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Rootstocks for almond.

Historical review, present situation and perspectives in Greece

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RESUME - La situation générale des porte-greffes de l'amandier est surveillée en Grèce, ainsi que la recherche sur ce sujet à l'Institut de Pomologie de Naoussa. On surveille aussi les problèmes les plus importants en ce qui concerne les porte-greffes, surtout la résistance à la sécheresse et les problèmes phytopathologiques.

Mots-clés: Amandier, porte-greffes, Grèce.

SUMMARY - The general situation of almond rootstocks in Greece is presented, as well as some research on this field at the Pomology Institute of Naoussa. Also reviewed are the most important problems related to rootstocks, mainly drought resistance and phytopathological problems.

Key words: Almond, rootstocks, Greece.

Historical review

The almond has been known in Greece from prehistorical times, and may be from the campaign of the Greeks to Troia as it is guessed from the fable of Phyllis and Dimophon.

During the centuries its cultivation passed across many phases. The importance of the rootstock and the variety were known to Greeks at least 2.300 years ago, as it is referred from Theophrastos. Later on, for reasons not completely known, almond was propagated by seeds without grafting and many areas were covered by seedlings. A new era of almond culture in Greece started after 1950 when grafting and rootstocks were used for propagation.

Ten to fifteen years ago there was a strong tendency for irrigated culture of the almond, but in the last years this tendency stopped and moreover the trees from many irrigated orchards were uprooted, because they were not able to compete with other more dynamic crops like clingstone peaches, actinidia etc.

In the irrigated orchards both almond and peach seedlings were used as rootstocks.

The almond seedlings were either from sweet or from bitter almonds. The peach seedlings were either from populations of wild peach trees or from G. F. 305 and Nemaguard rootstocks. The use of almond seedlings in irrigated soils caused problems of apoplexy and infections by phytophthora. Apoplexy appeared in heavy soils and in the cases when too much water was used for irrigation.

The use of peach seedlings as rootstocks caused mineral deficiencies specially on Nemaguard rootstock. Also zinc and manganese deficiency and iron deficiency in calcareous soils were observed. Moreover it was observed that when the irrigations are not applied in time, the trees very often show symptoms of stress from lack of water.

Present situation

Today the almond culture is spreading mainly in non irrigated soils and especially on the hills.

The main problem in these areas is the lack of soil moisture, especially in summer and sometimes in spring. To overcome the problem of soil drought, the use of resistant varieties and rootstocks is essential. We think it is necessary to discuss the subject of varieties resistant to dry conditions in a future meeting. For rootstocks, the subject of this meeting, it may be very interesting to discuss the possibility of future research work. The resistance of a rootstock to dry soil conditions depends mainly on the deep root system. The question is which almond is preferable for research: sweet or bitter almond?

Among Greek farmers prevails the opinion that bitter almond is better, because they consider that it is resistant to *Capnodis tenebrionis*, to different rodents and to birds. We have some experience for resistance to rodents and birds but not to *Capnodis tenebrionis*. Some authors refer that the

seedlings of bitter almond proved to be resistant to *Agrobacterium tumefaciens*.

From tests made in our country (Psallidas-Stylianidis) it was proved that after artificial inoculation only 50% of the seedlings didn't show symptoms in the first year. But in the second year all the trees showed symptoms. We have not found almond seedlings resistant to bacterial canker. The same is referred by researchers from other countries.

In other tests carried out in the Pomology Institute of Naoussa for resistance to *Pythium*, it was found that the most susceptible were the seedlings of a self-compatible bitter almond and the seedlings of *Amygdalus webbii* with bitter seeds. Less susceptible proved to be the seedlings of the sweet almond variety «Drepanoto».

Also the seedlings of *Amygdalus webbi* with bitter seeds showed high susceptibility to *Rhizoctonia* and to *Verticillium dahliae*.

From the foregoing we consider that it is interesting the research both on sweet and on bitter almonds. No systematic research is carried out in Greece. From some tests for resistance to *Phytophthora*, *Rhizoctonia*, *Pythium*, *Agrobacterium tumefaciens* and *Verticillium* we obtained some experience.

From all these trials and observations we consider that for our conditions the most suitable almond seedlings as rootstocks are those from the cross Pangrati x Marcona and also the seedlings of the «Drepanoto» variety.

The seedlings of the «Drepanoto» variety proved to be also resistant to *Pythium* and *Rhizoctonia* spp., they are vigorous and with satisfactory resistance to dry conditions. All these advantages are confirmed also after use in the nursery. The only inconvenience with this rootstock is its very early blooming time, and therefore it is subject to late frost damage. We suggest it to be cultivated in areas without problems of frost damage.

