matter. You understand that the present Electronic Leaf is actuated by a change in resistance of the film of water on the surface of the "leaf." Therefore, an impurity in the water *might* interfere with proper action if it *did* change the conductance of the water to a great degree.

My other suggestion is as pure in principle as pure can be. It measures the amount of water by measuring the hydrogen atoms in it. Therefore, the quality of the water has nothing to do with it. If it is water — H_2O — two hydrogen atoms and one oxygen atom, the device will measure it. Of course, in this case the water must not be contaminated with some other source of hydrogen such as a hydrocarbon (alcohol or sugar, for example). But then, I don't suppose any of you intend to spray your cuttings with beer!

Seriously, the quantity of water *can* be measured "atomically" by measuring the number of hydrogen atoms in it. It can be done this way: A polonium-beryllium source is used to provide a stream of fast neutrons. Such fast neutrons are scattered and de-energized (that is, slowed down) by hydrogen atoms, the amount of scattering and de-energizing being in proportion to the amount of hydrogen atoms present. Some of the neutrons are returned, by the scattering, to a silver foil detector sufficiently de-energized so that they can be captured by the silver. The silver foil in turn emits beta rays which are counted by a Geiger counter. This in turn can be made to turn the mist off and on. It is not easy though!

Such a scheme does have advantages. The purity of the water does not matter. Nor does the physical state of the water matter. The device will measure the quantity equally well in either the solid, liquid, or vapor phase. The device will average the quantity of water over a considerable radius — say about 12 inches. It does not matter where the water is. It can be inside the cutting, on the surface of the cutting, or as a vapor in the air. Thus turgidity of the cutting, surface wetness, and relative humidity of the air can all be measured and corrected by one device at one time.

THE MILLENNIUM IS HERE!

MIST FROM A CUTTING'S VIEWPOINT

Charles E. Hess
Department of Horticulture
Purdue University

When softwood cuttings of plants such as *Prunus serrulata* were placed under intermittent mist or under conventional double glass, superior results were obtained under the mist as shown in Table I. Some of the reasons for better results under mist can be found by studying the micro environment and tissue temperatures under mist and double glass.

The vapor pressure or relative humidity under the two conditions is approximately the same when the mist is off, near

Table 1 Rooting response of *Prunus serrulata* cuttings under intermittent mist and double glass.

	Double Glass	Mist
Percent rooting	37	87
Average number of roots per cutting	6.0	8.1
Average length of roots (cm)	1.9	2.5

saturation. So the benefits of mist can not be attributed to a higher humidity. A real difference is found, however, when the tissue temperatures under mist and double glass are compared. During a typical 24 hour period, the average leaf temperature under double glass was 86° F. and under mist it was 75° F. The lower leaf temperature is caused primarily by the evaporation of the film of the water from the leaf during the time when the mist is off. Although the vapor pressure of the moisture in the air surrounding the cuttings under mist and double glass may be approximately the same, the vapor pressure within the leaves was higher under double glass because of the higher leaf temperature. The theoretical result is that the cuttings under double glass would have a tendency to transpire about twice as much water as do the cuttings under mist. The actual moisture relationships can be determined by measuring the gain or loss of fresh weight of the cuttings during the rooting period and subtracting the gain in dry weight. Cuttings under mist gained an average of 4.1 grams of water per cutting and cuttings under double glass lost an average of 1.8 grams during the 30 day rooting period.

Another environmental factor which was substantially different under mist and double glass was light intensity. In order to keep the temperature under double glass at reasonable levels, it was necessary to use shade. Double glass is a heat trap as well as a moisture trap and unless shading is used, the air and tissue temperature will reach a level at which the cuttings are damaged or killed. The light intensity on a clear day inside the greenhouse was 7000 foot candles. The light intensity under the double glass was 240 foot candles and the rate of photosynthesis is greatly reduced.

We must also remember that at the same time plants are making sugars through photosynthesis, they are using sugars in respiration. While light intensity regulates to a large extent the rate of photosynthesis, temperature has a primary effect upon respiration. Generally speaking, the rate of respiration is doubled for every 10° F. increase in temperature. Therefore, not only are the cuttings under double glass not able to maintain a high rate of photosynthesis, they are also utilizing whatever sugars they may have at approximately twice the rate of the cuttings under mist, since there was a differential leaf temperature of 11° F. By actual measurement, the sugar content of the cuttings under mist increased 138 milligrams per cutting during the rooting period and only 17 milligrams per cutting under double glass. The interaction between temperature and light intensity are shown diagramatically in Figure 1. Here cuttings are represented as storage tanks with the inlet values controlled by light (photosynthesis) and the outlet valves controlled by temperature (respiration). The cuttings under double glass were exposed to low light intensity and higher tissue temperatures. So food manufacturing was low and use was high. In contrast, under mist, light intensity was high and leaf temperature was low, and therefore, food manufacturing was high and use was low. As has been mentioned above, the cuttings under mist accumulated more than 8 times more carbohydrates than the cuttings under double glass. This larger reserve of sugars can be used both as raw material for the synthesis of substances needed for root initiation and as an energy source needed for rooting.

In summary, the reasons that higher percentages of rooting and better quality cuttings can be obtained with mist propagation can be attributed to one, a more effective technique of moisture or transpiration control through lower leaf tissue temperatures, higher rates of photosynthesis through higher light intensity, and reduced respiration because of lower tissue temperatures.

