PRODUCTION OF BARE ROOT TOBACCO TRANSPLANTS

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Producing quality bare root transplants in plant beds requires much effort and attention to detail on a daily basis. Following is an outline of management practices which has proven to be effective over the years. Attention should be given to each step.

PRODUCTION PROGRAM FOR BARE ROOT TRANSPLANTS

1. Plan to seed 80 to 100 square yards of conventional plant bed for each acre of tobacco to be transplanted. Growers with large acreage and those who have a high level of management may be able to produce sufficient transplants with less beds. Multiple clipping of plant beds along with excellent management may reduce the required yardage to less than 50 yards per acre.

2. Select a plant bed site with well drained soils, wind protection on the northeast side, a southern aspect and an irrigation source. To avoid black shank and tobacco mosaic virus problems do not locate beds in fields where tobacco was the previous crop. Methyl bromide will not control black shank. Prepare a good seed bed. Chop and incorporate any crop residue on the bed site early in the fall to allow ample time for decomposition before fumigation. Plant material may drag on the fumigation injectors causing uneven bed surface and poor fumigant distribution. The soil should be well tilled to a depth of 4 to 6 inches and free of clods.

3. Apply 3-6 lbs N/100 square yards. This nitrogen may be obtained from 50 to 100 lbs of 6-12-6 or 75 to 150 lbs of 4-9-3. Additional phosphorus and/or lime should be applied at this time if suggested by a soil test. Incorporate all fertilizer into the top 2 to 3 inches of soil.

4. Fumigate with 9 to 11 pounds of 98% methyl bromide, or 10 to 12 pounds of 68.6% methyl bromide per 100 square yards when soil moisture is good for cultivation and the air temperature is above 55°F. Since no herbicides are available for use in plant beds, a good job of fumigation is very important. Fumigated soil should not be disturbed deeper than 2 to 3 inches to eliminate the risk of bringing up untreated weed seeds and nematodes.

5. Perforate plastic with 1/4 inch holes, 2 inches apart, before removing from the bed prior to seeding.

6. Beds should be seeded 60 to 65 days before the desired transplanting date if perforated plastic is to be used as the exclusive bed cover. Beds seeded too early may germinate early and be damaged by winter frosts. Broadcast 1/6 to 1/8 ounce of raw uncoated seed or less per 100 square yards. For coated seed aim for a final stand of 30,000 to 40,000 harvestable plants per 100 square yards. When calculating seeding rate account for the germination rate of the seed with additional reductions for losses due to weather, insects and disease.

7. Ridomil is no longer labeled for application to seed beds for protection against blue mold and damping-off (caused by Pythium sp.). Use of Ridomil in seed beds may increase the potential for accumulation and spread of Ridomil insensitive (resistant) forms of blue mold and may actually result in greater injury to field production.

8. Apply a thin layer of fumigated wheat or clean pine straw to hold the cover off young plants. Approximately 15 to 20 lbs of straw per 100 square yards of bed space is sufficient. An alternative is to use a roller/packer to firm the bed surface and form small ridges approximately one and a half to two inches high. These ridges will hold the cover up off the newly germinated plants avoiding damage from the movement of the plastic by the wind.
9. Irrigate beds to wet the soil 6 to 8 inches deep (one half inch of irrigation) just after seeding but before covering with plastic. Providing adequate soil moisture is of greater importance when coated seed are planted and when large areas are seeded such as is the case with commercial plant production. Adequate moisture must be supplied for coated seed to absorb enough moisture over a short time period to allow for successful germination of a high percentage of the seed. Small irrigation gun orifices and high pressure should be used when irrigating seeded beds in order to provide small droplets which will not cause seed to be washed or covered by washing soil.

10. Cover beds seeded with raw seed tightly with perforated plastic or other covers immediately after irrigation. Solid plastic can act like a greenhouse and accumulate heat with no opportunity for ventilation. However, beds seeded with coated seed often benefit from being covered at first with non-perforated covers until the seed have germinated. Water which funnels through the perforations in the plastic will float coated seeds along the press wheel track and pile seeds at the lower end of the bed. Care should be taken to monitor temperatures under the cover until germination occurs and the plastic can be perforated. Excessively high or low temperatures will cause damage to seed or young plants. Seed germination uniformity may be reduced by temperatures in excess of 80°F when these temperatures are experienced prior to germination. Temperatures in excess of 100°F can reduce seed viability resulting in a reduced plant stand. Tight covers will minimize plant damage from wind blown covers.

