Panel Discussion On Magnolia Propagation

FRIDAY AFTERNOON SESSION

December 11, 1953

The fourth session convened at 1:40 o'clock, President Wells calling the meeting to order.

PRESIDENT WELLS: Gentlemen, the subjects contained in our program were chosen by you. Junipers were first choice and magnolia was second. The selection of magnolias was rather a surprise to some of us. In looking around for someone to moderate this section of the program, it was decided that Professor R. P. Meahl of Pennsylvania State University was the person. He has done a lot of work with woody materials. I think that all of us know his reputation as a top scientist in the nursery industry, and without further ado, therefore, I would like to turn over the meeting to Professor Meahl, who will review the known facts about the propagation of magnolias, and then will moderate the remainder of this session.

CHAIRMAN MEAHL: Thank you, Mr. Wells. As far as the review of literature is concerned, the subject of magnolia propagation is certainly much more scanty, at least as far as I was able to determine, than that which was reported this morning concerning junipers. There is considerable reference to magnolias in this book or that book, in some of the older propagation books and also some of the more recent ones. However these are generalized statements and do not necessarily give any scientific data based on the result of experimentation.

Professor Meahl presented his paper, entitled "Recorded Work on the Propagation of Magnolias—A Review." (Applause)

Recorded Work On The Propagation Of Magnolias—A Review

R. P. Meahl,
The Pennsylvania State University

A search of the literature reveals very little reference to the propagation of magnolias. Older books on propagation, however, are generally agreed that the seeds exhibit a dormancy, and should be stratified to secure good germination. Before sowing the seed, it was recommended that the outer fleshy covering be removed to prevent rapid deterioration by fungi.

Millais (5) mentioned that *Magnolia macrophylla* seeds sown immediately after gathering, germinated readily. He recommended the storage of freshly gathered seed of *Magnolia grandiflora* in dry sand until February, then in moist sand for seven to ten days to loosen the outer coat. After these coats were removed by washing in water, the seeds should be sown in a cold frame.

Toumey (7) found that seeds of *Magnolia acuminate* gave a germination of only about 3 per cent at maturity, even though about 68 per cent seemed sound. It was his belief that the hard endosperm of these seeds required several months for the absorption of sufficient water for germination.

Evans (4) working with *Magnolia grandiflora* and Afanasiev (1) with *Magnolia acuminata,* reported that the embryo is extremely small (about 1 mm. long and 0.4 mm. in diameter). At the time of maturity, the embryo is fully developed with clearly differentiated hypocotyl and cotyledons. The endosperm is massive and composed of large, thin-walled cells containing the food reserves in the form of proteins and oils It is surrounded by three distinct types of tissue. The outermost, the fleshy pericarp, bright red when mature, consists of three layers of cells, outer epidermis, parenchyma, and inner epidermis. Under the pericarp is a hard dark brown seed coat or testa, which is composed of several rows of cells with thick lignified cell walls. Between the seed coat and the endosperm is the inner membrane or nucellus, consisting of a row of large, elongated cells.

Practically all seeds of *Magnolia* go into a period of dormancy as soon as they reach maturity. The term "dormancy" implies a state of viable seed in which they are unable to germinate when exposed to external conditions that are normally favorable to the germination of the species. Crocker (2) in 1916 listed the following as the chief causes of inability of viable seed to germinate:

(1) necessity for the rudimentary embryo to complete development before germination can take place; (2) inhibition of water absorption by the seed coat; (3) mechanical resistance by enclosing structures to the expansion of the embryo and the seed contents; (4) interference with oxygen intake and perhaps carbon dioxide elimination by the seed coat or by other structures surrounding the embryo; (5) a state of dormancy in the embryo or in some part of it; (6) a combination of the above factors, (7) secondary dormancy.

Evans (4) found that the cause of the delay in germination lay partly, but not entirely, in the lignified seed coat. He conducted tests with seeds of *M. grandiflora* which gave germination in twelve days for seeds with one side of the lignified coat removed but thirty days for those with the lignified coat intact. He also shortened the time of germination by storage of the seed in moist sand at 10°C. for six to ten weeks.

