LAVENDER CLONE SELECTION FOR ESSENTIAL OILS IN TASMANIA

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In my particular field there are two kinds of experts dealing with the volatile oils. First we have the specialist, who has narrowed and deepened his field of study to the point where he knows nearly everything about almost nothing. Conversely, there is the general consultant, who covers such a wide field that, in effect, he knows nothing about everything. Now, here am I, a better specialist than a consultant and a better consultant than a specialist, uncertain whether I know anything at all; least of all something that might be relevant to the objectives of your Society.

On the other hand, the propagation of plants, and the selection of those plants that are worth propagating, is fundamental to all those industries and individuals that depend ultimately on things that grow in the soil. One way or another that includes us all. But to speak in general terms on this subject, would be like Mark Anthony, to "tell you only that which you do know." However, it may interest you to hear how plant and clone selection affects the production of those volatile oils which are used in the flavour and perfume industries. Since we all must eat and wash, this narrower field would also concern all of us. For example, an old-time advertisement which begged, "If you won't use our soap, for heavens sake, use our scent," has said it all.

When steam is passed through a charge of plant material which bears a volatile oil and the emerging vapours are condensed, most of the oil will separate spontaneously from the water in the liquid phase. Many valuable materials are recovered from a wide variety of herbaceous sources by this process of "hydro-distillation." The products won from nature in this way are called "essential oils" because, being derived by distillation, they are, by definition, essences.

The annual value of the world output of these essential oils is very great indeed, many billions of dollars. Compared to other countries, Australia, despite incomparable opportunities, is missing out and our production is insignificant by world standards. But even Tasmania's small share of this unimportant output nears some 1½ million dollars each year. Due to the multiplier effect, the commercial importance of these oils is magnified many times by the value of the manufacturing industries which use them. In fact, the detergent, soap, perfumery and cosmetics industries are assessed

as having the fifth largest group turnover in world trade. This does not include the even larger consumption of essential oils in edible essences, prepared foods, soft drinks, liqueurs and, last but not least, pharmaceutical applications. Clearly, the importance of plant breeding and selection to improve all the species from which these oils are derived, can hardly be overstated.

With the advent of greatly improved synthetic chemicals to supply the less expensive sections of the market, natural essential oils will, in future, have to justify their higher production cost and the prices in the upper echelons of the market where only the very best will be good enough. Certainly, the products of unselected or unimproved planting stock will not be able to do this.

Essential oils are natural mixtures of one or more main compounds with numerous trace components; the latter are often the most important constituents of the oil. For example over 60% of the odour value of rose oil is provided by ketones which amount to less than ¼ of one percent of the whole oil. The trade requires these oils, either as a source of one of its main constituents, or for use in its natural state to take advantage of the synergic properties of the natural mixture which human science does not know how to duplicate. Many oils, in fact, are used in both these ways and it follows that any intending producer must first be sure that there is a ready market for his product in one or other of these established applications and that the composition of the oil will suit the use for which it is intended.

While having planting stock of the right species is, of course, necessary for this purpose, it by no means guarantees that a saleable oil can be produced from it. Even with oils that can be marketed, clonal type variations cause big differences in the price. Two examples will suffice:

Oil from the citronella grass grown in Ceylon contains only 10 to 15% of the desired adlehyde, contronellal. The same species grown in Java has some 50% of this component and is much more sought after. Similarly, the geranium oils from Reunion have a much greater rhodinol content and are far more highly prized than those from Egypt or Morocco.

The oils produced by many plants are influenced by length of day (or night). It follows that the variants of any species selected for oil production must be adapted not only to the climate but also to the latitude of the growing area. My own company imported mint plants to Tasmania in 1951 and produced oil from them in the north of the island for some 20 years. The project was then transferred to the south, scarcely 2° further from the equator, where due to the longer summer days and cooler nights, the same stock produced better oil and more of it.

