HENRY H. CHASE: Yes, there is nothing there except the adventitious buds which will come next spring to produce the forty-five to fifty stems we use.

RALPH SHUGART: I would like to ask Mr. Heit what seed bed density he used for pine?

MR. HEIT: This depends upon how long you are going to leave the seedlings in the bed. If you transplant them after the first year, you can grow up to 100 per square foot. If you are going to grow 2 year seedlings, we cut it down to fifty to sixty per square foot. If you are going to grow three year seedlings, cut the number down to 30 or 40 per square foot.

MR. LOWENFELS: I don't want to start another argument here, but on this anti-desiccant business, Dr. Snyder gave a talk to the Holly Society and between these two talks I don't know whether to use them or not because Dr. Snyder says the materials wore off.

DR. REISCH: It does wear off in about three to seven days.

MR. LOWENFELS: So what is the benefit of using it in the field if it is going to wear off?

DR. REISCH: That's a good question.

WILLIAM FLEMER *III*: I would like to ask Dr. Pridham if he found clonal differences in rooting the different elm cuttings or did they all root relatively uniformly?

DR. PRIDHAM: I think that everybody who plays with elms, runs into a few trees that don't want to root. However, we did get at least twenty percent rooting of all the varieties we took this past summer.

MODERATOR DUGAN: Our next subject is the no tillage method of propagation and production which is just about as controversial as you can get. Many of us had the pleasure of seeing this operation last December and we know that the plants do grow. Today we will have the opportunity to hear how it is done. Hugh Steavenson.

## MULCH CULTURE OR "NO-TILLAGE" METHOD OF PROPAGATION AND PRODUCTION

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Those of you who have visited our nursery in Northeast Misouri know we are situated in quite hilly terrain overlooking the Mississippi River bottoms. Our primary production over the years has been seedlings, but in the past decade or so our production has included material as large as specimen (caliper) shade trees and container stock. We grow a long list of tree and shrub seedlings as well as a variety of evergreens and other stock; so my comments on mulch or "no-tillage" culture are not restricted to just a few items.

For years I was convinced that seedlings and transplants could be most economically and feasibly produced on the light, nearly level alluvial soils that occur where creeks empty upon the bottom ground. For over a century these creeks deposited an out-wash eroded from the nearby hills. While these "made" soils are indeed suitable for most nursery crops, it took years of observation to demonstrate any species or variety would perform as well on our hills and many items would do much better. Furthermore, air drainage was far superior on our ridges and hillsides and seeding, planting and harvesting could proceed when the bottom grounds were too muddy to touch. Our hills did lack adequate water for irrigation and it took a decade of constructing reserviors and diversion terraces to solve the water problem. These hills adjacent to the river are covered with a loessal mantle, long recognized as a horticultural soil, but at the same time a very erosive one. To produce nursery crops and still keep the soil in place requires comprehensive soil conserving practices, including terraces, contour planting, sod rotation, cover crops and strip cropping. Not the least benefit of our mulch or "no-tillage" culture is the fact that it is a key practice in erosion control.

Mulch culture is an intensive practice. That is, it is not cheap and demands a high production per acre. I think most nurserymen would agree that nursery crops in general, which represent a lot more value per acre than most agricultural crops, demand the best soils available, brought to a high state of fertility and physical condition. This is especially true with a system of mulch culture.

Our program is to bring land ultimately scheduled for nursery cropping to a workable grade by bulldozing and land leveling. This does mess up the top soil somewhat, but with loessal soils this is not too serious. Next limestone is applied, usually dolomitic as our soils are generally deficient in magnesium. When this is plowed down, rock phosphate is applied if the need of phosphate is indicated. Then the land is planted to a perennial sod crop, usually alfalfa and brome grass or an alfalfa-fescue mixture. The grass is fertilized as indicated by soil tests and rotationally grazed. Mixed fertilizer is applied semi-annually to maintain the forage at optimum productivity. Growth is clipped as needed and all clippings are left on the ground — no hay crops are removed.

