ABSTRACT

Walnut production in France has been static with about 2 million trees, 50 percent in orchards and 50 percent scattered, producing 20,000 to 25,000 metric tons annually over the past ten years. The two main production areas are Grenoble in the southeast and Perigord in the southwest. The more modern orchards are in the Grenoble region where acreage is increasing by about 100 to 200 hectares per year and the leading cultivar is Franquette, almost entirely on J. regia rootstock. Less than 50 percent of the trees in the Perigord region are in orchards and many of these hillside plantings are going out of production because of extreme frost hazard, generally poor soil conditions and inferior varieties. Walnut researchers evaluated seedling selections from throughout France and about 200 varieties obtained from various parts of the world during the 1960's and 1970's, but no suitable replacement was found for Franquette which continues to be the leading variety planted. Current research on walnut cultivar and rootstock improvement is being conducted at the INRA Station near Bordeaux while extension-related activities are performed at two stations of CTIFL. The current cultivar improvement program involves evaluation of open-pollinated manregian seedlings of PI 18256 from Oregon for improved nut characteristics and possible blight resistance and hybridization and selection in which 20,000 controlled crosses have been made since 1976, looking specifically for precocious seedlings that leaf-out around the same time as Franquette. The current emphasis in rootstock improvement is on the production of hybrids of J. nigra and J. regia for increased vigor and oak root fungus resistance.

OBJECTIVES

1. To gain through observations and discussions first-hand knowledge of various aspects of walnut production in France with particular emphasis on the cultivar and rootstock improvement program.
2. To determine the desirability and arrange for importation into California of promising English walnut seed sources for testing as potential rootstocks.

PROCEDURE

1. Travel in June, 1984, to the INRA Horticultural Research Station at Bordeaux to confer with E. Germain about his walnut breeding and selection program.
2. Visit CTIFL research stations in the major walnut production areas and the Averzeng nursery in the Garonne Valley.

RESULTS AND CONCLUSIONS

There are about 2 million walnut trees in France, 50% in orchards
and about 50% just scattered trees. Production is 20,000 to 25,000 metric tons and it has been at about the same level for the past 10 years. Of this supply there is about 3,000 metric tons exported in-shell and 1,000 metric tons exported as kernels which means that the total export amounts to about 5,000 metric tons. Their main export markets are Germany with about 2,500 metric tons, Spain 1,200, and smaller amounts to Belgium and England.

The two main areas of production are Grenoble and Perigord. The Grenoble area in the southeast consists of the departments of Isere with about 8,000 to 8,500 metric tons production and Drome with 3,500 metric tons. The Perigord area is in the southwest of France and has a total production of about 13,000 metric tons. It consists of the departments of Dordogne with about 7,000 metric tons, Lot 4,000, and Correze 2,500.

**Grenoble Region**

The more modern orchards in the country are located in Isere and Drome where acreage is increasing by about 100 to 200 hectares per year. Thirty-five percent of the orchards in that area are less than 15 years old. The primary cultivar in Grenoble is Franquette, about 80% of older plantings and 90% of the newer orchards. Other varieties grown are Parisienne (10%), Mayette (6-7%) and about 3% of other varieties. Virtually all (99%) are grafted trees. Ninety-five percent of the trees are on J. regia rootstock and only 5% on J. nigra. The current rootstock interest in the Grenoble area is to use J. regia x J. nigra hybrid for increased vigor.

**Perigord Region**

In Perigord, 50% of the trees are not in orchards. Production in this area is decreasing because many of the hillside plantings are going out of production. The main variety in the area is Corne but it is not a good variety because of small size, poor shelling characteristics and it is not precocious. The production of Corne is about 5,000 metric tons or about one-third of the production in Perigord. The second main variety is Marbot consisting of about 1,500 metric tons primarily in the Correze and Lot Departments. It has a problem with bad shell seal. The third variety is Grandjean with about 1,000 metric tons and it is sold mostly to Great Britain as kernels. New orchard plantings in the area are around 80% Franquette, 10-15% Marbot and 5% Grandjean. Since 1956, many of the trees planted have been grafted on J. nigra. This amounts to about 100,000 or 15% of the trees in the area that are now faced with a blackline problem.