Afanasiev (1) agreed that the seed coat delayed germination, but only to the extent that it slowed down the after-ripening of the embryo. He found that when seeds are after-ripened, germination proceeds similarly in both the naked kernel and the seed with its coat intact, provided neither had been treated with certain chemicals. One of these chemicals is calcium hypochlorite, which was often used to sterilize seed, but which Afanasiev found prevented or delayed germination. He conducted tests which indicated the embryos of non-after-ripened seeds of *M. acuminata* are dormant. Excised embryos and naked kernels of freshly

collected seeds failed to grow or germinate. He concluded that although in some cases a small percentage of seeds may germinate immediately upon maturity, the vast majority require a certain period of after-ripening.

After-ripening refers to those physical and chemical changes in a mature viable seed which takes place between the time of seed maturity and germination, and without which the seed is unable to germinate. The exact nature of all the changes taking place during the process of after-ripening is not yet known, although much has been learned. For example, it has been determined that increased acidity and greater water holding capacity accompany the after-ripening of many seed. Also, changes in the activity of two oxidizing enzymes, catalase and peroxidase, have been reported (Eckerson 3). Changes in the amount and form of food reserves have been noted by many workers. These changes ordinarily constitute a gradual transformation of foods from forms unavailable for physiological processes in the seed to easily available forms or to forms easily translocated.

According to Afanasiev (1) the after-ripening of seeds of *M. acuminata* will take place during moist storage at any temperature from 0° to 23°C. However, if stored moist at room temperature for a prolonged period, nearly 100 per cent of the seed would be lost through infection. He secured 86.5 per cent germination with seed stratified at 0°C. as compared to 44.4 per cent with seed stored dry at 0°C. He recommended stratification of approximately eighteen weeks in moist peat moss at a temperature of 5°C. for those seeds intended for spring planting. The peat moss should be kept moist at all times and the pulp should be removed from the seed before stratifying.

Afanasiev also studied the effect of temperature on germination. He used both constant temperatures and temperatures alternating between a low for six hours and a high for eighteen hours. The constant temperatures used were 20°, 25°, 30°, 35°, and 42°C. respectively while the alternating were 5° to 26°, 15° to 26°, and 15° to 30°C. He found that germination at 20° began later and proceeded more slowly than at other temperatures tried. Only 34 per cent had germinated by the end of 30 days, whereas 74 per cent had germinated at 25° and 76 per cent at 30°. Temperatures of 35° reduced germination, with germination ceasing after reaching twelve per cent on the 12th day and all remaining seeds either decayed or began to decay by the end of thirty days. At the temperature of 42°, all seed showed evidence of injury in two days and all were dead in four days. The percentages of germination for the alternating temperatures were 72 for 5° to 26°; 80 for 15° to 26°; and 72 for 15° to 30°.

While conducting his experiments with *M. acuminate* seeds, Afanasiev observed the production of green tissue on the endosperm under certain conditions. Upon further investigation he noted that the pigment seemed to appear only as a result of injury and that it was produced equally as well in the dark as in the light. He also found a close correlation between the ability of seeds to produce the pigment and their viability. Not every

seed that produced the pigment germinated but a very high percentage did and every seed that did germinate was also pigmented. Seeds which did not produce the pigment also failed to germinate. He suggested the scratching of the surface of apparently sound kernels and placing them on moist cotton or blotting paper at 24° to 30°C. for several days as a reliable test for germinating ability.

The number of references on propagation by cuttings is even more scant. Some work has been done, however, and reported along with rooting of other plants. Wells (9) has reported some of his work with magnolia. He was successful in rooting *M. soulangeana*, *M. soulangeana nigra*, *M. soulangeana Lennei*, *M. stellata*, and *M. stellata rosea* when taken from early July until late August, wounded at the base, and dipped in hormone powders. He (10) stressed the importance of the age of the stock plants. Cuttings of *M. soulangeana* taken from large plants (20 feet high) had not rooted well over several years, with the percentage of rooting sometimes as low as 40 per cent. In 1952, cuttings taken from young vigorously growing liners, which had been rooted in 1951, gave strong rooting of 99 per cent in five weeks. He (10) also secured excellent results with constant mist in outdoor propagation. The rooting response of *M. soulangeana* was 100 per cent, *M. soulangeana nigra* 92 per cent, *M. stellata* 96 per cent, and *M. stellata rosea* 56 per cent.

Sheat (6) gives general recommendations on grafting but does not report the results of experimental work. He suggests *M. kobus* and *M. grandiflora* as understocks and says that grafting should be done in mid-July to August. The veneer type of grafting is recommended and the cuts should be made as near the base as possible. The union should be completed in thirty days.