Actually, all this really costs nothing. I can tell you there isn't much money in raising beef cattle these days, but the fact remains that ordinary pastures produce about 100 lbs. of beef per acre while a good fertilizer-management program will quadruple this yield. By bulk spreading we can apply 600 lbs. of fertilizer (usually 22-11-11) for $21.60 per acre and produce an extra 300 lbs. of beef worth at least $60 even on today's weak market.

During the build-up period — we like to leave the ground in sod for at least three years — weed control is of great im-

portance. Clipping will control tall growing weeds. A heavy luxuriant sod will crowd out most other weeds. I suspect it might be smart to leave legumes out of the grass mixture. This would permit spraying with 2-4-D, or other herbicides. Even for pasture it is probably more economical to grow straight grass and get nitrogen out of the bag.

A heavy sod is difficult to work into nursery beds. We like to go through one year of annual green manures before finally fitting the soil for nursery planting. If the sod is broken in the fall, rye or annual brome grass is seeded. This is turned under in late spring and followed with a couple of stands of thickly-drilled corn. Each green manure crop is generously fertilized and plowed or disced down before weed seeds mature. Corn is said to return more organic matter to the soil than legumes, such as soybeans. And corn lends itself better to weed control practices, i.e., herbicidal spraying.

So much for soil preparation. The soil should now be at an optimum level of fertility, with a low weed seed population, and in an excellent physical condition. Organic matter level will be near the peak that can be secured by agronomic practices, about 2½ or 3% at our latitude.

In our "mulch bed" culture, a sawdust mulch is applied immediately after sowing in the case of seed beds. Where the beds are planted with "liners," mulching may be delayed for 10 days or so in order to smother the first crop of weed seedlings.

I am sure there are better mulches than sawdust. The plant nutrient content of sawdust is very low, about one-half that of straw or one-eighth that of alfalfa hay. We have used ground corncobs extensively. They are excellent but grinding is tougher than you think. The processed sugar cane mulch the fellows in Rhode Island use looks beautiful. Sawdust does have the lovely quality of being cheap. Our only cost is hauling a few miles and spreading. Two inches, our average application, comes to about 135 yards per acre. With 30 or 40 acres to mulch, you can see that the sheer physical job of hauling and spreading is no little chore.

The influences and benefits of mulching are well known and scarcely need enumerating. An open, porous mulch insulates the soil surface against summer's heat and winter's cold. It induces better penetration for rain or irrigation water. It conserves soil moisture and reduces surface evaporation and may thereby appreciably reduce irrigation requirements. It acts as an erosion buffer. We observe noticeable improvement in soil tilth, structure and mellowness under mulch as against usual tillage, and can assume that soil aeration, or gas exchange, is markedly benefited by mulching in contrast to soil compaction resulting from repeated tillage.

We observe that a lace-work of feeder roots will proliferate right at the soil surface under a good mulch while these surface roots are generally destroyed by tillage.

Mulching can pay for itself in weed control. The proper thickness can smother many weed seedlings while permitting the nursery crop seedlings to germinate and emerge without difficulty. It would be misleading to suggest that mulching can solve the weed problem; but it can supplement and abet other control measures. Indeed, the advent of chemical herbicides has made mulch culture for field stock much more practicable.

Several years ago, and for a period of years, we used goslings as weeders. As selective herbicides came into the picture, we "retired" our goose herd. This is not a paper on chemical weed control, but I will mention we favor some of the less "hot" materials, such as Dacthal and Casoron for first-year linings and seedlings. Chloro IPC does an outstanding job on winter and spring weeds while Simazin is excellent for summer weeds (or weeds any time) and does give long season control. Nevertheless, we see just enough evidence of growth retardation and injury in various situations and with a number of varieties that our trend has been to lighter applications of the chemicals and greater dependence on the milder types, such as Dacthal.

Our fellows, Bob Suddarth and Wayne Lovelace, have been testing a number of herbicides for direct application to the sawdust mulch immediately after seeding. We are now using Dacthal in this manner as a standard production practice, and as a follow-up treatment after seedlings have germinated. To me, this is treading on pretty thin ice, but so far results looks good.