Of course, the greatest cause of variation among the individuals of any species that can be propagated by fertile seed is undoubtedly genetic. The lavender genus provides an excellent example of the complex confusion that must be sorted out in selecting the best genotypes for essential oil production. There are only two *Lavandula* species of interest to the perfumery trade. Firstly, there is the vigorous, hardy *L. latifolia,* occurring naturally in the coastal regions of the northern Mediterranean. It yields a strong rich oil in which the odour of camphor is predominant. This restricts its use to those applications where the camphor odour can be tolerated. Native plants of the best form of the so-called "true lavender," *L. angustifolia,* are found only in a small area above 1000 metres altitude on the southern slopes of the French Alps. Its odour is very fine and completely free of any discernible camphor. It is, however, a smaller and more delicate plant than *L. latifolia* and yields far less oil.

At medium altitudes these species intermingle and are cross pollinated by bees, giving rise to sterile hybrids which are stronger and yield more oil than either parent. Unfortunately, despite its current very large production, the future of this oil is in some doubt. Having neither the richness of *L. latifolia* nor the refinement of the *L. angustifolia,* it may well be overtaken by synthetic substitutes which can exclude the still dominant camphor note.

Expert advice was that any two parents of either species can give rise to at least 2500 different viable genotypes in their progeny. Since all variants of both species appear to be interfertile, a mathematician might expect some 6.25×10^6 different genotypes among the hybrids. Since it is these hybrids that nurserymen have propagated asexually and given them names like "English Lavender," "French Lavender," etc. we find them in most home gardens. However, the hybrids can copy the visible characters of either parent as well as showing every possible combination of them. But the less desirable camphor component will still dominate the odour of most of the hybrid oils without any assurance that the rest of the oil will make it suitable for an established application. As will be seen, whatever its appearance may suggest, the chances of a garden lavender being suitable for oil production appear to be less than one in several million.

Since my company's lavender plantations were started from a large quantity of seed taken from high up in the Alps where no *L. latifolia* plants existed, there was little danger of any hybrids being included in the planting stock, and this did prove to be the case. At the same time we were advised that, due to the large number of seeds originally grown, it was probable that most viable genotypes of *L. angustifolia* would be found in our fields. All we

had to do was to isolate the most desirable variants and propagate them asexually by cuttings to preserve their genetic characters. In 1949 a long term research programme was initiated to do just that.

Of course, given time, those plants with inadequate longevity would eliminate themselves. Similarly, those with insufficient resistance to the normal hazards of existence in Tasmania would become weak and unproductive. Many more could be eliminated by experienced olfactory examination detecting undesirable odors in the flowers. In the event, after these eliminations, we still had 487 promising genotypes which we had to test in the field for periods from 7 to 11 years to confirm their ability to produce good oil in adequate quantities over a reasonable number of years.

Appearances were deceptive. One plot of exceptionally vigorous plants yielded 8500 kilos of flowers per hectare but only 8 kilos of oil. The adjacent plot had a slightly less vigorous type which yielded only 5000 kilos of flowers but some 60 kilos of oil per hectare. There were many plants which produced small quantities of good oil and even more that produced large quantities of indifferent oil. But from the presumed original 2500 genotypes only 13 produced large yields of quite good oil. Only three produced superior yields of very good oil. These are now the basis of our plantations, and of these three only one produces exceptional yields of superlative oil.

The selection programme took 23 years to complete It was tedious but not particularly difficult or costly. Since it costs no more to maintain a plantation yielding exceptional quantities of superior oil than one of mere average performance, the commercial advantages resulting from the research programme become significant. The present plantations yield at least double the normal amount of oil per hectare and the oil has 2½ times the average content of the most desirable trace component. At the same time, all the off-colour perfume notes normally contributed by inferior genotypes in unselected plantations, have now been eliminated. The clonal selection has given an advantage in lower production cost and a higher market value which is reflected in the selling price and the bottom line of the accounts.

As a final note, I would like to observe that selling price is important but it does not only depend on the quality of the product. It requires knowledge of the market and shrewd judgement of what is required right now and how this may change in the years ahead. The classic example of misjudging a market comes in a fable told me by a Scotsman many years ago. It is said that, during the great depression of the early thirties, the city council of Aberdeen lowered the bus fares from threepence to twopence a mile. The citizens were furious, because they could save only twopence instead of threepence by walking.