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CHAIRMAN MEAHL: I want to thank you for your time and your attention. If there are questions that relate to the reference work, I shall attempt to answer them. If you have questions that relate particularly to the three practical methods of propagating magnolias, however, I suggest that they be held until after the various gentlemen speak on the particular phase of propagation.

MR. RICHARD H. FILLMORE (Shenandoah-Lakes Nursery, Shenandoah, Iowa): What are the environmental conditions which will produce the test type of bleeding-growth on a scratched seed?

CHAIRMAN MEAHL: Afanasiev mentioned that if seed were placed in a moist chamber and kept at room temperature, the green growth or green coloring develops in a relatively short time.

MR. CASE HOOGENDOORN (Hoogendoorn Nursery, Newport, R.I.): Does that just refer to magnolia seed?

CHAIRMAN MEAHL: That I cannot say. His work dealt only with *Magnolia acuminata.* I cannot say if it applies to other kinds of magnolias nor to other types of seed.

MR. HOOGENDOORN: Didn't you also mention a specific reference to a recommendation of *M. acuminata* for understock rather than *M. Kobus?*

CHAIRMAN MEAHL: That was the *Nursery Manual* by Bailey—a general reference on plant propagation. It doesn't say specifically; it just has a paragraph on propagation by grafting. Bailey states that *M. acuminata* is a good understock. I would say there are others that would be better.

MR. HOOGENDOORN: I don't agree with him.

DR. SNYDER (Cornell University, Ithaca, N.Y.): Incidentally, the *Nursery Manual* was last revised in 1921. It was based primarily on the literature and general practices at that time. Although it contains considerable good information, it is very much out of date in many respects.

CHAIRMAN MEAHL: That is the point I wanted to emphasize concerning the literature that is available on the asexual means of propagation of magnolia. What we have is either found in an old book of this sort or it may be a new book, but again, the material in the newer books is frequently based on some earlier traditional work which has been handed down from one propagator to another and is not based on experimental work.

DR. JOHN MAHLSTEDE (Iowa State College, Ames, Iowa): Were

you to go through the Woody Plant Seed Manual, which many of you have, you would notice mentioned quite often a temperature of 41 degrees for after-ripening. Even at our institution, we do not have facilities to hold a definite temperature, say within plus or minus two degrees. In reference to magnolia, how important is it to maintain a temperature of 41?

CHAIRMAN MEAHL: I think it can be wide. For many species the temperature can be anywhere from 33 to 50 degrees Fahrenheit. I think if you keep within that range you ought to have satisfactory after-ripening taking place. There might be some seeds which are more specific than this. As far as magnolia is concerned, I feel certain that such a range would be quite satisfactory. The work of Afanasiev indicates it would take place at much higher temperatures, but the difficulty encountered is the destruction of the seed through infection if the temperature is too high, for example around 65 to 70 degrees Fahrenheit.

MR. AART VUYK (Musser Forest, Inc., Indiana, Pa.): I have seen some very good results in grafting magnolias using understock of two-year-old seedlings of *Magnolia liliflora*. They are easy to grow from seed, if the seed are gathered when ripe and planted immediately. It is a very good stock.

MR. SIDNEY WAXMAN (Cornell University, Ithaca, N.Y.): You mentioned the very small size of the embryo. Have you read of any work with excised embryos?

CHAIRMAN MEAHL: Some of these workers to whom I referred did remove the embryo. They were able to get germination if the seed had been after-ripened. If, however, it had not been after-ripened, even though the embryo was removed from the seed, there was no germination.

MR. WAXMAN: Was the medium just plain moisture or a nutrient solution?

CHAIRMAN MEAHL: The report indicated a plain moist medium without nutrients.

DR. SNYDER: Did these reports include any information whether there was any actual change in the size or structure of the embryo from the start of the after-ripening period to the end of it?

CHAIRMAN MEAHL: No, although at the point of germination it had increased about twice the original size from the start of the after-ripening until the seed were ready to germinate. Whether there was a short period when this increase took place or whether it was a gradual increase, I do not know.

MR. HERBERT TRAUTMAN (Trautman Nurseries, Franksville, Wis.): Your statement would lead one to think that possibly the green substance in the seed coat is absorbed in some way by the embryo and makes it possible to germinate afterward.

