15 to 20 minute intervals between batches to allow cleaning time. Occasional stirring is very important to prevent hot spots and give uniformity to the treated batch.

After the seed has been treated, cleaned, washed, and inspected and passed satisfactorily, it can be mixed with an equal quantity of moist peat and grit and given a warm period of two to four weeks at 20°C to break down any remaining parts of the seedcoat. This will also help to mature the embryo. After this, place the seeds in a polythene bag in a refrigerator for 10 to 12 weeks at 2 to 4°C, turning once a week to aerate and prevent mould development.

Ideally, give 10 weeks chilling then sow at the end of February or early March; this will finalize the chilling and the damp atmosphere is ideal for maximum germination. Frost damage is unlikely in our locality at that time.

I have found that *Crataegus monogyna* seeds require between 30 minutes and 2 hours acid treatment and *C. crus-galli* and *C. prunifolia* up to 4 hours. I treated a batch of imported seed of *C. coccinea*, received in late December 1981, and with a 2-hour acid treatment, followed by 4 weeks warm and 12 weeks chill treatment, achieved 80% germination.

PLANT STANDARDS FOR FRUIT NURSERY STOCK IN THE U.K. — AN UPDATED RESUMÉ

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In my advisory career I have always found that economics are an extremely potent incentive for new technology to be adopted. If we take this point in the context of better quality fruit nursery-stock I am sure it is the improved results of using this certified stock which has led to its rapid acceptance by the industry.

At the recent "Fruit Focus Exhibition" in Kent, the Ministry of Agriculture's Fruit Certification Schemes were featured in the Agriculture Development and Advisory Service (ADAS) Exhibit and whilst I was there two very well known fruit growers were discussing the subject with me. One of them who has been around long enough to have known the situation prior to certification said, "John, it was like the Irish Sweepstake when we used to buy stock before certification standards put reliability and confidence into fruit production."

I propose to outline my talk with an examination of why improved health standards in fruit tree production are so important to the fruit industry and then, look at some of the factors which influence this. And finally, to show you how these standards are maintained at present.

The basic reason why first class trees are required and demanded by fruit growers is because it is sound economics. When you consider it costs £4500 to £8,000 per hectare to establish an orchard, to plant poor quality trees is a very poor investment. The variable costs of production in the first year show that the trees themselves account for over 53% of the establishment costs, indicating the economic significance of the tree.

It is also worth emphasizing that the orchard is there for probably 20 years and the ongoing costs in that period are extremely high; if you are putting resources into an orchard of poor trees economic losses are likely.

Over the years an enormous amount of work and research has gone into cleaning up fruit stocks from virus diseases and we can clearly see the value of that improvement (Table 1). In plums and cherries there was a dramatic improvement, with crop yield increases of between 28 and 42% and, in pears, there was a similar improvement in cropping. Apples varied from 7 to 26% improvement in both cropping and fruit quality. Orchards with greater productivity were, in fact, a tribute to the better stock that was supplied from reputable nurserymen of yesteryear, such as Rivers and Bunyard, household names in horticulture. One might go back still further and discover that fruit growers always consulted the nurseryman in order to get the best stock that was available; reputable nurserymen based their success on their ability as plantsmen and their ability to select quality as well as their ability to know their customers. Obviously orchards planted with trees of doubtful origin, of doubtful health, and doubtful cultivars often had to be grubbed out because they were so unproductive.

Table 1. Effects of Virus on Cropping in Fruit Crops.

	Age	Average percentage decrease
Plums	10 yrs	−28
Cherries	10	−42
Pears	15	−28
Apples:		
Cultivars on M.2	16	−26
Cultivars on MM.104	9	−20
Cultivars on MM.106	9	−16
Cultivars on MM.26	9	−7

Research has also shown the value of increased yield from better branched trees which arise from good healthy material.

Yield increases from 26 to 60% have been recorded. Such trees can produce up to 11 kilograms of extra fruit in the first 4 years of production, which more than pays for a better quality tree. The improved tree structure is also an advantage over the whole life of the orchard.

Summary of Benefits of Certified Healthy Stock — EMLA

1. Trees are of higher and more consistent quality, generally producing better branching.
2. Better yields of quality fruit are produced.
3. Greater productivity during the life of the orchard.

East Malling and Long Ashton with their combined efforts managed to clean up apple mosaic and other complex viruses, such as "rubbery wood" and "chat" fruit, which were common in cultivars such as Lord Lambourne. "Star crack" virus was also present in other apple cultivars. Good nursery management backed by sound research work has provided the key to raising and improving standards of fruit stock. These high standards are now expected and demanded in the U.K. fruit industry.