11. Check beds daily for problems with soil moisture, loose covers, insects, disease, or high temperatures.

12. Remove perforated plastic when daily temperatures reach 75°F for 2 consecutive days. Replace if temperatures are expected to drop below 45°F.

13. Begin regular clipping when plants are approximately four inches from the soil line to the bud. Plan to clip three to four times, approximately one half inch above the bud to improve uniformity. Additional clippings may be required for slow growing plants or beds which are of poor uniformity.

14. Undercutting well managed, uniform beds prior to pulling can significantly reduce labor costs by making pulling easier. Caution should be used to avoid root injury due to shallow undercutting. Undercutting beds which are of poor uniformity may result in pulling plants of assorted sizes. Small plants will have to be sorted out as they may not survive transplant shock.

PLANT BED PROBLEMS

Production of healthy transplants is the first step toward a successful and profitable crop. Poor quality transplants may cause a variety of early-season problems and may predispose the plants to season-long problems accentuated by disease and/or weather resulting in lower yields and leaf quality. Costs of production are increased by beds with poor stands, plants damaged by improper fertilization inadequate cover management, poor moisture management, and replanting fields with poor stands. Adequate, but not excessive moisture is a must to insure timely seed germination and proper growth of young transplants. Drainage, cover management, and irrigation all play a part in moisture management.

DRAINAGE

Locate beds in sites with good surface and internal drainage. Crown or raise beds to provide for natural removal of excess water. Install ditches or drains around beds to remove standing water. To avoid water soaked spots in beds the plastic tarp should remain covered until time for seeding. Rake or shape beds if necessary prior to
seeding to remove low or uneven areas. Large amounts of water do not normally penetrate perforated plastic covers, but beds should be checked closely for wet spots after prolonged rainfall.

COVER MANAGEMENT

Perforated plastic covers are used by a majority of tobacco transplant growers in Georgia. Plastic used for covering fumigated beds is perforated by punching out 1/4 inch holes every two inches. Perforated plastic may eliminate the need for purchasing an additional cover for the beds. Plant growth may be more consistent and transplanting date more accurately predicted with plastic than with some synthetic or woven covers.

After germination, remove plastic covers from beds when air temperatures under the plastic reach 100°F before the plants reach the size of a quarter. Older plants may tolerate temperatures up to 110-115°F for short periods of time depending on existing humidity under the plastic. As a rule-of-thumb plastic covers should be removed after outside temperatures have reached 75°F for two consecutive days and replaced when temperatures are expected to drop below 45°F. A thermometer placed so that it may be read through the plastic provides a sure way of monitoring temperatures under the plastic. Transplant producers who have large numbers of beds, other farm enterprises, off-farm employment, or other time restraints may have difficulty properly managing perforated plastic covers.

Some growers choose to replace perforated plastic with synthetic or woven covers as the daily temperatures increase. Advantages of these covers include improved ventilation, no build up of radiant heat, and increased infiltration of rainfall or irrigation. Spray applications may be made without removing these covers. Covers need only be removed to provide access for clipping. Beds covered with synthetic covers have a tendency to dry out in advance of plastic covered beds and need additional monitoring and irrigation.

IRRIGATION

Plant beds should be irrigated following seeding to settle the seed and provide good seed to soil contact. Soil should be wet six to eight inches deep (1/2 to 3/4 inches of irrigation) before covering with plastic covers. Leaving the beds uncovered until it rains is risky as heavy rainfall may puddle seeds and result in poor plant distribution or washed out beds.

PLANT BED FERTILIZATION

Tobacco seedlings require relatively high amounts of nutrients to insure the rapid growth desired for transplanting. However, the temptation to over fertilize plant beds should be strongly avoided. Excessive rates of N and K fertilizers can decrease stands and damage young growth. Heavy N applications can cause plants to become too tender and succulent, and require more frequent clipping. Excessive succulent growth can increase the potential for disease under the plant canopy. Tender plants may be damaged when pulled and transplanted. Tender plants can be more easily damaged by sun scalding or by blowing sand once transplanted.

Select sites for plant beds early in the fall. Have the soil tested for lime and fertilizer requirements. Be sure to identify the crop as a "tobacco plant bed". Apply needed lime as early as possible to allow sufficient time to react with the soil.

