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RESUME - La culture de l'amandier a subi des changements profonds pendant les dernières années dans les pays du Bassin Méditerranéen. Des nouveaux cultivars à floraison tardive et autocompatibles ont déjà représenté un grand avancement dans la production. Il y a aussi de bonnes possibilités d'avancer de façon similaire par l'utilisation des nouveaux porte-greffes sélectionnés, tant en ce qui concerne des francs d'amandier et de pêcher que dans le champs des porte-greffes clonaux, comme les pruniers et les hybrides interspécifiques. La sélection de nouveaux hybrides interspécifiques du genre *Prunus* est spécialement intéressante pour qu'on puisse élargir les possibilités d'adaptation de l'amandier à différentes conditions de sol et même incorporer la résistance à maladies et ravageurs propres du sol. On travaille dans ce domaine dans divers Centres de Recherche et on dispose déjà d'une gamme importante de nouveaux porte-greffes qui sont maintenant à l'étude.
Mots-clés: Amandier, porte-greffes.

SUMMARY - Almond growing has undergone essential changes in the Mediterranean countries during the last years. Newly released cultivars, late blooming and self-compatible, already represent a good advance in production. There are also good possibilities to reach a similar advance by the use of new selected rootstocks, both seedling (peach and almond) and clonal (plums and hybrids). Especially interesting is the selection of new interespecific plum hybrids, which may broaden the adaptation of almond growing to different soil conditions and incorporate resistance to different pests and diseases related to the soil. Some work is already advancing in this way and a wide range of new rootstocks are under study.
Key words: Almond, rootstocks.

Introduction

Almond was traditionally propagated by seed. Nowadays there are still some countries and regions where the usual propagation system is by sowing seeds from the best plants from the point of view of production or fruit quality. This, however, is not a good indication for a good rootstock behavior. Besides, as almond is a cross pollinated species because of its self-incompatibility, the plants obtained by seed differ remarkably among themselves and from their origins, giving rise to a very high characterized polymorphism.

At present, an orchard, either of almond or of another species, can only be established with selected plant material, concerning both varieties and rootstocks, in order to obtain homogeneous, high quality fruit and good adaptation to the environment and soil conditions.

Till recently, almond has been grown almost exclusively in dryland, using preferably seedlings from bitter seeds as rootstocks. These plants have given acceptable results considering their relatively poor growing conditions. Differences between plants affecting vigour, productivity, precocity, etc., were accepted as normal in this dry culture and, in many occasions, they were not either detected or taken into acount by the grower.

When this species was planted in better growing conditions, as it happens with other fruit species, the above differences were evidenced and it has become necessary the use of a plant material able to produce more homogeneous plants giving better fruits for the market, in a higher quantity and with a more regular production along the years. That is to say, selected varieties and rootstocks that would maximize production under different growing conditions and in different areas.

Concerning varieties, only a reduced number are used in the most advanced areas, giving good results to the grower for their productivity and to the market for their aspect and quality. Also, in other less advanced areas, there appeared some varieties that show good characteristics, but they are still grown together with a high number of different local types. But in those less advanced areas, where Mediterranean countries should be included, the lack of homogeneity of the plants is not the only problem, as there is also a remarkable lack of productivity which has become a priority for the GREMPA working group. The GREMPA cooperation and joint effort have resulted in a group of new varieties, now under an advanced study, being an important progress in relation to most of the previously available varieties.

Likewise, a certain advance has been obtained with roostocks, as the use of peach seedlings for irrigated orchards, studies on compatibility of almond varieties with rootstocks from the plum group, and, especially, the selection and use of some peach x almond hybrids. All that is modifying the present and remodeling the future of this crop. This situation allows to foresee a favourable evolution

of almond production in dryland as well as under irrigated conditions.

In dryland, present productivity is very low in most of the Mediterranean countries. For example, in Spain, the national average is not over 125 kg kernel/ha. The modernization of the growing techniques and the use of good varieties indicate that in dryland almond production can be competitive in relation to other crops under the same conditions (RAMOS, 1987). In dryland as well, good clonal rootstocks are proving to increase results (VARGAS et al., 1985; GALL, 1974).