CHAIRMAN MEAHL: Apparently it had no effect on the germination as such, but if the seed coat was injured slightly this green material developed and it seemed to develop only on those seeds which were viable, that is, with the ability to germinate. Therefore, if the seed is scratched and this green material developed, it was an indication only that the seed was capable of germination. It was not necessary to injure the seed in order to obtain germination. In other words, the green color does not appear unless the seed is injured, but the substance is there. Whether it affects the after-ripening, I do not know.

DR. SNYDER: The fundamental question is "What is after-ripening?" There are quite a number of changes which occur as the embryo becomes after-ripened. Seeds with dormant embryos have different degrees of dormancy. Some dormant embryos will germinate completely if removed from the seed, others will show some degree of activity, such as a slight spreading or greening of the cotyledons, while others will show no evidence of growth unless the embryo has been completely after-ripened. We are concerned with something which has been called after-ripening. Actually this is double talk since we don't know what happens during the period of stratification which makes the seed capable of germinating.

MR. TRAUTMAN: What I meant was that there is a possibility that these chemicals or substances that are necessary are really in the seed coat.

CHAIRMAN MEAHL: I would say there was that possibility, but it has not been determined that the green pigment has any effect on germination. Its presence merely is an indication that the seed is capable of germination when given the right conditions. Let us say when air and moisture get through the seed coat, this green material develops. Whether the same material that makes the green pigment develop is also the same material which will enable the seed to germinate, I don't know.

MR. RICHARD FILLMORE: I am very much interested in obtaining simple tests for viability of the seed of woody plants. It seems to me in the case of these seed which when injured will develop a green color, that there must be a substance there which will permit or encourage germination and which at the same time, or previous to germination, will develop this green coloration so the green coloration and the germination are simply symptomatic of something else which is in there and if we knew what that was, we would have the answer.

CHAIRMAN MEAHL: I think that is right. Gentlemen, we don't want to take any more time from the other speakers. Their material will be much more practical and will be much more helpful to you, I am sure, than that which has been presented up to this point. At this time, I should like to present to you Mr. Fred Galle who will discuss magnolia from seed. Mr. Galle is formerly from the University of Tennessee, later

Ohio State University, and currently at the Ida Casons Garden, Shipley, Georgia.

Mr. Fred Galle presented his paper, entitled "The Propagation of Magnolias by Seed." (Applause)

The Propagation Of Magnolias By Seed

F. C. Galle
Ida Casons Garden, Shipley, Georgia

Due to my limited experience with only one species (*M. grandiflora*) and only two specific references (1 and 2), I sent out letters to nurserymen and members of the Plant Propagators' Society, requesting their experiences and procedure in handling *Magnolias* by seed. I received twenty-five (25) replies from this inquiry and wish to thank the contributors, for I have compiled my talk from their varied experiences.

From the references and the letters, I obtained information on fifteen (15) species and several varieties. The most common species normally grown from seed were *M. grandiflora, virginiana (glauca), Kobus, accuminata, soulangeana, and stellata.*

Collecting and handling seed:—The cone-like fruits of magnolia, depending on the species and area, ripen from late summer to fall. The cones consist of several to many coalescent, one to two seeded follicles. At maturity the red to scarlet outer seed coat is fleshy and oily, and the inner seed coat is hard or stony. The seeds when ripe are usually suspended from the open follicle by a slender elastic thread or funiculus. The seed are best collected when the follicles begin to open and are placed in a warm building or greenhouse where they continue to open and expose the seed. Some cones, if collected too immature, will fail to open, making seed removal difficult.

Two nurserymen reported good germination of seed without removing the fleshy outer seed coat, however, all others recommended removal of the fleshy seed coat, taking care not to allow the seed to dry out. The failures and poor germination of imported seed are often due to improper handling and allowing the seed to dry out.

To clean the seed of the fleshy outer seed coat, water is generally recommended. Macerating in hot water is faster than using cold water, however, it was reported by John B. Roller, Verhalen Nursery Company, that with *M. grandiflora,* following the hot water treatment, the seed planted in outside beds would germinate in warm periods during the winter and consequently were frozen. This might be an advantage when planted in a greenhouse. Carl Kern uses a detergent in the final water rinses to remove any oily film or residue. Roger Coggeshall, Arnold Arboretum, uses a Waring Blender to clean seed. The metal blades, however, were replaced with a square piece of truck tire, thus cleaning the seed thoroughly and with no injury to the seed coat.