**Garonne Valley**

A third area of production in France is the Garonne Valley which includes the departments of Lot de Garonne and Gironde. It is an intensely cultivated area of clay loam soils. There are only about 500 hectares, mainly Franquette on J. nigra.

**Future Plantings**
The area that seems most suitable for future walnut plantings is Isere. The winter is cold, but there is virtually no spring frost problem after the trees leaf out and the summer is relatively warm. The next area of potential new production is the Garonne Valley which has the best soil. The trouble here is that Franquette production is too low and future plantings depend on the availability of new late-leafing varieties. If they are developed, it is possible for many new hectares to be planted here in the future. The Perigord area is gradually going out of production because it has poor, shallow soils and the highest risk of spring frost danger in France.

WALNUT CULTIVAR AND ROOTSTOCK IMPROVEMENT PROGRAM OF E. GERMAIN IN BORDEAUX (INRA STATION DE RECHERCHES D'ARBORICULTURE FRUITIERE, LA GRANDERRADE)

The walnut variety program in France was originally started in 1960 in the Perigord area near the town of Brive. During the 1960's the objective was to look for seedling selections from throughout France that had outstanding characteristics. That program was not successful and Franquette still continues to be the leading French variety. In 1970 the variety development program shifted to Bordeaux and since that time about 200 varieties obtained from throughout the world have been studied at this station.

French Cultivars

According to Germain, the French walnut varieties such as Franquette are characterized by late leafing and harvest dates, protandry, terminal bearing habit and low production. The trees have strong apical dominance reflected in a vigorous upright growth habit. The nuts have a good seal and shell with medium size and good kernel quality, although kernel percentage is low, being in the range of 40-48%. A good pollenizer for Franquette is Meylan but it takes 6 to 7 years before the first catkins are produced. Another pollenizer for Franquette is Ronde de Montignac. It is a good catkin producer after 4 years of age but has poor nut size which makes it unsuitable for the in-shell market.

California Cultivars

Germain characterizes the California varieties as having a spreading growth habit with weak to moderate vigor. The trees generally leaf out early (end of March for Payne) and harvest early (end of September for Payne). Production is considered high provided there is no frost. Nut size is good. The seal and shell are generally poor, however, with the early cultivars. Hartley is considered to have a good seal and shell. Nut quality and kernel percentage overall is considered good. The faults of the California varieties are their blight susceptibility and lack of cold hardiness in the fall which makes young trees very sensitive to fall frost damage in many years. Germain ranks the California varieties in terms of their adaption to France in the following order: Hartley (Grenoble, but not Perigord because of frost potential), Chandler and Howard (untested) and Pedro (poor quality).
Lara is a relatively new variety which is apparently a seedling of Payne being propagated by Averzeng Nursery in the Garonne Valley. The yield potential is considered to be about 4.5 metric tons per hectare compared to Franquette with about 3 tons per hectare. It is about 50-60% laterally fruitful and leafs out one week before Franquette which is a good pollenizer for it. It has two major faults: (1) lack of vigor and (2) high blight susceptibility. Germain feels that over the next 10 years it will become the major variety for France in the Garonne and Isere Valleys because productivity is higher than Franquette and nut quality is good.

Manregians

There are about 10 varieties from Oregon (manregians) being tested in France. Germain characterizes their vigor as good with an erect growth habit. They are considered more precocious and more productive than Franquette. Nut size and shell characteristics are good but there is some concern about dark kernel color. Germain feels that they may be blight resistant in that they leaf out with Hartley and have no blight. He considers the two best manregians to be Adams 10 and Chase D9.

Carpathians

A number of Carpathians from Hungary, Bulgaria, Rumania, and Germany have been tested in France. Their characteristics are early leafing and harvest dates (3 to 4 weeks before Franquette) and good nut size; the shell, however, is considered not as good because of perforations and poor seal. Also, kernel quality is poor (dark) and productivity is similar to Franquette. Germain concludes that the Carpathian cultivars from this area are not good for production in France.