Under irrigated conditions, it has been proved that the use of Mediterranean varieties and adequate growing techniques, allows to rise the production over 1.000 kg kernel/ha, even if the plant has not yet reached full development (DEL AMOR et al., 1987).

Therefore, the evolution of almond culture from that traditional situation to new orchards producing high yields has already been initiated. This evolution has precisely indicated the need of an adequate plant material: more homogeneous, better adapted and resistant to environmental factors and to pests and diseases and with a more regular production.

In relation to the comments above on the satisfactory results obtained through the GREMPA cooperation on variety improvement, this working meeting has been considered convenient to join advances and knowledge on almond rootstocks, covering from the existing problems in every growing area to the present breeding programs. In this way, it will be possible to work from now on with a more consistent approach, a broader knowledge and a higher number of plant materials. As the rootstock breeding programs are long, this cooperation may lead the GREMPA group to a worthy time saving as well as to breeding better rootstocks from the different points of view of behaviour, resistances, propagation ability, etc.

At an individual level, we have to be conscious of our limitations to evaluate accurately every new clone, because no Research Center has available the required specialists to study all those aspects which are interesting and necessary to know about a new rootstock before offering it to the nurseries and growers.

The obtention of better rootstocks is not only the aim of one country, but all of us are interested in it and we must collaborate to obtain and study them. Furthermore, all the Mediterranean countries have very similar environmental and soil conditions and common problems.

On the other side, we breeders do are responsible for supplying, together with our rootstocks, the maximum information concerning their propagation ability, behaviour and compatibility with varieties and also sensitivity to pathogenes and negative environmental conditions; if we do not work to obtain this information, the grower will suffer the consequences of using a plant material scarcely studied (CUMMINGS and ALDWINCKLE, 1988).

The physical medium where root develops, the soil, is very different from that of the aerial part. Temperature, gas exchange, moisture changes, etc. are completely different in the atmosphere than in the soil. In the same way, the biotic environment where the root is immersed is completely different from the aerial part. The root is exposed to those risks and problems caused by water movements of irrigation and rain, by gas, insects, nematodes, fungi, bacteriae, etc. and the grower cannot control them.

Therefore, it becomes necessary to study in depth the behaviour, resistance and sensitivity of every new rootstock so that the grower may have enough information to use the most adequate rootstock for the situation where it will be planted.

The important characteristics of a particular rootstock that should be known by its possible users, nurserimen and growers, are:

- Propagation ability:
  - By seed: — Need of stratification.
    — Germination capacity.
  - Vegetatively: — Most adequate system.
    — Productivity.

- Nursery behaviour:
  - Growth habit (shape and branching).
  - Most suitable time for grafting.
  - Compatibility with varieties.
  - Polyvalency (compatibility with different species).

- Orchard behaviour:
  - Definitive size and shape of the plant: homogeneity.
  - Degree of tolerance to different soil and climate conditions.
  - Anchorage.
  - Sensitivity or tolerance to different pathogenes.
  - Earliness induced to the grafted variety.
  - Productivity induced to the grafted variety.
  - Quality of the fruit produced by the grafted variety.
  - Longevity.
  - Tendency to suckering.
  - Resistance to:
    water-logged soils
    root and collar rot.
  - Nutritional performance of nutrients, water, etc.

Present situation

In order to obtain the adequate information, it is necessary to know the following: problems affecting the present plant material in the growing areas where it is used, what other material could give solutions and which is the possibility of applying those solutions to the plant material possibly used in the future.

The plant material actually used is the following:

Almond seedlings

Till short time ago, the most commonly used seedlings were from bitter seeds without paying too much attention to their origin. Normally, they came from mixtures of different origins and there has never been an orchard to produce those seeds. In some cases, seeds were collected from wild species more or less cross pollinated with cultivated trees. This is the case of the seeds collected from the population of P. webbii existing in the Spanish province of Toledo (FELIPE and SOCIAS, 1977).

