PEAT-BASED COMPOSTS: THEIR PROPERTIES DEFINED AND MODIFIED TO YOUR NEEDS

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The diversity of the modern nursery stock industry inevitably means that any compost has to be "many things to many plants". Scientifically, the properties of a compost can be divided into physical, chemical, and biological. These can be interpreted to mean that the compost must provide a matrix which can physically support the plant, supply air and water, contain the chemicals which are required both as major nutrients and micro elements, and allow the microbes (required for the completion of biological cycles) to exist.

Due to the diversity of species being grown in any one compost on any one nursery there is a difficulty in defining precise levels of air, water, chemical, or biological activity. Generally a single mix is expected to "do" every species on a particular holding and variations in physical structure only occur among nurseries.

PHYSICAL PRINCIPLES

From the growers' point of view the most important properties of a compost will be the air-filled porosity, available water, and its bulk density. It is very difficult to achieve all the desired physical properties using a single material and usually mixes of two or more are used.

Air-filled porosity (AFP). The beneficial effect of higher AFP on plant growth was demonstrated by Paul and Lee in 1976 and recent trials work on hardy nursery stock in the UK has confirmed this. Not all plants require the same porosity (Table 1), which emphasises the need for specifically designed composts at least for the specialist producer.

Table 1. Minimum root aeration requirements. (Bunt after Johnson).

Very High 20%	High 20–10%	Intermediate 10–5%	Low 5–2%
Azalea	*Antirrhinum*	*Camellia*	Carnation
Orchard	*Begonia*	*Chrysanthemum*	Conifer
(Epiphytic)	*Daphne*	*Gladiolus*	Geranium
	Erica	*Hydrangea*	Ivy
	Podocarpus	Lily	Palm
	Rhododendron	Poinsettia	Rose
	Saintpaulia		

Currently within the UK three or four methods exist for measuring AFP and each method gives different numbers for the end result. It is fair to say that within Western Europe there are ten to fifteen methods for AFP alone. The important end point is to relate measured AFP to growth and hence be able to index values determined in separate laboratories to avoid quoting individual figures. This would overcome the existing problem where a single compost could be given AFP values of 30%, 20%, or 10%, depending upon the method. If these relate to excellent growth, then they could all be classified as index 4 on a scale of 1 = poor to 5 = superb.

Available water. It is generally accepted that this represents the difference between container capacity and 50 to 100 cm tension equivalence. Much work has been carried out using a modified "Haines" apparatus by Bunt, and several French researchers. Other workers have chosen the pressure cell apparatus. All the methods have difficulties but, as with AFP, do have merit when clearly identified. Much more information is required in the near future because the increasing of AFPs to avoid waterlogging and increase available oxygen can have a profound effect upon the easily available water. (See Figure 1).