Current Cultivar Improvement Program

Germain's current cultivar improvement program has two major thrusts. One involves evaluation of open-pollinated manregian seedlings of PI 18256 obtained from Lagerstedt of Corvallis. Germain planted 300 nuts from this source 3 years ago from which he was able to select 40 late-leafing seedlings. These were placed in a selection block, and he is now evaluating them for nut characteristics and blight resistance. An additional advantage of manregians is that they appear to have good frost tolerance in fall and winter.

The second thrust of Germain's current program involves hybridization and selection. Since 1976 he has made about 20,000 controlled crosses. The breeding program involves making 3,000 crosses for a given set of parents. Out of that cross 600 are grown in the greenhouse from which 400 to 500 seedlings are planted in the nursery. The seedlings are evaluated in the second year for late leafing and only those that leaf out between one week before and one week after Franquette are saved. These are then transplanted after the second year to a selection block at a spacing of 6 x 4 meters. The objective is to try and develop 100 late-leafing seedlings from each cross for further evaluation.
Rootstocks

The rootstock development program was started about 20 years ago. They selected about 100 seedlings of J. nigra obtained from 300 J. nigra trees growing as seedlings throughout France. Apparently the original trees were brought over from the U.S. and planted in France some 70 to 80 years ago. These 100 promising seedlings were then grafted to Franquette, and based on their performance, 10 were selected as potentially valuable rootstocks. Germain feels that 3 or 4 of these are good seed sources but the program has been terminated because they are no longer interested in J. nigra as a rootstock. Germain has concluded that the dwarf types of J. nigra are not good rootstocks. Not only does tree size go down but production goes down as well. Also, any J. nigra tends to be unsatisfactory on poor soils as compared to J. regia.

The new approach to rootstock development is the production of hybrids. Germain has three J. nigra trees that produce about 80% open-pollinated hybrids crossed with J. regia. J. nigra #23 appears best and he now has three orchards of this selection with three different J. regia pollen sources included for the production of hybrids. The vigor of these hybrids seems to be about the same as Paradox. The interest in hybrids is due to their increased vigor and the fact that J. regia is very susceptible to Armillaria. The J. nigra x J. regia hybrids seem to be more resistant to Armillaria, but Paradox (J. hindsii x J. regia) seems to have even greater resistance according to Germain. However, he has trouble in getting a supply of Paradox because J. hindsii does not do well in France due to a serious problem with Anthracnose.

There are several INRA researchers working with walnuts in addition to Mr. Germain at Bordeaux. These include Mr. Mauget at Clermont Ferrand (physiology), Mr. Scotto at Antibes (nematode transmission of blackline), Mr. Huguet at Avignon (nutrition and irrigation) and Miss Dosba at Bordeaux (blackline).

VISIT TO THE ISLAND RESEARCH FARM OF INRA IN BORDEAUX (INRA DOMAINE D'ARBORICULTURE DEL'ILE d'ARCING1EN GIRODNE)
The island farm is 25 hectares in size and is located in the Garonne River Valley near Bordeaux. It is frost free which is good for the study of the full range of walnut cultivars particularly the early ones. There is a water table at about 1 meter in winter and 2 meters in summer because of the influence of the Garonne River. Germain has about 150 cultivars here under test, 45 of them from California, 25 from eastern Europe, 5 from Germany and 10 from other places.

VISIT TO INRA JARRES RESEARCH FARM NEAR THE TOWN OF LANGON IN THE GARONNE VALLEY (INRA DOMAINE D'ARBORICULTURE DES JARRES EN GIRO)
This 60 ha research farm is located a short distance out of Bordeaux and it is the place where Germain is doing his hybridization work for new cultivars. The oldest trees in the collection are fifth leaf hybrids which are the result of crosses made in 1977, growing the trees in the nursery in 1978 and 1979 and planting them in the orchard in 1980. He has 800 seedlings from the 1977 crosses
in this collection. The spacing is 6 x 4 meters.

VISIT WITH AVERZENG AT LANGON IN THE GARONNE VALLEY

Averzeng has 150 hectares of walnuts in production and grows about 80,000 walnut nursery trees each year, which makes him the largest nurseryman.

