Hamamelidaciae but none has surpassed that of grafting in mid-July to mid-August on *Hamamelis vernalis* roots.

Finally, a word of warning. Young *Hamamelis* plants are very susceptible to attack by vine weevil. Every effort must be made to control it or the results will be most devastating.

PHYSICAL AND CHEMICAL PROPERTIES OF PEAT

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The understanding of peat compost and the changes that can take place in the compost throughout the growing season are important factors in producing quality nursery stock. Knowledge of composts can be summarised as follows: know your peat, know your nutrition.

Peat Types. Peat may be defined as a mass of organic matter at a stage of decomposition. Peat type depends on the source of plants and stage of decomposition. Sphagnum moss peat with which nursery stock producers mainly work is the final stage of a process which began approximately 10,000 years ago. Peat was laid down in a number of stages which may be divided as follows:

(a) Tundra conditions prevailed at the beginning with vegetation colonising higher ground. Arctic willow and birch formed the main woody plant life.

(b) Mixed forests of pine, oak, and yew gradually covered the areas above flood level while phragmites reed beds encroached the lakes. These constituted the first peat type.

(c) As lakes were filled in by reed beds forests began to encroach these areas to form "woody-fen" peat. These layers are composed of non-sphagnum mosses with woody remains, mainly birch.

(d) In the Central Plain area of Ireland when forests began decaying true acid bog peat began to grow. Thus true bog growth began and was succeeded by younger sphagnum composed mainly of relatively unhumified sphagnum mosses. This process is characterised by a complete absence of woody remains.

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(e) The process of regeneration complex of young sphagnum gives rise to the raised bogs of the Central Plain. Sphagnum grows in hummocks with hollows between which form pools. As the hummock growth reaches a climax, growth ceases. The pool stage takes on a pronounced sphagnum growth outgrowing the original hummocks. This regeneration process raises the bog area.

Sphagnum Moss Peat Characteristics. The two most significant characteristics of sphagnum moss are:

(1) Sterile medium, i.e., free from harmful pests and diseases.

(2) Low salt concentration—it contains virtually no nutrition. Thus the user can add a known quantity of nutrients with the knowledge that all batches of compost are similar.

Sphagnum moss peat has a simple cell structure with a pH range of 3.8 to 4.3 (pH water extract 2:1).

The bulk density, a measure of mass, is low. This means the air- and water-holding capacity of sphagnum peat is high.

Sphagnum Species. The most common sphagnum species in Central Plain moss peat are both—

Sphagnum papillosum, and *Sphagnum imbricatum*, with *Sphagnum magellanicum*, *Sphagnum rubellum*, and *Sphagnum plumalosum* accounting for the remainder.

Nutrition of Crops. This is a most vital aspect of growing plants. The method of applying nutrients varies depending on the crop and the size of plant.

Propagation by cuttings or seeds requires small quantities of nutrition. Early formation of plants require a compost with low total salts but high in phosphorus.

Mature and long-term crops require a balance of major and minor nutrients listed later in this paper. These may be provided by supplying a longterm source or by liquid feeding. Nursery stock growers are adequately catered for in this regard with the availability of controlled release fertilisers. This nutrient advantage compared with other sectors of horticulture should not minimise the requirement for good management. This requires the grower to know what is taking place in compost throughout a growing season.

The addition of lime, nutrients, and the nursery water supply changes the characteristic of the original moss. The most important characteristics of composts are:

(1) Cation Exchange Capacity
(2) Fertiliser
(3) Lime
(4) Nursery water source

Cation Exchange Capacity (C.E.C.) This is the mechanism by which peat regulates the supply of available nutrients to the plants. A peat particle is surrounded by negative charges. To stabilise these charges, they require positive charges. These are obtained from added nutrients.

Plant nutrients applied to compost are composed of electrically charged ions, e.g. potassium nitrate comprises the potassium ($K+$) cation and the nitrate (NO_3^-) anion. The peat's negative charges attract the positive charge of the potassium which creates a stable balance. This balance is maintained until the plant requires potassium. This element is then removed from the peat and taken up by the roots. As peat contains large numbers of these exchangeable charges (120 meq per 100 ccm solid), it is an ideal material for the supply of nutrients.

Source of Nutrients. Plants get their nutrient requirements from two sources, lime and fertilisers.

Lime—Addition of lime has two roles in compost:

(i) It increases the pH, i.e. reducing the hydrogen ions in the peat, and

(ii) It provides calcium (Ca^{++}) and magnesium (Mg^{++}) for plant growth.

As both these elements are positively charged, they are held by peat by the Cation Exchange Capacity.

Fertilisers—The following elements are required in a compost for successful plant growth:

Major	*Minor*
Nitrogen (N)	Zinc (Zn)
Phosphorus (P)	Copper (Cu)
Potassium (K)	Iron (Fe)
Magnesium (Mg)	Boron (B)
Calcium (Ca)	Molybdenum (Mo)
Sulphur (S)	Manganese (Mn)

Nitrogen may be supplied in both the ammonium ion (NH_4^+) and nitrate (NO_3^-) form. Bacteria will convert the NH_4^+ to NO_3^- over a period of time. Due to the NO_3^- anion being rejected it may be leached from the compost. Nitrogen can be replenished by applying a longterm source of nitrogen to the base fertiliser or by liquid feeding.

As already described potassium, magnesium, and calcium have positive charges and are attracted to and held by the peat particles.

As phosphorus is supplied in the form of $P_2O_5^-$ which has similar characteristics to NO_3^- it is not held by Cation Exchange Capacity. It is normally replenished in a compost by applying a long term phosphorus source or by liquid feeding.

All minor elements are normally supplied as cations and are thus held by peat in the Cation Exchange Capacity.

Nursery Water Source. The source of water for nursery stock can have a profound effect on growth and quality of nursery stock. While water is essential for plant growth, the source of water can have an effect on the supply and availability of nutrients to the plant during the growing season (Table 1). In hard-water areas, there is an upward drift in compost pH over the season. This drift can make some nutrients, e.g. magnesium and trace elements less available.

Table 1. The pH of compost from two water sources projected over a season.

	April	*May*	*June*	*July*	*Aug.*	*Sept.*
Grower One	5.6	5.7	5.9	6.0	6.2	6.2
Grower Two	5.7	6.1	6.4	6.9	7.3	7.5

This increase in pH is due mainly to the presence in the water source of calcium and magnesium bicarbonates: the pH of the water is not a good indication of alkalinity as Table 2 shows.

The upward drift in pH in compost can make nutrients less available to plants. The element iron is a good example. This element is normally supplied to nursery stock as a chelate. There are a number of chelates on the market and their availability is dependent on pH. As the pH rises, the iron becomes more insoluble and hence unavailable to the plants.

Chelates readily available with their insoluble points are as follows:

Fe EDTA	pH 6	Fe HEEDTA
Fe CTDA		Fe EDDHA or
		Fe EDHPA pH 7+

Hence a rise in pH can make this element less available to plants, causing a reduction in extension growth during the season.

Composts made up at the start of a season can change over a period of months. To control growth, it is important to know what changes are taking place. The understanding of these changes can be an important factor in increasing the growth rate of plants and hence increasing gross margins at the end of the season.

Table 2. Volume of 72% nitric acid required to reduce the pH of water sources to 6.0 (Kinsealy Research Centre).

		S. C. of Water		
Sample	*pH*	*Before*	*After*	*Litres of nitric acid per 1000 gallons water*
1	7.35	52	58	0.930
2	7.30	21	25	0.310