twelve hour period, but with the cyclic system, only 21 gallons of water were used.

We used a nozzle which has a cleaning device in it. When the nozzle shuts off, the nose is drawn into the body by a spring and there is a prong or needle which penetrates the aperture of the nozzle. These nozzles were very good and we haven't had any trouble with clogging so far. However, they are expensive nozzles, retailing for $8.00 each.

PRESIDENT WELLS: What mediums were used?

MR. HESS: The medium we used was peat and sand in proportion of one-third peat to two-thirds sand. I think that actually the medium is not too important with regards to mist. It might be thought that the medium will become waterlogged and deficient in air. There are two factors involved here: first, as the mist goes through the air, it picks up quite a bit of oxygen. Secondly, when the mist is off, the water is draining from the cuttings, penetrating the medium, and draining from the bench. In the experiments which we ran, we found less basal rot on those cuttings under the mist than those which were propagated in a closed case and in an open bench.

It may also be that there are a certain number of fungus spores washed off the leaves by the mist. That is where this idea of getting a film of water, water which actually drips off the leaves, comes into play. Among the beneficial effects from the mist may be removal of fungus spores, increased aeration of the medium, and cooling of the tissue.

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CHAIRMAN FILLMORE: Since Mr. Spencer B. Chase is not present this evening, we will proceed to the last of the speaker-exhibitors. Roger W. Pease, of West Virginia University, is a holly enthusiast and one of the early supporters of the Plant Propagators Society. I am certain that he will present a very interesting discussion on the use of overhead irrigation of holly.

Mr. Roger W. Pease presented his paper, entitled: "The Response of Rooted Cuttings of *Ilex opaca* to Overhead Irrigation in a Lath House." (Applause)

The Response of Rooted Cuttings of Ilex opaca to Overhead Irrigation in a Lath House[1]

ROGER W. PEASE
University of West Virginia, Morgantown, W. Va.

During the wet season of 1951 rooted cuttings of *Ilex opaca*, transplanted in April from the rooting cold frame to a clay soil, averaged 5.4

[1]Published with the approval of the Director, West Virginia Agricultural Experiment Station, as Scientific Paper No 479.

inches of growth when shaded and protected by six inch porous drain tile one foot high. The plants were mulched with sawdust and fertilized with both cottonseed meal and a 5-10-10 mixture. During the comparatively dry season of 1952 cuttings from the same clones, given similar treatment, showed negligible growth. No water supplementary to rainfall was applied during either season Because of these observations it was thought that water in excess of rainfall might be advantageous to the growth of rooted *Ilex opaca* cuttings, especially during a dry season. It also seemed possible that rooted cuttings carried for the first growing season in a lath house with well-drained soil and overhead irrigation would show unusually good growth.

In the fall of 1952 a lath house was constructed which admitted one half constant light and had tile drainage, a crushed rock and sand fill to cover the tile, and a soil medium of one third light soil, one third sand, and one third rotting leaves and forest litter A line of half inch pipe was run about ten inches over the soil medium. Skinner Superior nozzles were mounted on the pipe, and water was supplied by the city system. Ammonium sulphate was spread over the soil bed late in the fall, at the rate of one pound to about forty square feet.

In April, 1953, sixteen rooted cuttings of *Ilex opaca* were selected at random from each of two clones characterized by vigorous, upright growth. Eight rooted cuttings from each clone were transplanted into the lath house at about six inch spacing. Approximately one half tablespoonful of 5-10-10 fertilizer was applied per square foot. No other fertilizer was added during the growing season. Whenever the surface of the soil was dry, the irrigation system was turned on late in the afternoon and left on until water ran from the drain.

On the day when the holly was set in the lath house, the remaining eight rooted cuttings from each clone were transplanted. They were set in two rows in a clay soil to which sawdust and fertilizer had been added annually for several years The spacing was six inches in the row and two feet between rows. 5-10-10 fertilizer was added at the same rate as in the lath house. Six-inch porous tile were placed over the plants, and about four inches of peat moss was spread to cover the entire plot. Cottonseed meal was spread over the peat moss, allowing about one half cup to a plant. Neither water nor additional fertilizer was added during the season.

On September 20 height measurements of the holly were taken. Clone I, grown without irrigation, showed a survival of six of eight plants and an average height of 4.18 inches among the survivors The median height was 4.5 inches. The same clone, grown under irrigation, showed 100% survival and an average height of 13 83 inches The median height was 13.5 inches. One non-irrigated plant of clone II died, and the other seven averaged 4 29 inches in height, with a median height of 5 inches. Under irrigation clone II showed no mortality, an average height of 13.5 inches, and a median height of 14.5 inches.