Apply a complete tobacco plant bed fertilizer that will supply at least 3 and no more than 6 pounds of N per 100 square yards. This may be obtained with 50 to 100 pounds of 6-12-6 per 100 square yards (2400 to 4800 pounds of fertilizer per acre). Use lower rate with plastic covers. Mix fertilizer with the upper 2-4 inches of soil prior to seeding. Irrigate to wet soil to a depth of 6 to 8 inches (1/2 inch of irrigation) after seeding but before covering to prevent fertilizer salt injury and promote uniform germination. Since much of the growth will occur in cool soils which have been fumigated, at least 50% of the applied N should be in the nitrate form.
NITROGEN SOURCE

Mineral sources of fertilizers usually provide more consistent results than organic sources. Organic sources can encourage buildup of some insect pests, and can provide a favorable environment for damping-off diseases, both of which reduce the stand. Natural organic materials have however, been touted as slow release forms of N that will continue to provide N over a long period of time, and offer protection against leaching.

Studies with these materials indeed show an initial slow availability of organic N; it takes about three to four weeks for unusable organic N to convert to inorganic forms which the plant can use. Of the organic N which becomes available over a 90 day period (about 30-50% of the total N), essentially all is converted during these first few weeks. Thus little protection against leaching results. The uncertainty of this conversion process, and the variability of natural organic compounds further complicate use of these materials. In view of the disadvantages and additional costs of organic sources, mineral sources of fertilizers are strongly recommended for plant beds.

YELLOW PLANTS

Excessive rainfall can leach nutrients out of the root zone, resulting in yellow, nutrient deficient plants. Tissue analysis is the only sure way to know the cause of the yellowing, but leaf symptoms can sometimes provide a clue. If the plants show yellowing of leaves and stems on the lowest leaves first, the problem is usually N deficiency. Additional nitrate-N may be applied once plants are dime-sized to maintain desired color and promote rapid growth. Limit application to 0.5 to 1 pound nitrate nitrogen (3 to 6 pounds of nitrate of soda or calcium nitrate) per 100 square yards which is equivalent to 25 to 50 pounds of N (150 to 300 pounds nitrate of soda or calcium nitrate) per acre. If color does not improve within a few days, N deficiency is not the problem. If the whole plant is yellow, sulfur may be deficient, and extra N will not correct the problem. Magnesium deficiency symptoms are similar to those of nitrogen in that the lower leaves turn yellow first; however, the veins of Mg-deficient plants remain green. Magnesium and sulfur deficiencies may be corrected by applying potassium-magnesium-sulfate (K-Mag or Sul-Po-Mag) at a rate of 3 pounds per 100 square yards (150 pounds per acre) or Epsom Salts at a rate of 5 pounds per 100 square yards (250 pounds per acre).

Do not apply fertilizers to wet foliage. Irrigate after application to wash fertilizer material off the leaves. Pelletized materials are less likely to cause leaf burn, but are somewhat slower to dissolve than pulverized materials. When applied properly, either source should be safe and effective.

TOBACCO MOSAIC VIRUS (TMV)

TMV is spread mechanically by handling plants, cultivation, etc. It is favored by excess nitrogen. Symptoms can be quite variable and often disappear in mid Summer. Control is achieved through crop rotation, root and stalk destruction, and careful handling during transplanting as outlined below.

a) Rinse hands with milk prior to each plant handling operation.
b) Do not handle tobacco products or weeds around plant beds during or prior to handling plants.
c) The following varieties could be used where TMV is a major concern: NC 297 or Speight G H20.
d) See section on clipping for mower sanitation instructions.

NOTE: These precautions are important. TMV may not show up until after transplanting at which time precautions are too late. As soon as possible after completion of transplanting, destroy the plant beds.
Table 1. Plant bed Fumigation and Disease Control

<table>
<thead>
<tr>
<th>CHEMICAL AND FORMULATION</th>
<th>RATE</th>
<th>REMARKS AND PRECAUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weeds and Nematodes</td>
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<td></td>
</tr>
<tr>
<td>Methyl Bromide 98%</td>
<td>9 lbs/100 sq yd</td>
<td>APPLY METHYL BROMIDE WHEN SOIL TEMPERATURE IS ABOVE 50°F. Cans: Release gas under plastic covering. Plastic should be raised in the center and sealed around the edges with soil. Leave covered 24 hours. Remove cover 72 hours prior to seeding.</td>
</tr>
<tr>
<td>Methyl Bromide 68.6%</td>
<td>10-12 lb/100 sq yd</td>
<td>Cylinders: Inject into well prepared soil with chisel applicators. Cover immediately with plastic and seal all edges. Leave covered for 48 hours. Remove cover 72 hours prior to seeding.</td>
</tr>
<tr>
<td>Vapam</td>
<td>37.5 gal</td>
<td>A. Spray Vapam on soil surface, incorporate 6&quot; deep with tiller, and cover with plastic tarp all in a single operation as is done with Methyl Bromide. B. After treatment wait 7 days before punching plastic. C. After punching plastic wait 7-14 days before seeding.</td>
</tr>
<tr>
<td>Vapam + Telone C-17</td>
<td>37.5 gal + 10 gal</td>
<td>A. Spray Vapam on soil surface, chisel in Telone C-17, incorporate/seal by tiller (6&quot; deep) behind chisels, and cover with plastic all in a single operation as with Methyl Bromide. B. After Treatment wait 7 days before punching plastic. C. After punching wait 14-21 days before seeding.</td>
</tr>
<tr>
<td>Blue Mold, Pythium Damping-Off, Rhizoctonia Damping-Off and Target Spot</td>
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<td></td>
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<tr>
<td>Dithane DF 1.4-2.4 lb/Acre (0.7-1.2 oz./150 sq yd)</td>
<td>Use as an over the top spray and continue on a 7-day schedule as long as conditions warrant. Spray after clipping.</td>
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DO NOT USE ACROBAT MZ or FORUM IN PLANT BEDS OR GREENHOUSES.