With seedlings, the greatest benefit of mulch culture is securing a stand. Many seedling growers, such as those in the western prairies, have sandy loams that permit them to secure good stands with a number of tree and shrub species when seed is drilled or planted in rows. This is not true with our clay loams. We need a loose, friable mulch over the seed to secure satisfactory emergence, particularly with the lighter seeds. (Incidentally, I note that growers in east Tennessee and northern Alabama use a rotted sawdust or peat covering over seeds sown in drill rows or shallow furrows; the beneficial effect on seedling emergence is similar to that we achieve with mulch beds.)

We prepare raised beds (4 ft. wide, 6 ft. center to center) mechanically with no handwork whatsoever. Beds are finished with a narrow guage corrugated roller (Brillion) and the seed broadcast on the bed surface. The seed is rolled in with the same corrugated roller. Now sawdust is applied with a manure spreader. By making several "passes" the desired depth and a good uniformity of covering is achieved.

The same covering procedure is used in mulching transplants or field lined stock.

One pernicious problem with seed beds is the blowing off of the sawdust covering.

Recently we have discovered that the light netting (Erosionet) used for highway grass seedlings and the like, does an excellent job of holding down our sawdust seed bed covering.

It can be removed as the seedlings germinate and stored for reuse. Wind is still a problem, however. Last spring we suffered heavy seedling losses just as many seedlings were emerging in early May. Netting had been removed when severe winds in a single day actually blew the sawdust covering and seedlings out of exposed beds, or driving particles of dust sheared off seedlings. We are now planting shrub windbreaks to mitigate this hazard.

Obviously, mulch culture is economically practicable only under intensive cropping. Seed beds are by their very nature "intensive." The same is true with transplants. Beyond seedbeds and transplants, much of our mulched acreage is devoted to what we refer to as "15 in. spaced sttock." Here we use the identical 4 ft. beds as for seedlings and transplants, but stock is set in rows 15″ apart with plants spaced 15″ apart — about 15,000 per acre. This high population justifies such intensive practices as mulching, heavy fertilization and irrigation. Under this system we produce small-size B&B evergreens and some of the more dwarf shrubs and the like.

In passing, the well-known nitrogen-starvation effect of sawdust (and other raw organic substances) should be mentioned. Something like 2 lbs. of nitrogen per 100 sq. ft. of surface for every inch of sawdust applied is necessary to compensate for nitrogen tied up by soil organisms as they break down the sawdust. This amounts to almost 1,000 lbs. of N per acre for each inch of sawdust. We would never apply this much N at one time for fear of crop injury. (In fact, we have decimated seedling stands with a dressing of ammonium nitrate when the fertilizer particles clung to the foliage). We prefer to use a mixed, high-nitrogen fertilizer and make repeated application as soil tests and crop growth indicate. Indeed, rapid break-down of the sawdust mulch is *not* desired. All that is necessary is to maintain a good nutrient level for the nursery crop and the sawdust break-down will pretty well take care of itself.

Now we have used this sawdust mulch culture for 23 years, we are convinced that soils constantly improve with this system. Where such land has gone back to farm crops, yields have been remarkable. Indeed, once into the system it is doubtful that further rotation with sod crops or other green manures is necessary, except possibly for disease control.

But I should hasten to say that all authorities do not agree with our experience. Warren Baldsiefen, New Jersey grower of rhododendrons and azaleas writes:

> "The commercial use of sawdust, which has resulted from accessibility and low cost and the ease of application, has, from my observations of its use from Oregon to New Jersey, resulted in many failures. In commercial growing a crop is removed from an area every few years either to be re-spaced or to be sold. And it is here that the trouble begins, for when these plants are

lifted some mulch, left from digging, falls into the hole and the sawdust becomes an ingredient of the soil. Perhaps meticulous care might prevent this but I have never seen it so, and in every instance where plants were removed, sawdust, only partially decomposed, was mixed with the soil and the next plants placed there had to compete with it for nitrogen. Many sorts of woods (as sawdust) take a dozen years or more to break down and in this time several crops of rhododendrons can be taken from a given area. Each time more sawdust enters the soil and each time the supplemental nitrogen feeding becomes more grotesquely complicated. I have seen it bcome so hopelessly disastrous that, as a consequence, fields were left fallow for years.