These results should not be interpreted to show that the growth differ-

ences obtained were caused by irrigation only. Irrigation, soil characteristics, drainage, methods of shading, may all have been contributing factors. Since the city water used in the trials had been observed to damage the foliage of cuttings under continuous mist, it is possible that growth differences might have been greater if more suitable water had been used.

* * * *

CHAIRMAN FILLMORE: Thank you very much, Roger, for an informative discussion on the American holly.

MR HARVEY GRAY: Did you note whether you had more than two spurts of growth? In other words, was there an interruption in growth during the season?

MR. PEASE: Yes, I definitely did notice interruption in the growth of holly, however the spurts were more noticeable in rhododendron. In the holly, you can't trace these spurts after the season's growth. My memory would say there were two spurts and the second grew much farther than the first.

MR. GRAY: In holly, for a salable plant, we like to have one that is well branched. Have you made any check to determine whether a pinching at the close of the first spurt of growth might encourage lateral branching rather than a continuous straight growth?

MR. PEASE: Again, I did not try that with holly. I wanted to see how high I could get the plants in one season. Accidentally, I tried it with some rhododendrons The central leader was broken off and on the second spurt of growth two or three lateral shoots developed. That was on just one plant however.

MR. GRAY: On rhododendron, concerning the breaking of the strong terminal growth, it is very true that more than one break develops. I have noticed in this general connection that major breaking possibly develops on the first spurt of growth each season. The secondary and tertiary growth, that might be developed from laterals rather than the terminals, are not as numerous as they are on the first spurt of growth.

MR. TEMPLETON: There seems to be hardly any limit to the amount of fertilizer holly can use. In stands of holly so thick the plants were actually choking themselves, we put 4,000 pounds of 6-12-12 fertilizer to the acre in four applications. Applications were two or three weeks apart and at a rate of 1000 pounds to the acre. Every time we put it on, we could see a response to it. It responded to the four applications. It might have responded to a fifth, too.

American holly seems to take enormous quantities of water if it is in a heavy stand. They were growing in beds and we had to furnish them lots of water. We noticed that of all the plants we were growing, American holly wilted quickest.

MR. DON VANDERBROOK (C. W. Stuart Nursery Co., Newark,

N.Y.): Does the fact that your municipal water is heavily chlorinated have any effect on the plants used with a mist system?

MR. PEASE: I couldn't answer that. Our water is heavily chlorinated. It also contains many other minerals. I noticed that the leaves became coated with white substance which I couldn't wash off. It was very harmful. I took some leaves to the biochemists and they couldn't get the material off to analyze it.

MR. HOOGENDOORN: Mr. Templeton says that he keeps feeding fertilizer continuously every two or three weeks and he has good response. By that excessive feeding, don't you weaken the plants and make them softer? Will they stand the winter?

MR. TEMPLETON: Apparently. Every time we put on an application of fertilizer the plants make further growth and they held up perfectly over winter.

MR. PEASE: In our West Virginia climate, where we get sudden cold weather, I have found that using cottonseed meal or any slowly-available nitrogen fertilizer, may cause a great deal of winter damage.

American Holly Clone 1 has rust spots all over it, and that is definitely due to letting it go into winter too soft. I've checked it year after year. Therefore, for practical purposes, I wouldn't advise anybody to push holly the way I did in this experiment.

PRESIDENT WELLS: Many of you may not have heard of Dr. C. W. Thornthwaite. He is an international expert on climatology. He has devised a method of measuring water loss which sounds complicated, but really isn't. He pointed out to me that a tin can is an ideal piece of equipment for determining water loss. Many of us are interested in growing nursery stock in containers and a container is an excellent evapo-transpirometer, which is what he calls his equipment for measuring water loss.

Water loss can be in either of two ways. It is evaporated from the soil surface or transpired from the plant and so the combined loss is evapo-transpiration. Water loss can be determined by weighing a can of soil containing a plant and determining how much the weight decreases. The decrease is the water lost by evapo-transpiration. You can also determine how much water the soil should have at full field capacity.

It has been proven that if you can maintain the soil as close as possible to full field capacity, about 90%, you will obtain optimum growth and you will not require any other protection against sunlight. In fact, you can use the maximum sunlight for growth The controlling factor is water. I think that Dr. Thornthwaite could give us some valuable and fundamental information. Perhaps we might have him here next year.

CHAIRMAN FILLMORE: That concludes the formal portion of the speaker-exhibitor session. It has been an interesting and informative session. At this time I want to call your attention to the exhibits in the room. We appreciate each exhibitor's contribution and hope that each of you will find the time to look at them.