Recently, some studies have been carried out to obtain seed producing varieties suitable to produce seedlings with interesting characteristics, such as the works by VOZMEDIANO and RAMOS in Spain, EL GHARBI in Tunisia, KOCHBA and SPIEGEL-ROY in Israel, etc. mentioned by OLIVIER and GRASSELLY (1988). But, as these authors state, the fact of gathering in one or two varieties the positive traits of each one of the lines studied in those different countries has not yet been made.

In Spain, at present, the most worthy rootstocks are those produced by seeds from the variety «Garrigues» which give a nursery plant of good size, rather homogeneous with a strong, very ramified root system. However, up to now, their resistance or sensitivity to negative environmental factors or to soil pathogenes are not yet known. With this purpose, a study in collaboration with some specialists from IRTA-Cabrils (Spain) has been started with the aim of studying the behaviour of these rootstocks versus different Spanish populations of nematodes.

— Positive characteristics of almond seedlings

In general, the most remarkable and positive characteristic is their great rusticity shown by their ability to survive on poor soils with high limestone content as well as with a scarce availability of water. This characteristic means that when these seedlings are grown in not too extreme conditions and with the adequate orchard management techniques, they can give a competitive production as compared to alternative crops, either woody or herbaceous. Under extreme situations, that rusticity allows them to survive when other crops cannot. But actually, the productions thus obtained are scarce or not interesting from the economical point of view.

— Negative characteristics of almond seedlings.

They are rather numerous:

— They suffer at transplantation from the nursery to the orchard, and many failures appear, even when the necessary keeping and transport facilities are used.

— They are sensitive to the soil diseases: Agrobacterium, Phytophotora, Armillaria, etc.

— They are sensitive to root and collar rot, therefore, they are not suited for irrigation, unless the system is a localized irrigation.

— Future possibilities.

It can be foreseen that in the future there will be available seedlings from good clonal lines and with a better known agronomical behaviour.

There is the possibility in the future of using some vegetatively propagated clonal selection as well as micropropagated plants. In both lines, there are some first experiments under study in Spain.

Peach seedlings

Peach seedlings are better adapted to irrigation because of their lower sensitivity to most of the problems affecting almond seedlings.

They show a good compatibility with almond varietes, producing a quick development of the plants in the first years.

Peach seedlings from varieties specially bred for seed production are preferable because they are more homogeneous and better known (not as much as wished in relation to almond) regarding their agricultural behaviour.

— Positive characteristics of peach seedlings.

As a general positive characteristic, we should mention their better suitability (though not perfect) to irrigation. Also, the existence of more seed producing varieties with a known agronomical behaviour versus certain problems, such as nematode resistance, etc.

— Negative characteristics of peach seedlings.

In general, peach seedlings cannot be considered as the definitive solution for almond, though they are a worthy improvement for irrigated orchards. They continue to be sensitive in a high degree to some common soil diseases: Agrobacterium, etc.

— Future possibilities.

Given the existence of many peach varieties acceptably propagated by cuttings, it is possible that in the future there will appear some clonal selection gathering all the positive characteristics actually found separately in the different varieties used for seed production.

Plums

I. Slow growing plums

BERNHARD and GRASSELLY (1959) include in this group the species P. domestica and P. insititia L., that is: European plums, Saint Julien, Damas, etc.

There is a sufficiently large experience on almond growing on this group of rootstocks, showing in many cases a good compatibility. But some varieties, when grafted on some clones from this group, show a localized incompatibility and the plants broke at the union earlier or later.

There is a population within this group, the «pollizos de Murcia», which present a generalized compatibility if they are really «pollizos». The problem is that there are many hybrids of «pollizos» with other plums which present localized as well as translocated incompatibility. Recent selections, not still in the market, show a good general compatibility with almond.

— Positive characteristics of slow growing plums.

Rootstocks from this group are more tolerant to water-logged soils as well as to root and collar diseases such as Phytophthora, Armillaria, Agrobacterium, etc. than peach or almond.

They produce smaller trees favouring semi-intensive almond growing under irrigated conditions. They provide an excellent anchorage as well.