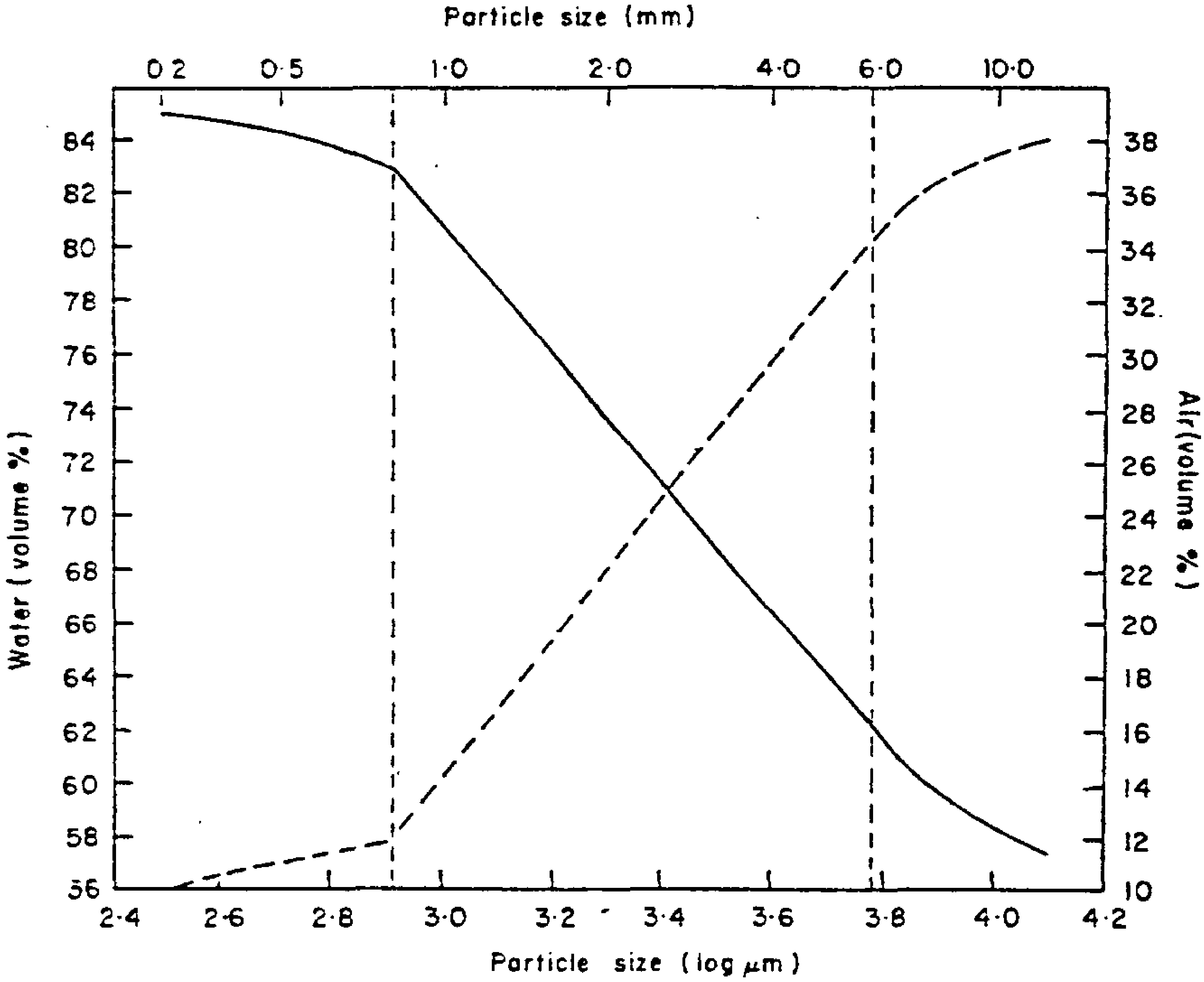

Figure 1. The influence of particle size on air-water relationship (after V. Puustjarvi). Solid line = water (volume %). Dashed line = Air (volume %).

PHYSICAL COMPONENTS

Peat. Although peat remains the major bulk component of loamless composts, it is not universally uniform. Peats vary in age from the very young white peats of the Baltic through the highly decomposed sphagnum and sedges of the English levels. Each has differing properties which when defined will indicate their suitability for specific compost requirements.

Sand. Sand and grit are still being used to misguidedly "improve" drainage. In fact most sand and grit particles lodge in existing pore space so reducing AFP and impeding drainage. However, the addition of sand and grit increases bulk density which improves root anchorage and the stability of the pot. Very little work is being carried out to establish the ideal bulk densities for nursery stock subjects. Values less than that achieved in 75% peat, 25% grit/sand have proved very satisfactory. Where sands are used to improve rewetting properties of peats, then up to 5% by volume may be sufficient. For this latter purpose the particle size should be as small as is consistent with good aeration, perhaps between 0.5 mm and 1.0 mm. (See Figure 1).

The introduction of grit/sand into a compost also introduces another variable—calcium carbonate and its effect on pH. Horticultural sands should contain low levels of available calcium carbonate; pH is a very poor measure of this as can be seen in Table 2.

Table 2. Samples of sand used in UK horticulture (1985).

