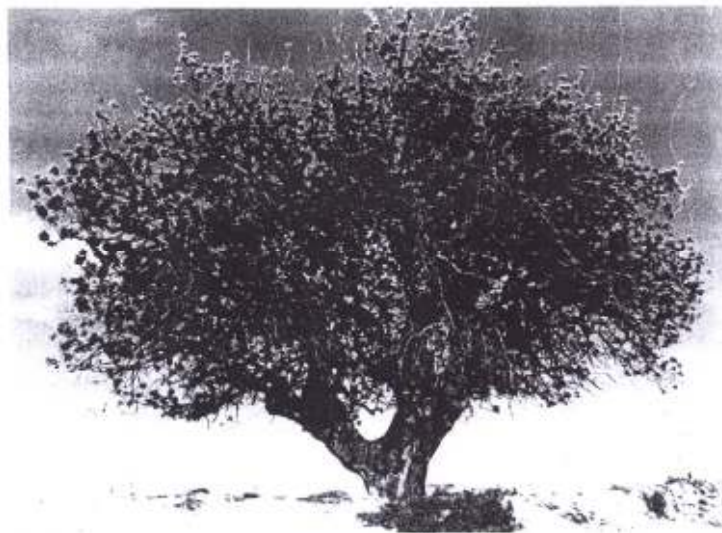


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EVALUATION OF PARAMETERS AFFECTING THE ROOTING OF HARDWOOD CUTTINGS IN Ceratonia siliqua L.

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SUMMARY

Vegetative propagation by rooted cuttings will be a useful tool in reforestation only when rooting problems are overcome. Intensive studies on promoter factors of root induction will be necessary.

This paper represents a systematic study of different parameters affecting the rooting of carob shoot cuttings. Seasonal effects, hormonal treatment efficiency and cultivars were examined. Hardwood cuttings of carob were excised both on March and April. An acclimatization period under freeze conditions followed by an hormone treatment of 4000 and 8000 mg/l indole butiric acid was tested. After this treatment cuttings were inserted in a rooting bench with expanded clay as substrate and maintaining inside the greenhouse for a two month period. Splitting the lower segment of the cutting, prior to placing them on the clay have no significant results on rooting.

On cuttings harvested on March, the response seems to be conditioned principally by the hormonal concentration, in spite of those from April where cultivar seems to have the most influence on rooting ability.

Rooted plantlets present a high mortality after transplantation to a soil mixture under greenhouse conditions.

KEY WORDS: carob, Ceratonia siliqua, hardwood cuttings, propagation.

INTRODUCTION

Carob (Ceratonia siliqua L.) is a tree species widely cultivated in zones with a mediterranean climate. It grows on rocky or stony soils and it is very well adapted to drought stress (1).

Carob trees are generally grown from seeds. Once the seedling rootstock has attained 2-4 years old it is grafted with buds taken from productive female trees. With this method the tree only produces after 8-10 years.

To circumvent the difficulties of the long juvenile phase, classic vegetative propagation offers a simple and cheap method as a mean of plant multiplication in order to obtain propagation of plants in which the productivity and fruit quality are preserved.

Vegetative propagation by rooted cuttings have recently been obtained by the group of Medrano (2,3) They have shown that the cultivar characteristics and the time of cuttings'harvest are the major factors controlling rooting ability. So, in view of the great deal of attention on carob propagation system, shorter than the traditional ones, it is important to compare in what extent are the portuguese cultivars, harvest time or hormonal concentration, more relevants for root ability of hardwood cuttings.

The objective of this work was to compare the rooting response of the two more common portuguese cultivars, with those from Spain (Mallorca). The influence of harvest season and hormone treatment on the rooting ability were tested.

MATERIAL AND METHODS

The experiments were carried out under greenhouse conditions at Tavira Station from Direcção Regional de Agricultura do Algarve.

Hardwood cuttings with 1-3 years old were taken from lateral branches of two portuguese cultivars more common on Algarve region: "Mulata" and "Galhosa". Harvests were made both on March and April, in order to evaluate the seasonal effect on rooting ability.

Cuttings were sterilized with captan after a freeze treatment during one week period, according to Allorda and Medrano (2). The hormonal treatment was applied by dipping the cuttings in an aqueous solution. IBA (indole butiric acid) was tested as root promoter on two different concentrations: 4000 and 8000 ppm. One control, without hormone, have been included. Twenty cuttings were used for each treatment. On half the cuttings taken on March the lower segment was split in order to test the capability of a better root induction.

After the hormonal treatment the cuttings were inserted, 15 cm in depth, in a rooting bench containing expanded clay as substrate. Temperature of the rooting bench was $24^{\circ}\text{C} (\pm 1^{\circ})$. An intermittent mist system was operating 8 sec. every 15 min. to assure the necessary humidity. All cuttings were kept under the same greenhouse environmental conditions from March to June.