— Negative characteristics.

This good compatibility with almond is not general, not having yet a large experience, therefore, there is the danger of appearing some cases of localized incompatibility.

They present a more or less marked tendency to produce suckers.

— Future possibilities

Several works have been made on the breeding of new clones of rootstocks included in this group. For this reason, we can suppose that in a short term there will be some new available clones showing a good compatibility. This is the case of a «pollizo» clone (named 'Montizo'-646) under study in Zaragoza (FELIPE et al., 1988).

II. Quick growing plums

BERNHARD and GRASSELLY (1959) include in this group plums belonging to the species P. cerasifera Ehrh. (myrobolan), P. salicina Lindl. (Japanese plum) and some hybrids such as Marianna (P. cerasifera x P. munsoniana) and others.

This group shows in general a poor compatibility with almond varieties. Their usual incompatibility is translocated though in some combinations a localized incompatibility is produced at the graft union. Some clonal selections when grafted with certain almond varieties, present an acceptable compatibility (GRASSELLY, 1969). This fact, as it happens with peach, encourages the search for clones with a better behavior.

— Positive characteristics of quick growing plums.

These rootstocks usually provide a good vigour and development when grafted with compatible varieties from other species. They show a good adaptation to different types of soils as well, enduring a certain degree of humidity. They are tolerant to Phytophthora and Agrobacterium. In general, they are suitable for vegetative propagation, produce a good anchorage and show low suckering.

— Negative characteristics of quick growing plums.

Besides their poor compatibility with almond varieties, there are not, in general, other specially negative aspects to be remarked.

— Future possibilities

Though it is possible to obtain some clones compatible with almond, it seems more feasible to obtain clones from interspecific hybrids able to solve this problem and supply other desirable characteristics.

Interspecific hybrids

The use of the first almond x peach hybrids as rootstocks for both species (BERNHARD, 1949; BERNHARD and GRASSELLY, 1981; CAMBRA and ITURRIOZ, 1986; KESER and ASAY, 1986), has proved that interspecific hybrids may be a very interesting way to obtain new rootstocks because of their new possibilities for a better adaptation to different conditions.

Concerning almond, there is already an important experience on the use of almond x peach hybrids because several clones are already available in the market. Also, other hybrids between almond or peach and different plum species are under study and can give interesting results.

I. Almond x peach hybrids

Among the Prunus interspecific hybrids, these are the most studied and best known. Several of them are already availabe (BERNHARD and GRASSELLY, 1981; CAMBRA and ITURRIOZ, 1986; KESTER and ASSAY, 1986) and many others under study in different research centres.

— Positive characteristics of these almond x peach hybrids.

The outstanding vigour of these plants was firstly remarked. This aspect is interesting for almond due to the excellent development obtained either on dryland or under irrigated conditions.

Their use has proved that they are suitable for different types of soils and endure irrigated conditions better than almond. Likewise, they are giving good results on dryland surpassing almond seedlings in growth and production.

At transplanting, less failures are produced than if the rootstock is a seedling.

— Negative characteristics of almond x peach hybrids.

Besides all these good qualities showed by the new clones, there are other negative aspects still to be solved. A common aspect for all these clones is that propagation is not still as easy as it should be to obtain a satisfactory rootstock.

Some of these clones are sensitive to Agrobacterium, others to nematodes. All of them are, at a larger or shorter extent, sensitive to root rot.

There is not available a hybrid with a medium vigour, equivalent to or something less than peach seedlings, to be used in intensive orchards, etc.

—Future possibilities

The interest for these hybrids has fostered the study of new possibilities at several research Centers. New crosses with red leaf peach, resistant to nematodes such as Nemared and with other peaches wich can transfer other interesting characteristics are being studied.

In our works we have bred an easily rooting almond variety and it has already been crossed with peach. Other studies on resistance and behaviour have been started.

On the other side, there is the possibility, already observed, of selectig clones with a more suitable branching for woody cuttings because of their low feather production.

Other hybrids of almond and other peach species such as P. davidiana. P. mira, etc. include plants which seem interesting and whose behaviour is under study.

