each kind of plant. To achieve this we hope to expand and have the right environment for each plant transferred.

Our main objective for the future is to offer the highest quality product to the New Zealand grower and meet the demands required for export. Tissue-cultured plants hold an exciting future and it is our intention to continue our research and selection so that we can offer the industry quality that will produce high returns.

USE OF *PINUS RADIATA* BARK: A FOUR-YEAR EXPERIENCE

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Processed *Pinus radiata* bark has now been available in New Zealand for over four years and, during this time, we have used it exclusively for all our production of a wide range of New Zealand native plants.

Prior to using pine bark, we had been using sawdust for a number of years and had established that wood waste was a satisfactory medium in which to grow plants. Our prime motive for using sawdust had been economics. Our local timber mill was delivering 12-metre loads to our nursery free of charge, with the exception of a minor freight charge. Our respect for wood waste soon increased far beyond economic considerations. Besides costing nothing, it was weed-free. Plants developed far superior roots, with little or no pathogenic damage — generally described as water-borne fungi — such as *Phytophthora*. However, the longer we used sawdust, the more problems we were having with non-pathogenic fungi, which rapidly decomposed the sawdust. The final blow was a fungi which only took a couple of weeks to decompose an 8-pint planter bag full of sawdust. It also produced an unpleasant odor, along with enough heat to cook the roots of the plants, which subsequently died.

In order to overcome this decomposition problem we decided to change to pine bark, which had proved more than satisfactory in small trials. We spent considerable time designing a machine which would pulverise bark into a potting mix in one operation. However, while we were still working on this design, we were approached by a soil company, who asked what the prospects were for pulverised pine bark as a peat substitute in horticulture. We responded enthusiastically, and the company, known as Granulated Bark, was set up.

During this time, much discussion took place on what grade the bark should be. It was always my contention that the pulverised bark should be suitable for planting plants without any addition of sand or any other substance to alter its structure. From the very beginning, we planted into 100% bark with no fertilizer, placing the fertilizer on the top of the containers a couple of weeks after potting. This technique had two advantages:

(1) Pricking-out losses dropped off dramatically.

(2) It was useful to have the flexibility of being able to respond to the different nutritional requirements of each species.

We had discovered earlier that the biggest single reason for losses at pricking-out and potting-up was too much fertiliser in the potting mix. The big disadvantage in placing the fertiliser on the top of the container was that it was most desirable to do this just prior to a heavy rain, or during a heavy rain, and we never seemed to get enough heavy rain when we needed it.

After the Granulated Bark Co. installed a batch mixing plant we decided to have our fertiliser pre-mixed for two reasons:

(1) It eliminated one routine job from the work programme.

(2) The bark was often so dry we found it extremely difficult to wet. However, when water was added in the mixer, no further problems were encountered.

The most satisfying quality of bark is that it is impossible to waterlog and, in a container-growing nursery, this is of paramount importance. However, other growers claim that it is too free-draining. We would describe bark as a warm, living, organic medium, resembling in many ways the litter which is to be found on a mature forest floor. It is in this highly rich, organic litter that plants are always seen to be doing their best.

Iron deficiency became a chronic problem in the nursery after changing over to bark, as the tannin in the bark locks up iron. Therefore, fairly heavy applications of iron sulphate are desirable. We noted that if the bark was saturated with iron sulphate, it went black and, once black, the plants never again suffered from any iron deficiency. With this philosophy in mind (i.e., that the nutrients be locked up in the mix) — coupled with our knowledge of fertiliser toxicity — we decided that a potting mix should have most of its nutrients locked up. The nutrients then become available to the plant slowly, as the plant grows and requires it. We have now changed our fertiliser regime accordingly and, where possible, slow-release nutrients are used.

Dolomite lime provides us with calcium and magnesium — serpentine-reverted superphosphate for phosphate, calcium, and magnesium. We have found fish meal a good biological decomposition starter and an excellent source of calcium phosphate and trace minerals. Potassium and sulphur are provided from potassium sulphate, zinc from zinc sulphate, copper from copper sulphate, boron from sodium borate, and manganese from manganese sulphate.

Nitrogen is the nutrient which causes us the most problems. We have found that the correct addition of nitrogen to a potting mix is no guarantee that a plant is getting the correct amount, or any at all. On hot days it disappears into space as a gas, and on wet days it is washed out by the heavy rain. We currently use three sources of nitrogen in the nursery — calcium ammonium nitrate or sulphate of ammonia for quick-release, and urea-formaldehyde as a slow-release nitrogen. These are added to the bark mix. However, we also add calcium ammonium nitrate, and sometimes calcium nitrate, to our irrigation water, when I see nitrogen deficiency appearing around the nursery. I am now of the opinion that a container nursery should permanently lace its irrigation water with nitrate — say calcium ammonium nitrate — in the correct proportions, to ensure nitrogen levels are satisfactorily maintained at all times. If the irrigation water has a correct level of nitrogen, the plants correspondingly maintain that level.

The pH of bark is very low — 3.8 to 4.3 were the figures we obtained during tests. This, we feel, is a tremendous advantage as it provides the necessary acidity to release the nutrients from the alkaline fertilisers. In spite of the early dire warnings from agricultural officials, academic workers, and my fellow nurserymen friends, about the chronic toxicity problems inherent in bark, we have found none. At times we have obtained bark that is still juicy-fresh from the trees; at other times it has been composted for months. We have found no major difference, as long as the fertiliser levels are correct. The only toxicity we ever encountered was with a batch that had caught fire with spontaneous combustion, and this extreme heat had created creosote and tars that had condensed in the cooler parts of the heap. These toxins did, in fact, burn some plants at potting up. However, it is fair to add that those plants, once recovered, were some of the best I have ever grown. It could also be that such substances as creosote could be useful in repelling pathogens. Pine bark is extremely prone to spontaneous combustion so it should never be stored where it creates a danger to buildings and property.

Many New Zealand nurseries are now using radiata pine bark. A number of large Auckland nurseries are now using pine bark 100%, and enthusiastically extol its virtues. I have seen cuttings and seeds being propagated in it very satisfactorily. In conjunction with our experiences with pine bark, I can only say that we believe it to be an excellent growing medium, far superior to anything else we have used — subject to the addition of the correct nutrients for the crop being produced.

CONTAINER PRODUCTION OF ASPARAGUS SEEDLINGS

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Interest in asparagus (*Asparagus officinalis*) growing has increased rapidly in New Zealand in the last few years. In the Waikato alone, the area in asparagus has grown from 16 hectares in 1978 to over 700 in 1982. This had led to an increasing demand by growers for planting material. Traditionally, the supply of asparagus plants has been met by growers or specialist nurserymen spring-sowing seed in a prepared nursery bed using a precision sower such as the Stanhay. Late in the following winter, the dormant crowns are lifted, usually with a chain potato digger. The crowns are dipped in fungicide then planted out in the field, often after several weeks in cold storage. Because the open pollinated cultivars are variable in both growth habit and yield, considerable effort has been directed towards the production of more uniform and potentially higher yielding hybrids. Unfortunately, hybrid seed is more expensive than seed from open pollinated cultivars. This need to make every seed count is one of the reasons there is now increasing interest in the container production of asparagus seedlings. Other advantages of using container-grown stock over crowns include a lower risk of disease, less planting shock, increased germination percentage, and greater planning and planting flexibility for the asparagus grower.

There are probably as many ways of producing asparagus seedlings as there are growers. The following is an outline of the methods generally used at Ruakura where production is mainly to provide plant material for research purposes.