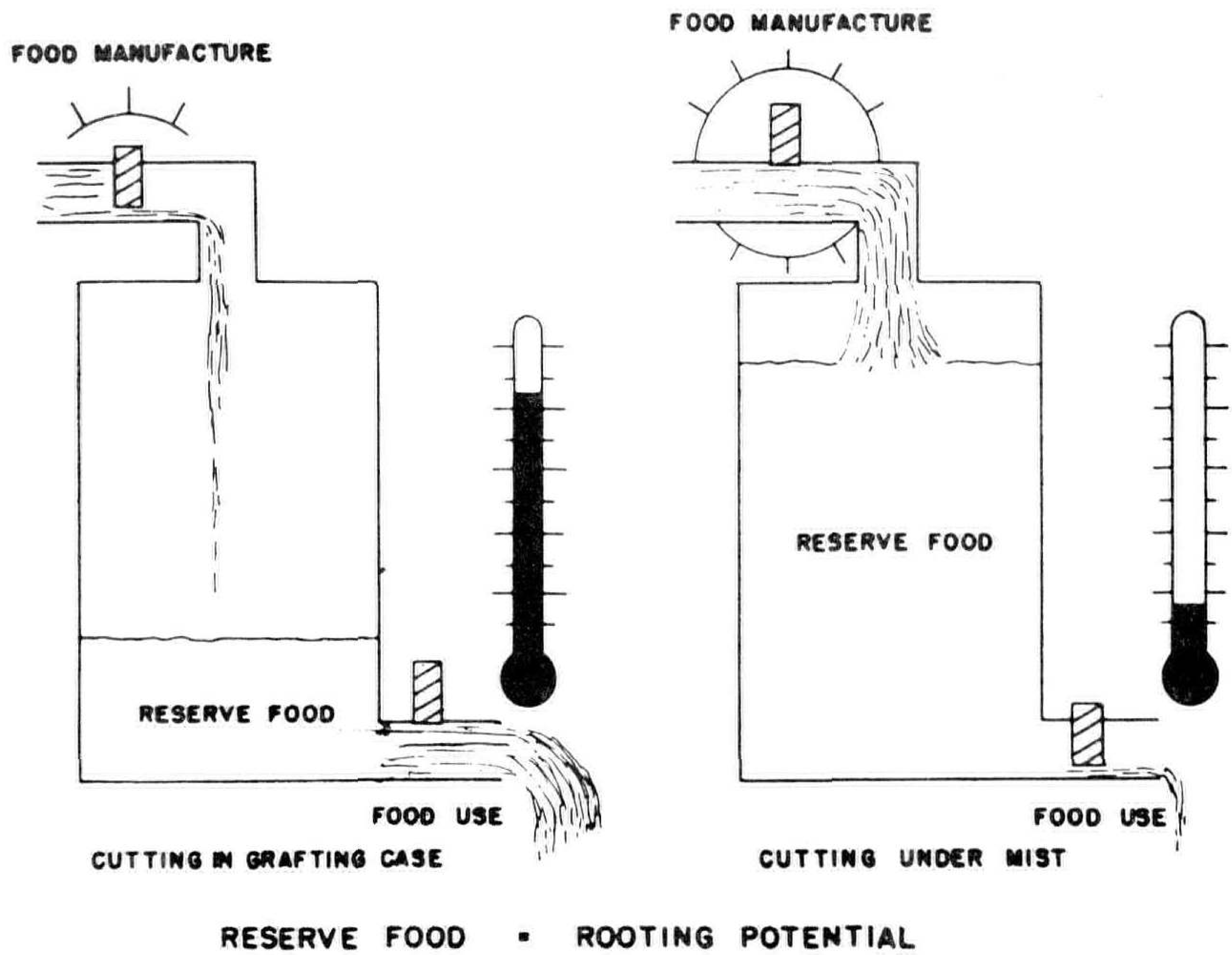

Figure 1. Diagramatic comparison of cuttings propagated in a grafting case and under mist.

MODERATOR HESS: Perhaps our balance of payments is not in too bad shape when you consider the fact that we have obtained and England has lost — or has almost lost — Jim Wells. Jim has the ability to express himself effectively and convincingly both in the written and spoken word. He has, perhaps more than any other member of the Society, shared his experience through a book, numerous articles in the *American Nurseryman* and by participation in the Society. It is an honor to introduce another Award of Merit recipient, James Wells.

MIST PROPAGATION PROBLEMS

JAMES S. WELLS
James S. Wells Nursery, Inc.
Red Bank, New Jersey

Back in 1947, when we commenced to use mist, one of the aspects which immediately became apparent was the absence of problems, particularly problems which we had anticipated. By this, I mean that we first thought that the regular application of relatively large quantities of water would produce a great deal of rotting and fungus troubles of all kinds. But this was not the case. In fact, one of the most striking features of mist propagation is the comparative absence of these problems as compared with more orthodox methods of propagation.

But as time went on, we found that a mist system did have its drawbacks, although in many instances they were quite different from those to which we had become accustomed.

MECHANICAL PROBLEMS

I think that it is in this category that most of the serious problems occur. Insufficient coverage, due to poor water pressure, is the first. Others are . . . poor coverage due to improper jets . . . highly mineralized water which quickly clogs the jets . . . improper placing of the jets over the area to be covered . . . insufficient units to overlap in all areas. These simple and truly mechanical problems resulted in many growers being somewhat disillusioned with their results. Yet these problems are quite easily overcome.

Water Pressure:

First, the question of water pressure. There is hardly a nursery which does not have a pressure of 25 to 30 PSI and there is an excellent jet which will give good atomization at this pressure. It is the Monarch H-261. However, the coverage of this jet, at this low pressure, is quite small and it is essential that jets be placed in pairs, at intervals of about 18 inches, on a 3 foot bench, the jets pointing to either side at a 45 degree angle.

On most greenhouse benches, this will give good coverage. If the bench is long, it is wise to start the delivery pipe with one inch lines, reduce down to ¾ inch, and if it is very long, reduce again to ½ inch at the far end. An alternative to this low pres-