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Some Notes on Garden Science*

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Public Analysts usually hold appointments as Agricultural Analysts and this does cover horticulture, a rather neglected branch of the subject as far as the analyst is concerned. The following is offered for a wider audience in the hope they will also benefit from what is a fascinating and relaxing hobby.

Fertilisers

These of course must not be decried but so many proprietary articles appear to be successful and probably the main reason for their success is that the person applying them ensures that the particular area under treatment is free from weeds. Then the proprietary fertiliser may be applied, and it is usually so diluted that if the directions are followed it is difficult to do any harm with it. Further discussion on a field scale may be relevant and can be arranged, if desired.

Alternatively it is possible to kill a plant in a 5 in. pot by adding five pellets of, say, Growmore fertiliser. The amateur gardener is apt not to work out what is meant by for example, 2 oz/yd^2 and commonly applies so much fertiliser that the salt concentration of the soil is increased to a point where the seeds are unable to absorb moisture at all.

At no time should fertiliser and seeds be applied together, whatever may be the recommendations in garden books or on the packets. The time to apply the fertiliser is after the seeds have germinated and the plants have developed sufficient roots to absorb the nutrients when the latter are applied.

Farmers, who used to obtain enormous subsidies for lime, usually waste it because they have to think of the expense (in terms of labour and tractor fuel) of getting it on to the fields. It is for that reason that they often apply fertiliser and seed together, but they do it in the knowledge of how thinly they can apply fertiliser and that most of it will wash down into the aquafers and rivers before the seeds need to grapple with it. Farmers' most commonly-used fertiliser is material they call "Bag muck" which is marked 15:15:15 to indicate the presence of 15 per cent. nitrogen (N_2), 15 per cent. phosphate (P_2O_5) and 15 per cent. potash (K_2O). Less expert purchasers of fertiliser are assumed not to be intelligent enough to use such material properly, so they are sold the same thing, diluted down with clay, and therefore grey in colour instead of sparkling white, and labelled 7:7:7 to indicate 7 per cent. of each nutrient.

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Seeds

The farmer also uses pelleted seed. The only reason for this is that he sows expensive seed mechanically. Turnip seeds, lettuce seeds, beet seeds, etc., come in different sizes, and one machine cannot sow such differently sized particles in a controlled way. Pelleted seed is merely seed rolled into balls of clay of uniform size. As it happens, the farmer also enjoys the bonus that the fertiliser he applies with his sowing will wash out of the topsoil before the clay case around pelleted seed breaks open. But for the small area gardener, pelleted seed is a waste of money, and if he sows it in a dry springtime the pellet may not get enough water to break the clay capsule, so that the seed, in turn, never gets enough water to germinate. It could be overweighed by the advantage of ease of handling with less waste of seed.

Seeds are usually capable of living for quite a long time. Stories of wheat taken from Egyptian tombs and germinating are nonsense, but that is not to say that such longevity in seeds is absolutely absurd. Some seeds are designed to withstand long periods of inhospitable climate, and there are batches of Arctic lupin seeds, obtained from the bogs of Alaska, which radio-carbon dating has shown to be 10,000 years old, and from which some seeds have germinated. A north Indian lotus possesses seeds which will germinate after being dormant for 200 years. Most common seeds will last three or four years, and EEC regulations which insist upon minimum percentages of viable seeds merely protect the purchaser from being given seed which is five or more years old. Kew Gardens keep seeds of rare plants in cold storage for very long periods, and are able to provide one or two seeds even of very rare plants to people they regard as having sufficient interest to make proper use of them.

The ordinary gardener does not need to keep seed for a hundred years, so those seeds sold in packets marked "packets sealed for longevity" are just employing a sales gimmick. While it is true that turnip seed, which would ordinarily last about five years, will, if packed in low moisture packs and kept at one degree centigrade, live on for a hundred years, all that the small gardener needs to know is that if he keeps seed dry, it can be used in the following year and in the year after that! We are beginning to see packets marked: "Sow before 1982" which is some concession to the fact that one does not need to use the whole of a packet of lettuce seed at one sowing. Packets of seeds could be kept in a drawer in the living room. Dryness is more important than cold, but if they can be kept dry and cold so much the better.

Taking an interest in seeds can be very rewarding. At this time of year (Autumn), Ness Gardens is importuned by seed merchants for seeds for Bonsai miniature trees. There is nothing special about such seeds. They are the ordinary seeds of any old trees such as Maple or Pine. Anyone with a Japanese Maple in his garden would probably find it producing seed in November and from those he should be able to produce the miniatures or the seedlings, usually 1 ft high, currently selling at about £4 each. The merchants make quite a lot of their money on the assumption that in practical matters the ordinary person is incapable of following instructions. To some extent they are justified in so thinking. A seedmerchant who sells specialist seeds tells a story of an experience he had with Australian Acacia seeds. These have a very hard seedcoat,

and normally take about two years or more to germinate, because the seedcoat needs to rot. He therefore advises that Australian Acacia seeds be covered with boiling water to soften the coat before they are planted. If this is done, one needs to take care that the high temperature does not reach the seed embryo and kill it, but despite his giving such a warning, a furious letter was once received from a customer saying that he had gone one better than had been suggested, and had boiled the seeds in a pan, but the seeds were no good because they had all gone into a mush!