After two months all cuttings were examined. Cuttings with one root or more were classified as rooted cuttings. Variance and Duncan multiple range test were applied to compare hormone concentration and time of harvest.

Rooted cuttings were transferred to plastic bags with 2.8 l of capacity containing a mixture of soil:peat:perlite (2:1:1) as substrate. Transplants were maintaining under the same greenhouse conditions, i.e., under both the same temperature and intermittent mist treatment, during one week period.

Final observations were carried out after the hormonal treatment period and two months following transplanting to plastic bags.

RESULTS AND DISCUSSION

Our preliminar results are shown on table 1.

Table 1. Rooting of hardwood cuttings after dipping the basal end in solution containing 0, 4000 and 8000 ppm of IBA. Values are average of 20 cuttings. Data without the same letter are significantly different (0.05) according to the Duncan multiple range test.

	MULATA		GALHOSA	
	March	April	March	April
Control	0 (b)	0 (c)	0 (b)	0 (c)
4000 ppm	19 (b)	5 (c)	15 (b)	33 (a)
8000 ppm	27 (a)	3 (c)	44 (a)	23 (b)

These results show that both hormonal treatment and time of cuttings' harvest have influence on rooting ability.

It was already observed (2) that the month of March was the best for root induction of carob hardwood cuttings, though with some variations depen-

ding on the cultivar (3). Besides it was already largely reported the influence of season on the sensitivity of cuttings to root promoters (4, 5, 6).

The data show that on March the rooting ability was significantly increased with high auxin concentrations in both cultivars. On April, rooting response was not hormonal dependent. Instead, it was influenced by the time of cutting harvest and also with cultivar characteristics. These different results are probably related with the vegetative cycle of the plants. Generally, winter season is the best time of the year to root induction of hardwood cuttings (7). On evergreen plants winter season is not related with a truly dormant period. The leaves are maintained on the tree existing therefore some low metabolic activities. Nevertheless it can be said that it is its period of bud dormancy. On March both cultivars are dormant therefore with more sensitivity to hormonal treatment. On April only "Galhosa" stays dormant since "Mulata" has already started its vegetative growth. It is interesting to note that on this month "Galhosa" is not dependent on the increase of hormonal treatment. This result can probably be related with endogenous levels of phytohormones. It was soon observed that the level of hormones and their ratio in the medium may affect the differentiation of the cells (8). This may account in part for the differential rooting response of "Galhosa" hardwood cuttings in March and April under the same hormonal concentrations.

One of the striking features of these experiments was the growth of axillary buds occurring without apparent root formation. They could survive almost during a month and a half. After that time they present no viability due to a non-root formation.

During the experience the roots didn't receive nothing more than water in a mist treatment. No nutrients were assayed. With the sprouting of some axillary buds there was probably a curtailing growth by carbohydrate starvation. It was observed that some of these shoots have no differentiation of roots. Probably carob hardwood cuttings are influenced by the supply of some inorganic nutrients and by carbohydrate supply. For instances on Tradescantia paludosa concentrations of sucrose above 2% resulted in a sharp increase (9) in proportion of root formation. Other experiments are now underway to study the possible relation of nutrients on rooting ability of carob hardwood cuttings.

In order to stimulate root induction another treatment was assayed: the split at the basal end of the cuttings. Some authors are in agree with this technique because it facilitates the development of root primordia (8,10). Be-

sides it was already observed that a continuous ring of sclerenchymatous tissue was a barrier to root emergence on carob hardwood cuttings (2). The difficult-to-root character of carob could be associated with this band. The split made at the basal end could prevent the development of this apparent barrier facilitating, therefore root primordia development.

Nevertheless, our experiments have shown that the split has had no significant effect on root promotion.

In our previous studies on carob germination (11) it was observed that the best substrate to root initiation and development was expanded clay. Perlite is a substrate more compact leading to many problems of damping off, instead of expanded clay which offers more air-free space necessary for root aeration. This was the reason why expanded clay was chosen for this experiment, instead of perlite as was used by Medrano (2,3). Besides a mixture of peat and perlite is largely used by many other authors in order to assure the continuing development of root system, initiate with tissue culture techniques (12,13).

Comparing our results with those from Medrano (2,3) we can have no emphasis on the suitability of using expanded clay instead of perlite. Besides it is important to consider that our objectives are to multiply plants and for this we have also to look the quality of roots. In fact, such small roots initiated on hardwood cuttings of both cultivars were tender and broke very easily. Another problem with the use of that substrate was on transplanting. Expanded clay was not able to promote a good soil-environment in order to prevent further dehydration. Because of all these problems it was impossible to study the evolution of rooted stem cuttings due to a high mortality observed after transplantation procedures.

This report is a step towards a better understanding of carob rooting conditions. It is necessary to conduct further studies on both endogenous - for instances, age of hardwood cuttings and cultivars - and exogenous - nutrients, hormones and type of substrate - factors. Both aspects are essential on the quality of roots and further autotrophic growth of rooted carob hardwood cuttings.

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