

from some of these men who are well versed and experienced in handling the propagation of taxus.

The first of our speakers this morning has had considerable experience propagating *Taxus* by seeds. He is from Amherst, Ohio. Mr. Laddie Mitiska will discuss "The Propagation of *Taxus* by Seed."

MR. LADDIE MITISKA (Amherst, Ohio): Mr. Chairman, members and guests of the Propagators Society: From the material Mr. Keen has given us we can readily see that the work that has been done in the past good many years has given varied results. We know a good many of the practices used then are outdated. Among the various propagators that are handling yews, everyone seems to have his own method.

In presenting this paper, in which I have gathered the facts as they have happened to us, I know there will probably be a difference of opinion and it is fortunate that I am being followed on this program by two highly successful nurserymen.

Mr. Mitiska presented his paper on "The Propagation of *Taxus* by Seeds." (Applause)

THE PROPAGATION OF TAXUS BY SEEDS

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Taxus are propagated by seed for two reasons. First is to produce the *Taxus "capitata"* of the trade. The other is to produce seedlings of the clones in a search for new varieties, which, to be reproduced, are propagated by cuttings or, very rarely, by grafting.

Although some nurserymen propagate *Taxus "capitata"* by tip cuttings of upright-growing branches of particularly good strain most plants of this type are grown from seed.

Much of the success or failure of growing taxus from seed depends upon the source and viability of the seed. If one is dependent upon a seed house or collector for the procurement of seed, it is important to know that the seed is from the current crop, and that it has not been exposed to undue heat or drying out. And too, one should make sure that the strain of seed has desirable characteristics. It takes several years before the true form of the plant is ascertained, hence it is important to start with good seed.

We have preferred collecting our own seed whenever possible and have found we could grow a very nice strain of Upright Yew by gathering seed from an especially large and nice specimen of *Taxus cuspidata*. Seeds of a true *Taxus cuspidata* tend to reproduce quite uniformly. Seeds gathered from some of the clones will produce an endless variation of seedlings. Although some may prove to have superior merit, the general picture is one of confusion in the genus *Taxus*. There is always room for superior selections in any group of plants, but instead of adding to the number appearing in the trade, some of the inferior ones should be dropped. Continuing studies by colleges and

experimental stations in growing and evaluating taxus selections should be intensified.

Although we propagate the greater share of our taxus by cuttings, and this has all been accomplished in out-door, heatless frames, some seeding is being done.

Taxus seeds usually remain dormant after sowing until the second season, unless some means are provided to break dormancy and hasten germination. Gathering the seeds before the fruit was fully formed and planted immediately was tried, but no germination took place until the second year. With some seeds, this procedure gives relatively quick germination. Another procedure tried was to treat the seeds with a sulphuric acid solution for 30 minutes to soften the seed-coats—again the results were negative. It seemed to indicate rather, that the after-ripening process must be artificially controlled. A batch of seeds collected and stratified immediately was subjected to alternate periods of warmth and cold. First the stratified seeds were placed in a cool temperature of about 35-40 degrees for eight weeks (Nov. & December); then brought into a warm room for six weeks (until mid-February); then returned to the cool temperature where they remained until sown in March in a previously prepared bed. A very small percentage of the seed germinated the first year, with a high percentage of the remainder coming through the second year. There was also some germination the third year. We felt that the cost of caring for the few seedlings that first year did not warrant trying to hasten germination unless a higher percentage is realized. It is most advantageous to harvest a crop of seedlings of the same age and of uniform size, even if it means waiting the extra year. However, the fact that even a few seeds germinated the first year seems to indicate that some method could be devised to successfully secure good first-year germination. Perhaps some nurseryman or scientist has already found the solution.

Not having the time and facilities to devote to more experimental work, we are content for the present to follow the slower, but for us, a sure procedure.

In our earliest sowings, the seed was stratified in fall and held over and planted in spring. Sand was used as a stratification medium in the volume of at least five parts of sand to one of seed. It was found that if the concentration of seeds was greater, there was a greater incidence of fungus damage. The container was usually a wooden box with drainage provided. Peat moss was tried but if kept too moist there was again the danger of fungus damage. If seed was purchased, it was soaked for several hours in cold water before being mixed with sand to give it an initial wetting.