Another almond seedling selected for resistance to *Verticillium dahliae* is the I D A 1/vert. It is now in the phase of multiplication. Later on the possibility of the fungus to pass through its tissues will be studied. It was also observed that the seedlings from the cross Retsou x Ferragnès are resistant to *Verticillium* but they are not sufficiently homogeneous and are also susceptible to *Phytophthora*.

Perspectives

Besides the use of almond seedlings as rootstocks for almond in all the world and for many centuries, we think it is necessary to test now the almond x peach hybrids as rootstocks for dry conditions. They are used till now on irrigated soils. But it was observed that isolated trees on G.F. 677 rootstock planted in dry soils showed a good resistance. This rootstock has a rich root system but it is not deep enough. If we find another hybrid with a deep root system it may be more resistant to dry soils.

In the Pomology Institute of Naoussa several local and foreign hybrids are now tested. The most important are the following:

1. *J1 (Adafuel)*: This hybrid from Spain is a little more vigorous than G. F. 677 and its root system is deeper. It shows better rooting ability but it proved to be very susceptible to *Phytophthora*.

2. *AN 1/6*: It was obtained in Greece (Nonpareil x I. D. S 37). It is more vigorous than G. F. 677 and its root system is also more rich but not deep. The resistance to the nematode *Meloidogyne incognita* is satisfactory enough but it has proved to be more susceptible to summer *Phytophthora* in comparison to G. F. 677. Its rooting ability is similar to G. F. 677.

3. *D. S. S.*: It is a natural local hybrid having a very strong and deep root system, susceptible to the nematode *M. incognita*. Its rooting ability is similar to G. F. 677.

4. *I. D. 11 x Marcona*: Obtained recently at the Pomology Institute of Naoussa. According to first observations it seems resistant to dry conditions. Its mother peach tree (I.D. 11) is a rootstock resistant to the nematode *M. incognita* and to dry conditions. The study of this hybrid will continue.

Our opinion is that the use of the almond x peach hybrids as rootstocks for almond depends also on their rooting ability because it is related to the cost of multiplication. Therefore we think it is necessary to select parents having the possibility of easy propagation by cuttings. For that purpose a research is carried out at the Pomology Institute of Naoussa to select peach rootstocks and almond varieties with good rooting ability in order to use them as parents in crosses. It has been found that the local selection of peach rootstock I. D. 10/1 showed a rooting percentage of hardwood cuttings with bottom heat of 90%, whilst the G. F. 677 hybrid showed a percentage of 60%. This rootstock showed also resistance to *Verticillium* and better growth than G. F. 305 in a place after uprooting of old peach trees. Also 8 almond varieties were studied for rooting ability of hardwood cuttings with bottom heat for 75 days at 20° C. The percentage of cuttings with callus and roots for each variety is the following:

NO.	VARIETY	PERCENTAGE WITH CALLUS	PERCENTAGE WITH ROOTS
1	Pangrati	24,2	0,0
2	Petmeza	7,3	1,0
3	Cristomorto	30,8	1,6
4	Phyllis	23,6	0,0
5	Texas	18,3	0,0
6	Drepanoto	8,0	0,0
7	Sovietic R S 74	48,1	0,0
8	Marcona	59,3	7,3

From these results we intend to use as parents in future crosses the peach rootstock I. D. 10/1 and the Marcona almond variety.

Our opinion is that research for almond rootstocks should not be limited only to resistance to dry conditions, though it is the most important trait for non irrigated orchards. It is necessary to study all the characteristics related to the problems for each country and for each area. The nematodes, bacterial canker, phytophthora, rhizoctonia, verticillium, silver leaf (*Stereum purpureum*), *Cytospora*, are the most common problems of rootstocks in many countries, where research is carried out.

We think also that the research work for the problems of nutrition, and especially for the ability of the rootstocks to

absorb the different nutrient elements, has not made satisfactory progress. This research may help to prevent many problems even in the case of lack of sufficient soil moisture. For example rootstocks having low ability of potassium absorption have an unfavorable influence on the grafted varieties for resistance to drought and to low temperatures.

We have referred the general aspects of the present rootstock situation in Greece and thoughts for future plans for research at the Pomology Institute of Naoussa. The use of suitable rootstocks for the control of all these problems is the first step. More research work and international cooperation is necessary to obtain new varieties and methods to find effective solutions to all these problems.