may seem high for some plants but we have never had deleterious effects from salinity level even when cuttings are struck directly in the mix.

The completed mix has the following physical properties of aeration and water retention for standard and squat 6" (150mm) pots. Note the difference due to the shape of the containers.

Standard 6" (150mm) pot.

		Volume	Percentage
Pine mix A		675ml	45%
Water		450ml	30%
Air		375ml	25%
	Total volume	1500ml	100%

Squat 6" (150mm) pot.

		Volume	Percentage
Pine mix A		530ml	45%
Water		470ml	40%
Air		175ml	15%
	Total volume	1175ml	100%

We also use a supplementary liquid feed programme, which provides the following elements:

N = 150 ppm	K = 120 ppm
P = 60 ppm	Fe = 2 ppm (as FeNa EDTA).

This is given every second watering with an average of about once a week, being applied more often in summer and less often in winter.

There are plants at the nursery which have been growing in the same mix for two years and are still growing strongly. The mix has not broken down any more rapidly in this time than one would expect from any medium having a high organic matter content, e.g. peat-based mixes.

PROBLEMS ASSOCIATED WITH PINE BARK AND HOW WE OVERCAME THEM

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When our local Department of Agriculture first recommended using pine bark as an alternative to German peat in 1979-80 we were overjoyed. We thought it was an unbelievably simple, cheap source of potting media and too good to be true. We discovered it was cheap, it was too good to be true, but it certainly wasn't simple.

At Grove Nursery we grow a variety of indoor shadehouse plants and we have an interest in growing *Ficus benjamina* and *Ficus lyrata* (Syn.: *F. pandurata*).

Our old mix prior to using pine bark was 40% German peat, 40% Jarrah (*Eucalyptus marginata*) sawdust, 20% blue metal. We had this mixed commercially by an outside contractor and it cost us $338 for 6m^3. Substituting pine bark for all the German peat resulted in magnificent savings so we decided to experiment further.

In the first season we encountered chlorosis and phytotoxicity problems in *Ficus benjamina* and *Ficus lyrata*, something we had never encountered before when using German peat. The puzzling factor here being the chlorosis was on the new growth, the old leaves remaining green. This didn't really indicate any deficiency that we were then familiar with. We contacted the Department of Agriculture who recommended a spray of iron chelate. So we sprayed with iron chelate to no avail. Our next approach was to modify the mix with a surface application of Osmocote 100 and UF38 at 1 tbsp./5 l. bucket. This cured the problem but we had lost two month's production time with two crops of *Ficus*.

In December, 1980, we decided to look at the problem from a different angle. We purchased a conductivity meter, a pH meter, a relatively inexpensive beam balance, and enlisted the help of a friendly student and attacked the problem from the back door.

Our first thoughts were what does a plant require from a potting mix and which of these characteristics were inherent in pine bark:

1. A substance to hold the plant upright.
2. A substance with a pore space at container capacity of 25 to 30%.
3. A good cation exchange capacity.
4. Dark in colour.
5. Cheaper and more economical then German peat.
6. Readily available.
7. Good water holding capacity.

We thought pine bark would give us all these qualities once we overcame the problems of phytotoxicity.

As we had had some success using nitrogen and Osmocote we first looked at the nitrogen uptake of pine bark. We constructed two cubicles out of pallets and put 1 metre^3 of pine bark in each. We learned that the C/N ratio of pine bark was approx. 450/1 compared to sawdust 150/1, so we decided to put 8 Kg Agran 34 per m^3 and 10.8 Kg m^3 to the second m^3.

The official consensus of opinion was that we would have ammonium toxicity and have too high a total dissolved salts (T.D.S.) The pine bark started out with a pH of 3.5 and finished six weeks later with a pH of 4.5 and a T.D.S. of 150 micromhos per cm, which is almost insignificant. To this compost we added these nutrients and grew a trial crop of *Ficus benjamina.*

About this time I read an article by Thomas and Perryman (2) which gave us a hint that the pH was too low for optimum use of nitrifying bacteria. To the next trial we added lime at the rate of 6 Kg/m^3 to raise the pH to 6. This proved very advantageous. Still further research and reading brought to light a lot of helpful information. The composting process is basically an aerobic function requiring oxygen for maximum composting. This led us to believe that a stack 1.5 m deep would compost easier and far quicker than one 3.5 m deep, as seen in many nurseries. During trials and experiments we verified this fact several times. As the composting process is aerobic the less machinery used on top of the heap the better. We found the compost in the middle and at the bottom of the heap tended to have an unpleasant odour of tannic acid, similar to decayed silage. We attributed this to anaerobic fermentation rather than aerobic composting.

Cappeart, *et al.* (1) suggest that the optimum amount of nitrogen would be 0.75% of the dry weight. This amount came to 5.6 Kg NH_4NO^3 per m^3. We used up to 10.8 Kg NH_4NO_3 per m^3 in trials with no adverse affects on plants. At present we are using 7 Kg m^3 with good success.

Cappeart, *et al.* also suggest that at the proper pH the microflora can absorb more oxygen therefore speeding up the composting process. We were able to lower our amount of NH_4NO_3 from 10.8 Kg to 7 Kg/m^3 once we had raised the pH by adding dolomite lime.

It was suggested that phosphate could be added to speed up the composting process; however Cappeart, *et al.* show that the addition of phosphates do not influence the oxygen uptake of the microflora, therefore it is doubtful whether we need to add any superphosphate at all to the compost heap. In fact, if the compost is being used for native plants it could be harmful.

Many people seem to think that the hotter the compost heap the better. However Cappeart, *et al.* show that the temperature in an unfertilized heap had little to do with the speed of composting. The respiratory rate of the microflora didn't increase with temperature. But, in a fertilized heap, the optimum temperature was around 40° to 47°C, depending on the amount of nitrogen available. This discovery also verified our suspicions that composting is quicker and more even in a shallow windrow where the centre does not reach temperatures in excess of 50°C.

Moisture is another critical factor in the composting of pine bark and there is a high correlation between moisture content of the heap and the speed at which the bark composts. Optimum oxygen consumption of the microflora occurs when the moisture content is between 50 and 70%. This again confirms our opinion that it is better to compost in a shallow heap to ensure good water penetration and drainage. Quite often in a large heap the bottom of the heap in the centre is quite dry, extremely hot, and relatively uncomposted.

Further research into literature also told us that the temperature reached in a heap of pine bark is high enough to remove *Phytophthora cinnamoni* and *P. regularii*, negating the need to sterilize or pasteurize our potting media, hence another cost saving.

Researchers in America have placed cultures of *P. cinnamoni* and *P. regularii* into heaps of composting pine bark and, in ten weeks' time, they haven't been able to find a trace of either pathogen. Similar sized heaps of sand maintained the pathogens for a period of ten weeks.

To summarize: At Grove Nursery we have had some success using pine bark compost as an alternative to German peat. In fact many of our indoor lines are grown in 100% pine bark together with the above nutrients, but for optimum success we must abide by these guidelines:

1. The heap shouldn't be deeper than 1.5 meters.
2. We add 7 Kg NH_4NO_3 (ammonium nitrate), 5 Kg lime/m^3.
3. The heap must be kept moist but not waterlogged.
4. If possible turn the heap at least once during the composting process.

LITERATURE CITED

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2. Thomas, Steve and Fred B. Perry Jr. 1980. Ammonium nitrogen accumulation and leaching from an all pine bark medium. *HortScience*. 15(6):824-825