of rainfall events after two months of drought.

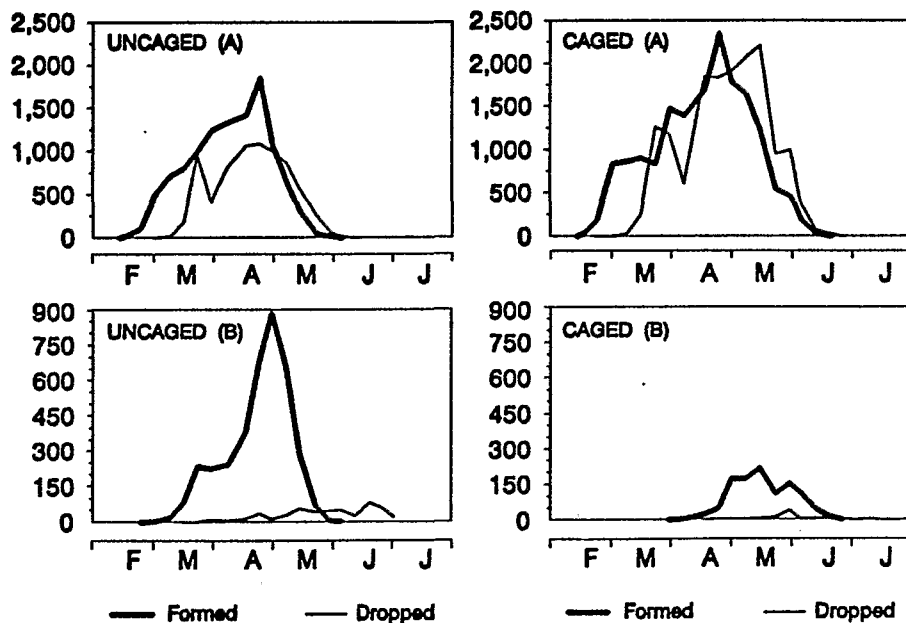


Fig. 3 - Flowers (A) and pods (B) formed and dropped daily

Onwards, the rate of flower drop was similar to that of formation, reaching the highest values (1000 flowers/day) around the third decade of

April.

Pod set began more or less one month after the beginning of flowering. The daily rate of pod formation seemed to increase until the end of April when it reached its highest value (around 850 pods/day); however, this rate did not increase in occurrence of the sudden reduction of the rate of flower drop.

The rate of pod drop was more or less steady during the whole period of seed filling; each plant produced on the whole 27000 pods, with a 33 % setting percentage. Pod drop percentage resulted 19 %.

The number of flowers/raceme was meanly equal to 11 flowers approximately; however, it showed a wide variability reaching maximum values of 22 flowers/raceme.

Pod fertility also showed a wide variability ranging from 1 to 7 seeds/pod (mean value 1.98).

	UNCAGED	CAGED	
N° flowers	81,455	119,525	N. S.
N° immature pods	26,985	7,419	**
N° mature pods	21,874	5,773	**
Pod set (%)	33.13	6.21	**
Pod failure (%)	18.94	22.19	N. S.
N° flowers/raceme	10.95	10.19	N. S.
Pod yield (g)	815.71	205.59	**
N° seeds/pod	1.958	1.629	*

** and * significative differences for $P < 0.01$ and $P < 0.05$

Tab. 2 - Some traits of the reproductive process

The caged plants, in the absence of pollinating insects, showed a pod setting percentage of 6 % approximately, clearly lower than that of the open pollinated plants, demonstrating selfing capacity; in relation to open pollinated conditions, pod setting began 40 days later, in spite of the contemporary beginning of flowering.

The flowering period was around 25 days longer and these plants produced 40000 more flowers, although this difference was not significative.

Maturity also took place twenty days later.

The dropping of formed pods was not different than that of open pollinated plants, whereas the number of seeds/pod was lower, probably because of the absence of pollinating insects.

Conclusions

The trial had the objective of describing the breeding system in *Medicago arborea* in open pollination and in insect-proof cages and showed that in field conditions this species has a pod setting percentage equal to 33 %, which is similar to that observed in the area in herbaceous legumes.

The lower pod setting (6 % approximately) and the lower number of seeds/pod, which were observed in the caged plants in relation to the uncaged ones, demonstrate the capacity of partial selfing, that not yet identified pollen vectors contribute to fertilization and, moreover, that within the selfing quota the absence of pollen vectors reduces pod fertility.

However, the considerable differences in the breeding system of the plants in the two studied conditions may be attributed principally to the absence of pollen vectors but they should also be related to the influence of the insect-proof net covering on the micro-environment which produced modifications of the vegetational characters (height and diameter).

In spite of the observed modifications, the presence of a selfing quota in this species represents one of the aspects of major significance because of the importance that it will have in future breeding plans. However, the information obtained on flower drop, which resulted 100 % in the initial phase and on the whole 94 %, shows that it is necessary to improve knowledge on the influence of the incompatibility and environmental factors on the selfing quota.

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