			Dry Sieving %		
	pH	$CaCO_3$%	>0.5 mm	0.5–0.2 mm	<0.2 mm
(a)	8.2	0.7	47.4	38.8	13.8
(b)	8.3	1.3	63.2	36.6	0.2
(c)	8.2	13.1	51.3	44.5	4.2
(d)	8.6	79.1	74.0	22.6	3.4
(e)	8.6	0.2	47.5	39.2	13.3

Bark. Bark strippings from forestry which were once considered a waste product have now become extremely useful in increasing air-filled porosities of compost. Bark varies widely from hardwoods to coniferous sources. Some contain toxins which have to be dissipated by composting and others do not remain stable over time. Whilst the effect of the addition of composted bark (with or without added nitrogen) increases the structural stability of composts, little fundamental research on bark/chemical interaction has taken place in the UK. Much is made of buffer capacity yet no work has been done on barks currently available in the UK.

Rockwool. This water-repellent material is favoured highly by some nurseries and certainly, in terms of opening up a compost, there does seem to be considerable merit in its use. The material is not wholly chemically inert and reactions do take place with peat which give rise to rapid pH alterations. This is still under investigation by Chambers and Bragg. Unfortunately, there is considerable consumer resistance and therefore use is often restricted to large scale amenity production.

Perlite. Perlite is an inert expanded volcanic ash, having an inter and intra capacity for water. The product can be obtained in all forms from ungraded to specifically graded products. High cost restricts its use to the propagation of nursery stock and pot plant production. However, its effect on AFP (Table 3) suggests that closer consideration of the material for larger pot work would be worthwhile.

Table 3. Air-filled porosity (A.F.P.) of Peat/Additive Mixes.

% Peat	% Additive	Fine Sand	3mm Grit	Coarse Bark	Perlite
100	—	12.8			
90	10	8.5	10.5	10.6	13.3
80	20	6.2	10.1	13.4	13.8
70	30	5.2	11.1	14.6	16.3
60	40	3.1	10.3	15.1	17.2

AFP value: Wolverhampton Rapid Method

Polystyrene granules. This is a waste product which when well graded will increase AFP. It is worthy of consideration as a dilutent if the cost is reasonable. Polystyrene has one major drawback—some samples contain highly toxic additives.

Vermiculite. The plate-like structure of this exfoliated mica allows it to hold and release large quantities of water. It has a high exchange capacity and contains available potassium and magnesium. Unfortunately, in nursery stock composts it is structurally unstable.

Surfactants and super-absorbent polymers. The chemical and physical effects of these substances are very complex and poorly understood.

Surfactants have been commonly used in peat-based composts to improve wettability. Although very effective for this purpose they are not long lived and may have to be reapplied during the production cycle. Some effects upon the chemical and physical make-up of the compost may be detrimental.

Super-absorbent polymers are capable of absorbing many times their own weight of water and a proportion of this is available to the plant. These materials may also be able to absorb and release plant nutrients and to improve the wettability of a compost. There is a trend that appears to show that polymers may increase AFP, although this trend has not been found to be consistent.

Durability. The physical durability of nursery stock composts is critical, especially where containers are exposed to winter rains on poorly drained standing areas. Not only must the physical component give the required water/air relationship at potting, but they must be sufficiently durable to provide acceptable levels at the point of sale which could be 15 months later.

RECOMMENDATIONS AND FUTURE COMPOST SPECIFICATIONS

From current work in the UK, the following overall comments can be made. The smaller the pot, the younger the plant, and the poorer the watering and standing area, then a more open compost can be expected to give better results.

At Efford EHS, Margaret Scott has shown that propagation composts containing 50:50 peat/pine bark with low level fertilisers are consistently the best. These mixes should be altered to 70% peat, 30% bark for liners, and final potting with the incorporation of grit/sand and controlled release fertilisers.

In the future we must learn more about plant requirements. Composts can then be specified in terms of available water, AFP, bulk density, particle size and distribution, and particle shape and durability. A computer program can then be designed to provide the most economical blend of components to achieve this specification.