Our own seed is cleaned by soaking the berries for four to five days in warm water. Slight fermentation may begin and apparently is not harmful. The seed is rubbed over a screen to separate it from the jelly-like pulp and thoroughly washed several times. As an added precaution against fungus, we usually wash the seed in a solution of potassium permanganate. Some growers have been using any of the common detergents.

In the process of cleaning, any seed that floats on the water is discarded. These seeds are usually found to be empty or lightly filled. Once the seed has been cleaned, it is well to plant or stratify it before the seed coats dry out.

The stratified seed is kept in a cool room at temperatures from 35-40 degrees, and checked occasionally that the medium is slightly moist at all times.

If it is difficult to provide a storage place at these temperatures, we have also tried with excellent results, to bury the container with the seeds out-doors in a well-drained place, preferably on the shaded side of a building. The container is placed deep enough to be below frost and the temperatures remain quite constant for a long period. A mulch can also be used, but protection must be furnished so no rodents can reach the seed.

However, sometimes when seeds are stratified for long periods, they are forgotten and allowed to dry out; or they may begin germination before they are sown in the seed bed. Whenever possible, we do all of our seeding in the fall. This not only applies to *Taxus*, but to other plants as well, namely: *Viburnum*, *Magnolia*, *Ilex opaca* and *crenata* types, *Mahonia*, *Junipers*, Dogwood, etc.

The construction of the seed-bed seems quite important to us. Our propagation is carried on at small scale and we believe that, although some of the precautions we take are not necessary, the little extra time expended is well worth a while. The seed-bed should be located where land drainage is adequate and where there is ample movement of air for good circulation. Protection must be provided against mice, moles, chipmunks and also some birds. So our seed-bed is completely enclosed. Sides are either of wood or concrete blocks, laid with-out mortar. On the bottom we use 1/2" galvanized hardware cloth. As a cover the metal cloth is again used on wooden frames in convenient sections. Mice and chipmunks will feed on the seeds even through underground runways of moles. Some birds were found to feed on newly germinating seeds. Hence these precautions.

The seedlings will remain in the seed-beds for two growing seasons, so adequate soil preparation must be provided. We find a fertile, sandy loam very good and like to work in a generous application of peat. Michigan peat or a similar product is excellent. This mixture should be fortified with a complete fertilizer, preferably one with an organic base as most of the nutrients will be demanded the second season after sowing. Soil depth above the protective hardware cloth is about four inches.

As to the method of seeding, we broadcast the seed by hand as evenly as possible. Our beds are made four feet wide and we cover about 20 square feet of surface with one pound of seed. *Taxus* seed runs approximately 8500-9000 to the pound, so this rate of sowing allows about 400 seeds to the square foot. With an expected germination of 50%, this gives us approximately 200 seedlings to the square foot. A higher percentage often results, but the finished stand will produce smaller seedlings due to crowding. If crowding is too severe, the seedlings will be thin and weak, and very susceptible to damping-off fungus.

We press the seeds into the soil slightly using a board or block of wood, and cover the seeds with a layer of clean washed sand about 3/8 of an inch thick. This is again firmed. Then the entire bed is covered with a layer of mixed wood shavings to the depth of 1-1/2 to 2". If shavings are not available, perhaps ground corn cobs or some other mulch material could be used.

This covering will remain the entire next year and until the following spring, when germination is expected. We find that there is no weed problem as long as the shavings remain, and that normal rainfalls will supply most of the moisture requirements. Only in periods of drought will any irrigation be required. So, aside from using space, the care of the seed bed the first year is negligible.

The shaving mulch is easily removed the second spring without disturbing the sand covering the seed. It should be removed very early in the spring as a mulch keeps the soil cooler, and it is desirable to have the warmer soil temperature to secure germination as early in spring as possible. Late germination brings the tender seedlings into hot weather when there is greatest danger from damping-off. The covering of sand prevents most of the weeds from growing, but if any should appear before germination begins, we have used a flame-gun to burn them off without damage to the seeds.

When germination does begin, the response is quite spontaneous and this period is over quickly. A light shade should be used as a hot sun can scorch the tender seedlings as they emerge and cause deformation of the stems.

Damping-off fungus poses the greatest danger to newly germinated seedlings. In the past we have resorted to some of the mercuric compounds at the first sign of damping-off. More recently, we have used oxyquinoline sulfate or Captan.