TOBACCO PLANT BED INSECT CONTROL

Insects can cause severe damage in tobacco plant beds. The most common pests in tobacco plant beds are vegetable weevils, tobacco flea beetles, cutworms, and mole crickets. Vegetable weevil larvae chew small irregular holes in the leaves and often feed in the buds and on the stems. Tobacco flea beetles feed on the leaves, leaving numerous small punctures. Cutworms eat small half circles in the leaf margins and cut young plants off near the soil surface. Mole crickets burrow in the upper 2 inches of soil and feed on the roots and stems of plants, uprooting them.

Other pests which cause occasional problems include green June beetle larvae, slugs and snails, aphids, and tobacco budworms. Aphids and tobacco budworms, carried from the plant bed on transplants, can start early infestations in the field. Plant beds should be checked once or twice each week for insects and their damage. Recognition of the insects present, their abundance, and their damage is essential in deciding whether or not to use an insecticide. Recommended insecticides for use on tobacco plant beds are listed in Table 2.
<table>
<thead>
<tr>
<th>INSECT</th>
<th>CHEMICAL AND FORMULATION</th>
<th>RATE PER 100 SQ. YDS.</th>
<th>REMARKS AND PRECAUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphids</td>
<td>disulfoton</td>
<td>9 ozs</td>
<td>Apply granules broadcast just before seeding or over top of small plants - water in immediately. Do not exceed recommended rate.</td>
</tr>
<tr>
<td>(preventive control)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Aphids, Flea Beetles or Vegetable Weevils</td>
<td>acephate</td>
<td>1 tbsp in 1 gal water</td>
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<tr>
<td></td>
<td>Orthene 75S</td>
<td>1 lb/Acre</td>
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<tr>
<td></td>
<td>Acephate 75SP</td>
<td>0.75 tbsp in 1 gal water (12 oz/Acre)</td>
<td></td>
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<tr>
<td></td>
<td>Orthene 97PE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Budworms</td>
<td>acephate</td>
<td>1 tbsp in 1 gal water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orthene 75S</td>
<td>1 lb/Acre</td>
<td>Apply to foliage as needed.</td>
</tr>
<tr>
<td></td>
<td>Acephate 75SP</td>
<td>0.75 tbsp in 1 gal water (12 oz/Acre)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orthene 97PE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutworms</td>
<td>acephate</td>
<td>1 tbsp in 1 gal water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orthene 75S</td>
<td>1 lb/Acre</td>
<td>Apply to foliage in late afternoon or at dusk.</td>
</tr>
<tr>
<td></td>
<td>Acephate 75SP</td>
<td>0.75 tbsp in 1 gal water (12 oz/Acre)</td>
<td>Scatter bait evenly at dusk around margins, walkways and open spaces in bed. Keep off plants as much as possible.</td>
</tr>
<tr>
<td></td>
<td>Orthene 97PE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>carbaryl</td>
<td>0.5-1 lb</td>
<td></td>
</tr>
<tr>
<td>Green June Beetle Grubs</td>
<td>carbaryl</td>
<td>5.5 oz in 50 to 100 gals water</td>
<td>Apply only to uprooted areas of bed.</td>
</tr>
<tr>
<td>Mole Crickets</td>
<td>Acephate and carbaryl 5% B as applied for cutworms gives helpful control.</td>
<td></td>
<td>See remarks under cutworms.</td>
</tr>
<tr>
<td>Slugs and Snails</td>
<td>Metaldehyde 5% B</td>
<td>4-13 ozs.</td>
<td>Scatter bait evenly at dusk around margins, walkways and open spaces in bed. Don't apply directly to plants.</td>
</tr>
</tbody>
</table>
PLANT BED MECHANIZATION

Direct seeding tobacco plant beds has become popular in recent years. Some facts should be noted before one considers direct seeding tobacco beds.