It must also be emphasized that it is the combined efforts of research stations (East Malling Research Station and Long Ashton Research Station), the Nuclear Stock Association, and MAFF which has led to the cleaning up and release of this certified stock to the industry. As you will appreciate, this is an on-going exercise and to maintain this health status we cannot afford to be complacent with the imminent threat of diseases such as plum pox and fireblight, which lurk in the background. The extra vigour from this healthy material also requires adjustment management techniques to harness the full cropping potential of this stock.

If we examine some of the other factors which are involved in fruit tree propagation we can see that it is not just the health standards that must be considered. If we are to consistently produce the high standards that are required, there are basic principles which we ignore at our peril. For example, to plant any nursery stock in badly drained land can lead to disastrous results. Similarly, soil analysis and tests for SARD (Specific Apple Replant Disorder) are equally important, bearing in mind, that repeated planting of *Malus* can soon lead to a decline in tree vigour. Good rotation, good soil structure, and isolation are also part of this whole exercise of giving first class technical management to get first class results.

Just as we have moved on in terms of health standards we have also moved on in terms of technology in propagation. For example, chip budding and rootstock production by hardwood

cuttings are now accepted commercial practices. Similarly, growth regulators such as M&B 25105 (a feathering agent) is now being used by nurserymen to produce better branched trees. This not only improves tree structure but also encourages earlier and heavier cropping. These certified well-branched trees are the very foundation of the future of the fruit industry and are an extremely sound investment, fully justifying the costs involved in growing and certification.

The recently introduced Plant Health Propagation Scheme is an "umbrella" scheme covering all the existing certification schemes of fruit crops and other crops and the schemes are administered by the Plant Health Administration Unit of MAFF based in London; the inspections are carried out by ADAS. These schemes are completely voluntary, the nurserymen fully accepting the regulations associated with the schemes. The ADAS inspectors assess the health, vigour, and trueness-to-type of the stock and the isolation requirements concerned. From time to time the fruit stocks are retested for virus in order that the health standards are maintained. This is done in close collaboration with East Malling, Long Ashton, Plant Health Branch, MAFF, ADAS and, of course, the Nuclear Stock Association, and the nurserymen concerned.

I must also stress that the health status must be combined with the improvement and selection of better clones of the stock and this is very much an on-going affair. In the EMLA scheme we have already seen the improvement in yield and quality by the introduction of better clones and this work is still proceeding.

There are times when we get variation or off-types occurring within this biological process. We had, for example, an off-type showing abnormal characteristics from one of the 'Bramley' mother trees.

In mentioning marketing we must constantly be aware of the sovereignty of the customer. Only the satisfied customer will come back for more and they will only do so if the quality is of a high standard and produces good results.

For this reason, and with the every increasing competition from overseas producers, I feel we must constantly strive to improve our standards of nursery stock production and increase our self sufficiency in this important sector. We must accept that the customers' needs are changing; they certainly are in the fruit industry and the nurserymen in the U.K. must be flexible enough to respond to these changing needs. If they fail to do so, there are other nurserymen elsewhere who I am sure will step in and help themselves to our home market. As you know, the hardest competition that first class U.K. stock

has to face is low grade U.K. nursery stock which does nothing to establish customer confidence.

I have tried to show that this confidence and reliability is not dependent on one factor, but the inter-relationship of many factors, not the least of which is the nurseryman. Only he can weld together these very essential ingredients to make the whole operation successful. This requires skill and a great deal of business accumen. A fundamental principle of both fruit crops and ornamentals is the basic law of economics. Therefore, may I congratulate the organizers of this conference with their very appropriate title "Cost Effective Propagation" because as specialists you are well aware that much time and effort go into the techniques used in propagation. Equally, land, time, effort, and capital can be wasted unless at the outset the very best clones for propagation are selected, which are both healthy and true-to-type.

BRITISH STANDARDS FOR NURSERY STOCK

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The establishment and maintenance of standards has long been a laudable objective of trade guilds and associations. It arises from a wish to standardize nomenclature and quality.

In 1927, at the request of the Empire Marketing Board, Hatton of East Malling wrote a paper entitled, "Standardization of horticultural material with special reference to rootstocks." There were requests for material of known status, and some fruit tree raisers set out to meet this demand.

The primary concern of any standards scheme is with trueness-to-name, as in the rootstock certification scheme introduced in 1946, and in the health schemes for bush and soft fruits, which are so important to the U.K. fruit industry.

In 1960 the Horticultural Trades Association, jointly with the National Farmers Union, published descriptive standards for nursery products. At the same time the Institute of Park Administration issued specifications for trees for roads and gardens, as did the Road Beautifying Association. A year later the H.T.A. and N.F.U. asked the British Standards Institution to consider standards for nursery stock. They convened a conference in 1962 and gathered representatives from a dozen organizations including the Horticultural Trades Association, the Horticultural Education Association, the Institute of Park and Recreation Administration, the Ministry of Agriculture,