There has been a marked increase in the occurrence of damping-off fungus (*Rhizoctonia solani*) on taxus in the past few years. The fungus may cause the rotting of new roots, or it appears as a collar infection at the soil level. It has appeared in seed beds, cutting off the plants at soil level. It shows in liners also, being carried over from cutting beds. The infections have been severe enough to cause the death of even mature plants. Francis W. Meyer of the Department of Plant Pathology & Botany at the Connecticut Agricultural Experiment Station has made a considerable study of this fungus on taxus and other plants. I am quoting from his findings. "We are of the opinion that oxyquinoline sulfate, rather than being a fungicide is 'fungistatic' and that it is taken up by the roots of the plant which thereby makes the plant resistant to further invasion by the fungus. Oxyquinoline sulfate is used at the rate of 1:4000, or one level teaspoon to three gallons of water, or one pound to 500 gallons. It is applied to the soil at the rate of 1 pint per square foot. Often one treatment will halt the losses."

Our results using this material are still inconclusive, but we feel that from our past summers experience, our losses due to damping-off were minimized. The cost of treatment is small and good insurance. The appearance of a fungus in the seed-beds can wipe out much of a good stand very quickly.

As the season advances, the seedlings harden-up and the danger is lessened. During periods of heat and dry weather, irrigation should be plentiful and thorough. Watering should be done early enough in the day, when the seedlings are still tender, so that the foliage is dry before dark.

In early September, when the heat of the sun has diminished, we remove the shading to give the seedlings a chance to harden up for the winter. Early in December, the seed-beds are given a loose covering of clean straw and the lath shade restored. We use a double layer of lath shading for the first winter. There will be no heaving of the seedlings if the soil is shaded and not

subject to alternate freezing and thawing. Protection against rabbit damage must be furnished.

Early the following spring the shading is removed and as much of the straw as possible. At this time we give a surface application of a good complete fertilizer, broadcasting it by hand and washing it off the foliage and stems with a hose. Rate of application is approximately 1-1/2 to 2 pounds per 100 square feet. The seedlings will be removed from the seed-bed after this second growing season and we try to get all the growth possible. It has been proven that taxus will respond generously to supplemental feeding and watering.

The shading is not replaced the second growing season unless extremely hot and drying weather is encountered in June to August. Only a very light shade is then used. A late spring frost, as some sections of the country experienced last spring, should be guarded against and seed-beds protected. Frosted new growth of taxus seedlings will injure and deform the structure of the plant.

After the first surge of new growth has been completed and the terminal buds have attained full size, we give two or three applications of a liquid feeding at two week intervals. This feeding should end by early August as late new growths will be damaged by freezing weather and will not mature properly. Rapid-Gro or a similar formula applied at the manufacturers recommendations have been used. Heavy watering during the summer period has given an additional burst of growth to produce a vigorous seedling for transplanting. It is good practice to begin irrigation before the soil has reached too great a degree of dryness. After new growth nears completion, no irrigation is done. Of course, as with all plants, and with evergreens types especially, no plants should go into the winter in a dry condition.

For the second winter a light protection of straw is all that is needed. We cover this with a raised lath shade merely to protect the seedlings from being crushed by heavy, wet snows.

The seedlings are now ready for transplanting. Digging has been made very easy because of the hardware cloth in the bottom of the bed. A sharp spade is run along the bottom to dig and root-trim the seedlings evenly. From here, seedlings may be either potted, bedded, or lined in open beds for further growing on.

We prefer to dig our seedlings early while they are still dormant. even if planting can not be done immediately. They are heeled into a peaty bed and shaded until used. If any of our seedlings or rooted cuttings are planted out-doors in an advanced season, we spray the foliage first with Wilt-Pruf.

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MODERATOR KEEN: We will take time for a few questions right now on this subject of propagating taxus from seed.

MR. WALTER C. ALDRICH (Jos. Olsen Nursery, Birmingham, Michigan): What was your recommended seed count per square foot?

MR. MITISKA: We try to sow at the rate of approximately 400 seeds per square foot.

MR. JACK HILL (D. Hill Nursery, Dundee, Ill.): What is the reason for the straw protection on your beds the second winter after germination? Is that to deal primarily with heaving or is that to reduce damage to the foliage by the winter conditions?

MR. MITISKA: We use straw the second season to reduce damage to the foliage because we are in a spot where we get a lot of wind. In the winter time the wind has a drying effect and sometimes discolors the foliage when it is unprotected.