BED PREPARATION

The tobacco bed area should be prepared and fertilized normally. Prior to seeding, the bed area should be worked lightly to provide a firm seedbed. Make sure that the press wheel of the planter makes a 1/2 to 1 inch depression in the bed at seeding. This will cause the plastic cover to rest on the soil, not on germinated seeds. Coated seed must be placed in direct contact with the soil. A concerted effort should be made to interface the soil and seed as much as possible. The seeded bed should be irrigated as normal. Care should be taken not to used large volume sprinklers. Use a combination of high pressure and small nozzle opening in the sprinkler head to produce small water droplets.

PLANTER OR SEEDER

The type of planter to use is one that will drop seed at a uniform rate. Commercial plant growers are using the belt or vacuum type planters.

SEED SPACING

Seed should be spaced 1/2" to 13/16" apart resulting in approximately 35 to 45 seed per square foot of bed. At this seeding rate the estimated plant population for a 100 square yard bed is 30,000 to 40,000 plants.

CLIPPING TOBACCO PLANT BEDS

Tobacco seedlings produced in traditional plant beds vary greatly in size and suitability for transplanting. Because of plant variability, only 10 to 20 percent of the total seedlings in the plant bed are available for transplanting in any one pulling. Tobacco growers often adjust to this shortage in plant availability by allowing more plant bed yardage per acre of transplanted tobacco or by transplanting fewer acres per day. Clipping seedlings increases the uniformity of seedling-height.

FIELD PERFORMANCE OF CLIPPED PLANTS

Studies in North Carolina have been conducted comparing the field performance of plants from clipped and non-clipped plant beds. These studies were conducted over several years at research stations and on-farm tests. Results from the research station experiments showed that yield from clipped plants was equal to and, in some cases, higher than plants from non-clipped plant beds. On-farm tests show similar results.

CLIPPING PROCEDURE

A high-suction lawn or tractor mounted mower may be adjusted to clip at a height just above the buds of the largest plants. This removes portions of the larger leaves from the largest plants and allows sunlight to reach the smaller plants. Growth of the clipped plants is reduced, and the smaller, non-clipped plants can then catch up with the larger ones.

To get the maximum benefit from clipping, mowing should begin when the tips of the buds of plants are approximately four inches from the soil line. Use a ruler to measure the height to the tip of the bud of the largest plants, and adjust the mower to one-half to one inch above that height. Some additional adjustments may be
needed if the soil is wet. After the mower height has been adjusted, mow across the plant bed to be sure the clipping height stays above the buds.

If plant bed middles have been raised or crested to shed water, it is best to start mowing to the immediate left or right of the center. If the mower straddles the center of the raised bed seedlings located on the crest may be clipped too low.

Sanitation is particularly important, if the mower is also used for general purpose mowing in which case it may come in contact with weeds such as horse nettle which serves as an alternative host for tobacco mosaic virus.

HARVESTING

Harvest can be accomplished by hand pulling or utilizing a plant bed undercutter. An undercutter has been used by vegetable growers for many years. It consists of a long, flat, steel blade mounted on each end to a frame. Once undercut, plants can be harvested easily by hand.

BED CLIPPING PRACTICES IN RELATION TO SEEDLING DISEASES

There have not been any disease problems associated with clipping plant beds. There are two practices which will help minimize chances of future disease problems.

1. Removal of clippings from the beds is less favorable for damping-off diseases than allowing them to accumulate on the beds. We would not expect any problems from clippings unless massive quantities accumulated on beds creating a mulching effect.

2. Tobacco mosaic virus (TMV) can be spread very easily by any handling operations. An operation such as clipping can spread TMV throughout a plant bed.

a) Hazards of spreading TMV from outside sources during clipping beds can be prevented by mower sanitation. Any mower that is used to mow weeds around beds should be cleaned before clipping beds. Many weeds such as horsenettle carry TMV. Any mower that is shared among growers or used to clip other plant beds including tomatoes or peppers should be cleaned before use in tobacco beds. Mower cleaning is very simple.

1) Clean all plant residue off the mower.
2) Wash the mower using a brush or rag with a solution of chlorine bleach (50% water & 50% household bleach).
3) Rinse with clean water.

b) If TMV is found in a bed DO NOT clip this bed. No amount of mower sanitation can prevent spread of TMV, if infected plants are in the bed.