II. Other hybrids between different Prunus species

Besides the above mentioned hybrids, others between almond and myrobolan, peach and other plums, etc. have already been obtained. There is less experience on these hybrids. Dr. Grasselly will explain the existing possibilities in this sense.

It is interesting to deepen on the possibility of crosses between different species that can be used to select plants gathering a behaviour and resistance that till present are found separately in each one of the pure lines (Layne and Sherman, 1986).

Conclusions

From all these comments, we can deduce that we are still far from the ideal rootstocks for almond.

The double possibility of growing this species on dryland and with irrigation can advise the future selection of two groups of rootstocks: one for each type of growing.

The selection of some clones of slow growing plum with a good compatibility with almond can allow to grow it on heavier and wetter soils with less risks than the presently used clones.

There are large possibilities of recombining the positive characteristics of different species, thus obtaining remarkable improvements in breeding rootstocks for the next future. However, to accomplish this aim a working group will be necessary to carry out the recordings and studies required.

Bibliography

BERNHARD, R. (1949): «Le pêcher-amandier et son utilisation». *Rev. Hort.,* 121 (2154), pp. 97-101.

BERNHARD, R. and GRASSELLY, CH. (1959): «Les pruniers portegreffes du pêcher». *Arboric. Fruit.* 62, pp. 27-28.

BERNHARD, R. and GRASSELLY, CH. (1981): «Les pêchers x amandiers». *Arboric. Fruit.,* 328 (6): pp. 37-42.

CAMBRA, R. and ITURRIOZ, M. (1986): «Caracteres descriptivos del patrón híbrido almendro x melocotonero Adafuel (Prunus amygdalo-persica [West]) Redh.» *An. Aula Dei,* 18 (1-2): pp. 65-76.

CUMMINGS, J. N. and ALDWINCKLE, H. A. (1988): «New directions in rootstock breeding: Introduction to the Symposium». *HortScience,* 23 (1), pp. 100-101.

DEL AMOR, F.; TORRECCILLAS, A.; RUIZ, M. C., y GOMEZ, J. (1987): «Respuesta del almendro al riego de alta frecuencia». *Frutic. Prof.,* 11, pp. 77-82.

FELIPE, A. J. et SOCIAS I COMPANY, R. (1977): «Un amandier sauvage probablement A. webbii, non encore mentionné en Espagne». *3.er Colloque GREMPA,* Bari 3-7 oct. 1977, pp. 78-79.

FELIPE, A. J.; BLASCO, A. B.; GELLA, R. (1988): «'Montizo' un clon selecto de 'pollizo de Murcia'». *Actas del III Congreso de la SECH* (en prensa).

GALL, H. (1974): «Comportement des varietés d'amandier greffées sur amandier, pêcher et pêcher x amandier dans les conditions de culture française». *I Reunión del GREMPA,* Zaragoza.

GRASSELLY, CH. (1969): «Etude de la compatibilité de l'amandier (Prunus amygdalus L. Batsch) greffé sur divers pruniers. *Ann. Amelior. Plantes* 19 (3), pp. 265-276.

KESTER, D. E. and ASAY, R. N. (1986): «'Hansen 2168' and 'Hansen 536': two new prunus rootstock clones». *HortScience,* 21 (2): pp. 331.

LAYNE, R. E. and SHERMAN, W. B. (1986): «Interspecific hybridization of Prunus». *HortScience,* 21 (1), pp. 48-51.

OLIVIER, G. and GRASSELLY, CH. (1988): «Amélioration des semis d'amandier porte-greffes. Etat d'avancement des travaux». *7.ème Colloque GREMPA,* pp. 111-115.

RAMOS, B. (1987): «Problemática del almendro en Extremadura». *Frutic. Prof.,* 11, pp. 89-92.

VARGAS, F.; ROMERO, M., et ALETA, N. (1985): «Porte-greffes d'amandier: aspects importants des programmes du Centre Agropecuari 'Mas Bové'». *Options Mediterr.,* 1985-1, pp. 61-68.