MR. HILL: Heaving is no problem?

MR. MITISKA: No, probably the roots are quite deep.

MR. CHARLES HESS, SR. (Hess' Nursery, Mt. View, N. J.): You say you collect your own seed for *Taxus "capitata"*?

MR. MITISKA: We have a plant of *Taxus cuspidata* that we thought was a true strain and is quite isolated from other *Taxus*.

MR. HESS: We have discontinued collecting our own seed. We found we were getting "mongrels". We have cross pollination and the only true seed we can get today is from Japan. We had a *Taxus "capitata"* and a *Taxus media bicksi* and we found the seeds to be a cross of "capitata" and *bicksi*.

You mentioned the danger from birds eating the seed. I happened to be at Sheridan Nursery in Ontario, Canada, last summer and they have the most novel way of protecting the seeds. They mix their seed with powdered red lead and it stays on in the weather and sticks with the seed. The birds will not touch the seed. They have given up all other protection. They had seeds of taxus, pines, and spruce. As you know, when they germinate they carry the seed coat with them and the birds will nip it off and all you have is roots and no foliage. They found by treating the seed with powdered red lead, it would stop all damage by birds.

MR. MITISKA: Years ago we experienced damage by birds on other seeds. At that time, the only recommendation was to use poison baits.

MR. HESS: This doesn't poison the birds. They won't touch it.

MR. deWILDE (Rhode-Lake Nurseries, Shiloh, N. J.): I can verify what Charlie Hess said about red lead. We use it on dogwood to keep mice off. The mice won't eat it. They won't even start on it. If you want to improve the thing a little bit to make it stick, I have found adding a tiny bit of linseed oil to the seeds before you put the red lead on, will make it stay better. I mix a pound of red lead with the oil and the seed, run it over a screen, and saved what fell out for the next time.

MR. C. DeGROOT (Sheridan Nurseries, Sheridan, Ont.): The application of red lead might be a tablespoon to one pound of seed. It should be wet so it sticks to the seed. The dry lead won't stick to the seed.

MR. ALBERT LOWENFELS (White Plains, N. Y.): If you kept the seed for 90 days at a warm 68 degree temperature and then kept them for 120 days in the cold, wouldn't you get germination the first year?

MODERATOR KEEN: That is what they found at the Boyce Thompson Institute, that is what will end the dormancy. Theoretically, you would have time to do it during winter but I don't believe that is commercially feasible. If they work on that basis, that wouldn't be too impossible. You would have to handle the seeds in flats. You could hold them in the greenhouse for 90 days at warm temperatures and go to cold storage.

MR. MITISKA: In relation to the work we do, I mentioned in my paper, a good many times seed that is stratified is gone. In a large operation where a person has charge of sowing seed and does one thing, it may work out perfectly. We find so many times that when we try to do too many things, some are forgotten. Even if it takes a little longer, we like to gather our seeds and to forget them until time for germination to take place. It may use a little space and it doesn't require very much care. The seeds are there. When the time comes, they are going to germinate.

I also wish to comment that our experience growing *Taxus "capitata"* from seed is that a good strong source produces seeds with good characteristics. I think that is the way to do it. So many times in the past we got seed in from some of the seed houses. Some was partly filled, some dried out. That is why we started collecting our own. If you do have a good source, I think that is the best way to handle the seed.

MODERATOR KEEN: Thank you a lot, Mr. Mitiska.

I want to commend all of you for the attitude of being willing to share information with the crowd. I heard, even as late as the breakfast table this morning, that one man was concerned with the sharing of propagation information that was going on at these meetings. He was afraid that we would just rush out and propagate more plants and would just swamp the market!

You know we can't all afford to make all the mistakes ourselves. When I can find 100 papers on the propagation of *taxus* in the small school where I am, - our library has only been there about 80 years - why there is no dearth of information for anyone who wants to dig! And that is our purpose here, to dig and share so that we all have enough information.

Our next speaker has had a world of experience in the propagation of *taxus* by cuttings. John Vermeulen has introduced a number of new varieties. He didn't follow Charlie Hess' example when he found he had a flock of "mongrels", which is the word Charlie used. John selected some of the better ones and has introduced them. At this time, we will hear from Mr. John Vermeulen on "The Propagation of *Taxus* by Cuttings".

Mr. Vermeulen presented his paper entitled "The Propagation of *Taxus* by Cuttings". (Applause).