Pine trees naturally expect treatment not unlike that mentioned by the above expert. Many people know the trick for getting pine seed out of pine cones. It is to take an oven up to high temperature, pop the cones inside for a minute and then take them out and let them cool. They will then open and let out the seed. This imitates the effect of a forest fire. Many pine cones will not open until after a forest fire because there would be no point in the seeds being deposited in forest undergrowth. Only after a forest fire is there a chance of their finding bare soil. Seeds of trees like spruce are also interesting in their special requirements, because these usually fall on to moss or deep leaf litter. Such seeds have adapted to this by becoming capable of absorbing their mineral requirements from very low concentrations. Spruce seedlings will therefore often do better in soils to which peat is added, despite the lowering of nutrient concentrations, than in the same undiluted soil or in peat to which about 25 per cent. of sand is added. The sand in this case does nothing but compress the peat, but in doing so it reduces aeration of the roots, and good aeration of roots is very important to spruce seedlings.

Most of the trees and shrubs—that is, all Maples, Rowan, Cotoneaster and most Berberis seeds require a winter's cold before they will germinate. From a plant biological point of view there are two ways of dealing with winter survival. One is to be profligate, so that some seeds will be likely to remain even after slugs and fungi have used a majority of the germinating plants for food. That is the mechanism of the weeds. The other is to delay germination until after the frosts are over. Tree and shrub seeds have an inhibitor of germination in them which prevents germination until they have experienced three months of cold. Those who want to grow trees and shrubs from seed therefore, should leave the seeds on damp blotting paper in a domestic refrigerator until they can be seen to germinate. One may appreciate that, in the wild, the seeds which fall in November, experience the cold of December, January and February before they germinate in the time of general growth, but a bird depositing a seed in January would have it experiencing only one month's cold. If its period of cold treatment were additive, next winter it might germinate after only December and January's cold, and would almost certainly end up as food for some wandering mouse. It is sensible therefore that the mechanism should provide for three continuous months' cold treatment. Children who plant plum stones at the wrong time of year can witness that it is sometimes necessary to wait the whole year round before the stone germinates. A gardening book by a journalist called Roger Grounds tells people to vernalise seed by putting it into wet sand for twelve months "stirring occasionally". Stirring occasionally

would break off all the roots, and the writer clearly had no idea what the biological reason for the dormancy was.

The joy of growing shrubs and trees from seed is that you have access to varieties which are not in the catalogues, and it is relatively easy to pick seeds up from under trees and shrubs in an arboretum or park. The Rowans, as an example, have almost infinite variety yet some of the more attractive ones are very rare. *Sorbus cascadensus* for example is an attractive little tree from Canada, yet apart from a small colony at Ness Gardens there is one in the arboretum at Winchester and another in the Forestry Commission Research Arboretum at Westonbirt near Gloucester. Another rare one which has just been introduced from the home of the Giant Panda in China, has white berries which last from Christmas to February. Most birds seem not to recognise white berries as food, although Tits and Finches break the berries open for the seeds and leave the pulp behind.

Fruit

Children are apt to eat fruit from any trees, and panic enquiries sometimes ensue about whether they will be poisoned. It is handy to know that fruit pulp from any of the rose family is safe to eat. Most of the kernels, however, contain cyanogenic glycosides and some children have been made ill by eating a dozen or so kernels from school meals prunestones. There is even on record a case of an American food crank who saved up a whole cupful of apple seeds, and by consuming them at once, killed himself by cyanide poisoning.

An amusing anecdote illustrative of this arose in a case of poisoning by cyanide where counsel for the defence stated that the deceased had died by consumption of a surfeit of apple pips. Following this the particular barrister had the nickname "Apple-pip" given to him. Berberis berries were once grown as a crop, and are perfectly safe for consumption.