The primary seed source for Averzeng's nursery is a J. regia cultivar called Lozeronne. It is an old variety that is not very good for commercial production, but there are old trees in the area. He considers them to be an excellent source of seedlings in that they are uniform and of good size (caliper), and he gets good germination. This is a seed source that we probably should try in California.

Averzen has a four-year nursery cycle compared to our two. Over this four-year period, he feels that he ends up with 70% saleable trees from the initial number of seed that he starts with. He sells his four-year-old nursery trees for about $8.00. Seventy percent of the trees that he sells are on J. regia and 30% on J. nigra. The first year of the cycle consists of stratifying the seed and planting them densely in a nursery row and the second year replanting the good seedlings from the dense planting into a wider spacing using a mechanical planter. In the third year, they patchbud in the fall using two-year-old buds, and then in the fourth year, they head back the tree to the bud forcing it to grow which results in a saleable tree at the end of four years.

The Averzen orchard that I visited in the Garonne Valley consists of 43 hectares. It has been producing about 155 metric tons over the past 5 years. The orchard is 13 years old on J. nigra, planted at 8 by 7 meters, which is considered too close for Franquette. A more common distance in France would be 9 x 11 meters. There is no blackline problem yet in this particular area.

He is working on a tree thinning program. In one area of the orchard he tried simply pulling out every other row on the diagonal, but does not feel that it is worthwhile. Production has been down in this area for the past 3 years, and the first year after pulling he had some serious limb breakage. It appears that maybe Franquette does not respond as quickly as Hartley to a tree removal program. He feels that whisking is better in terms of causing a minimal adverse effect on loss of production. This view is shared by other walnut experts as well.

VISIT WITH G. CHARLOT AT THE CTIFL STATION, ST MARCELLIN, ISERE VALLEY

Most plantings in this area near Grenoble are on J. regia and J. nigra is generally not considered a good rootstock for Franquette. Parisienne (a more vigorous cultivar) on the other hand is considered okay on J. nigra. There is considerable interest in hybrids of J. nigra and J. regia for increased vigor.

Hartley is considered the best California variety for production in this area. It produces more than Franquette, but the problem
is that Franquette has the brand name so it continues to be the predominant variety planted. Pedro has a problem of thin shell and dark color. Lara is considered not as good as Franquette.

VISIT WITH J. PRUNET AT THE CTIFL STATION NEAR BRIVE IN CORREZE

The area for which this CTIFL station is responsible is called Perigord which includes the Lot and Dordogne Valleys. The CTIFL people look at walnuts in this area of the southwest to shrink in the short run because of the frost hazard and generally poor soil conditions. In the long run, however, with new varieties from Germain, they look for increased plantings in the Lot and further south in the Garonne Valleys where the soils are generally better. They don't foresee any increase in plantings in the Dordogne Valley.

In the southwest region generally, irrigation of walnuts is very small. Only about 5 to 10% of the orchards are irrigated but it is increasing as growers realize its value. The biggest problem with walnuts in the southwest is frost, second is the lack of precocity because of having to rely on the Franquette variety (8-10 years) and third is bacteriosis or walnut blight.

At this particular location in Correze, J. nigra appears to be a good rootstock, comparable to J. regia. This is an acid soil with a pH of 4.5 to 5 which seems to be well suited to J. nigra. In contrast, the other walnut areas, St. Marcellin in the Isere Valley and the Lot and Garonne Valleys all are calcareous with a pH of around 7 to 8. In those locations, J. regia is generally superior to J. nigra. The recommended rootstock in the Correze area is J. nigra because the trees come into bearing sooner than on J. regia. In addition, J. nigra is much more resistant to Phytophthora cinnamomi than J. regia and this is a serious problem in the area. In the Lot and Garonne Valleys, on the other hand, the recommendation is to use J. regia so the rootstock recommendation in Perigord varies according to the specific location.

In the Correze area, Pedro is considered to have a good shell but both Pedro and Hartley are too early and affected by spring frost as is the case throughout most of the Perigord.