"The theory that periodic feeding will eliminate this fault is weak. If in the late summer, with leaves showing deficiency symptoms, we could ascertain with any degree of accuracy precisely how much nitrogen is needed, a safe application might be made. However, this is impossible, for we have sawdust both as mulch and as soil amendment in various stages of decay, possibly complicated by several different kinds of wood. To try to supply the proper amount of nitrogen without overstimulating the plant at such a critical time just before cold weather is, in my opinion, next to impossible. In sections which are subject to extremes of climate in both summer and winter, any measures which alter the plant's natural metabolism, even slightly, can be fatal at these sustained periods of high or low temperatures. I have also seen the quick death of plants from the effect of sawdust in the soil. In other instances, growth was retarded for a year before returning to normal."

Not being a rhododendron grower I would not care to challenge Mr. Baldsiefen. I do know some of the prettiest rhodies I have ever seen grown by Cottage Gardens of Eureka, California in containers in a wood shaving medium. At Semmes, this fall, I saw acres of superb azaleas grown in deep beds of virtually straight pine shavings. Mr. Baldsiefen's comments do point up the problem of nutritional balance in the use of a mulch, especially a sawdust mulch. But in our experience it is not a formidable one. Jack Hill, in discussing the problem of growth stimulation in late fall and subsequent winter injury, has stressed that this condition never need exist if *an optimum nutritional level is maintained throughout the growing season.* I am inclined to believe this the key to the whole problem.

## REFERENCES ON MULCHES

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The Use of Sawdust for Mulches and Soil Improvement Circular No. 891. U S D.A
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MODERATOR DUGAN: Our next subject is the grafting of junipers by Mr. Andrew Klapis, Jr. of Raytown, Missouri.

## GRAFTING JUNIPERS

ANDREW J. KLAPIS, JR.
*Raytown, Missouri*

Originally this material on pot grafting of Junipers was to be centered around the Bard-Parker surgical knife and its use as a grafting knife. Since my original training in the business world was in the pharmaceutical industry as a medical detailer, I couldn't see why a modified Bard-Parker knife wouldn't be an ideal grafting knife. I had a dentist friend who obtained the first two handles for me and a varied supply of blades. These two original knives proved to be too fragile for some of the heavier scions and understock and about four years ago I found the heavier handle which you see displayed on the tables. The knife handles and blades can be purchased at any good surgical supply house. The #6 Bard-Parker handle is the heavy grade, and blades numbering #20 through #24 are the series which fit the #6 handle. The price is about $3.00 each for the handle and $1.50 per dozen for the blades. We have found these satisfactory even for Blue Spruce and other heavy understock. In our experience, the blades retain their keen edges for about 200 grafts, and then they need to be changed.

Probably the first consideration in a discussion concerning Juniper Grafts is one of what understock to use. At Raytown Nursery for the past several years we have used both Hetzi Juniper and J. Virginiana with the heavier burden going to Hetezi — when we can get enough. The Hetzi understock we try to keep supplied from our own propagation. These cuttings are taken in the winter from the first killing frost on. We use fruit boxes as flats and horticultural perlite as the rooting medium. This gives us about 6 inch depth to the rooting medium, and we take cuttings of approximately 12 inch length. The ideal diameter of understock is somewhat smaller in our thinking than is held by many others. We graft on understock from $\frac{3}{8}$″ on down, but we feel the ideal is $\frac{1}{4}$″ down to 3-32″. We have proven to our own satisfaction and the satisfaction of our customers that these lighter understock and scions *in our operation* exhibit greater vitality and a much better survival percentage than when heavier understock is used.

The hormone used for these J. Hetzi cuttings is Indole butyric acid in talc in the strength of 20 mg/gm. We put 150 cuttings to each box and the boxes are placed in a small fiberglass greenhouse which is heated by a small gas furnace circulating hot air through downspout piping under and over the bench.