Sunlight and Soil

The commonly-held belief that all plants like sunlight is not always true. Most plants which have yellow leaves prefer shade. Another tree, a sycamore which shows pink leaves in spring, *Acer psuedoplatinus,* is a good example. In summer it either has yellow leaves or white-edged leaves. Plants like it have deficient biochemistry inasmuch as they are unable to generate chlorophyll as fast as sunlight breaks it down. Not all variegated-leaved plants are examples of that particular defect. It is now known that chloroplasts are not necessarily actually derived from the plant, but are probably derived from independent bacteria-like organisms which have their own genes. In any case, not all plant genes are in the nucleus. In a plant like variegated holly there is a peculiar hybrid called a Graft Hybrid in which the plant core and its skin are different, though related, plants. So in variegated holly a skin plant is found in which there is a gene deficiency which makes the chloroplasts unable to produce chlorophyll, overlying a normal holly from which the skin layer obtains its nourishment. The white leaf edges are the chlorophyll-deficient plant, and the surface cells, even of the green parts of the leaf, are also those of the chlorophyll-deficient plant. Sometimes little buds arise on the trunk of such a holly, and

they are pure white, but because they cannot feed themselves they die out. If a bud from the inner plant develops then normal holly results, and the plant is said to have "reverted". Ness Gardens has an interesting Graft Hybrid which resulted from a French graft of purple broom on to laburnum stock. In 1860 a bud grew out of the union of the graft, and the new shoot had a skin of broom with a core of laburnum. At some times one can see reversions of broom and laburnum on the same shrub.

A great deal is said about soil pH but plants can usually be found which will grow in soils at the acid end—normally about pH 4·5, or in soils at the alkaline end—normally about pH 7, and much less often pH 7·5. The British Rowans seem to grow equally well in the limestone cliffs of North Wales or the acid soils of Scotland but one can select a Rowan like the Japanese *Sorbus gracilus* which will prefer an acid soil or a Rowan like *R. aucuparia* from Mongolia which prefers lime soils. In temperate regions, pH of soil is usually controlled by the calcium content. In tropical areas the calcium is sometimes leached out and sodium rises to the surface to make soils as alkaline as pH 8. Chemical waste soils as alkaline as this may also owe their alkalinity to sodium. Peculiar soils like those with a high copper content also show a deviation from the relationship between calcium and alkalinity. It is seldom the alkalinity of soils which upsets plants, however. More often a high calcium component makes iron relatively insoluble, and although chlorophyll is a magnesium compound, iron is needed by the plant in order to make it. Plants which are said to dislike lime usually find themselves incapable of absorbing sufficient iron to enable them to make chlorophyll, and this shows as a yellowing of the edges of the leaves.

Rowans are potentially immortal. In the wild, one can see many examples of a main trunk drying from attack by fungus, yet with secondary suckers growing up healthily from the base. Only fire or landslide would ordinarily interfere with this, but the deforestation of Britain's mountains is due to sheep, which nibble off all the young growth. Some people say that the poor soil on mountain slopes is the reason for lack of vegetation, but it is amazing how little soil some plants need.

Rhododendrons are a case in point. Their seeds are dust-like, but it is fun to collect them—or you can get them through the "Friends of Ness Gardens". They are sown on pure peat and after a year they will be about an inch high when you prick them out into little pots of peat. In the wild parts of the West of Scotland and the West of Ireland one can see rhododendrons growing vigorously in 2 in. of poor soil over bedrock. In order to make them grow in a garden, one often needs to dilute the soil about one to ten with peat. Another way in which gardeners kill rhododendrons is by planting them in sunny places. These are often also places where wind will dry them out in winter. When one says they are not very hardy one is not saying that they cannot withstand frost as Rhododendrons will survive quite cheerfully in a sheltered, frost pocket. What they cannot do is absorb water at sub-zero temperatures, and because their leaves are rather thin they become dehydrated by wind, and cannot replace the water. Our native evergreens like Holly, Ivy, Pine and Juniper have thick leathery leaves which hold water and resist dehydra-

tion. Deciduous trees discard their leaves in order to avoid desiccation. In a sunny place there is another hazard. In a spot which catches spring sunshine the plant will break bud in mid-April and then will be caught by the late frosts. Apples and pears grown in the south of England tend to be vulnerable to a similar mechanism. Flowers which come out too early are apt to be damaged by late frosts. Another aspect of this hazard has been seen in connection with the past two years' cold springs. Flowering trees like Almond have come into flower late, and have escaped the frosts, and sometimes, for the first time in their lives, people have seen fruit on these trees. The place for a rhododendron is a cold, sheltered north-facing position or under the shade of trees. The first rhododendron to flower is *R. Mucronulatum*, a deciduous rhododendron which flowers in January and remains in flower sometimes longer than six weeks.

Concluding Remarks

Gardening is a most rewarding and relaxing pastime, but enough has been indicated that nothing can take the place of hard work since that is the best preparation for sound growth. The incorporation of an adequate amount of humus, which our forebears did by burning of stubble and turning in green crops, such as some vetches, and which the small gardener does with peat and compost, must not be overlooked. The correct use of fertilisers is important and must be stressed, whilst trace elements, which have only just been touched on, are subjects on which specialist advice should be sought, having regard to the soil and the plants to be cultivated.