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Building Nursery Soils

Ted Bilderback & Richard Bir
Nursery Crop Specialists
Department of Horticultural Sciences
North Carolina State University

Balled and burlap tree growers lose soil due to the nature of the business because soil is sold when trees are harvested and sold. Preventing further loss of soil and rebuilding soil in fields is very important. Perennial field grown nursery crops require three to seven years between cropping cycles. Therefore, nursery professionals need to implement growing practices which maintain and improve soil quality characteristics during un-cropped, fallow periods, as well as during field preparation for planting and even during the production cycle.

The term ?soil quality@ is the fitness of a specific kind of soil to function within its surroundings, support plant and animal productivity, maintain or enhance water and air quality and support human health and habitation Soil quality information is available from the Natural Resources Conservation Service on line at http://www.statlab.iastate.edu/survey/SQI/sqiinfo.shtml

The health and productiveness of soil is a concern for field nurseries. Loss of soil and nutrients from fields may be the largest concern for nurseries. Environmental conditions such as wind and rain storms are responsible for major losses, however farming practices such as frequent tillage results in loose soil that blows and washes away and in soil compaction which reduces water penetration and moisture holding characteristics but increases formation of gullies. Frequent tilling can also reduce soil microbial activity which contributes to soil and nutrient loss from fields.

Conservation efforts are needed to reduce soil and nutrient loss from wind erosion and stormwater movement off site. Soil stabilization and erosion control best management practices include: planting across slopes and contoured layout of fields, use of cover crops for fallowing land, use of vegetation in aisles, row ends, drive roads, field border strips, grassed waterways, sediment dams in waterways, bio-swale collectors, wetlands and irrigation practices that do not increase erosive ditches or the need for tilling due to weed germination stimulation.

Most practices to reduce soil loss involve planting and maintaining vegetation cover in fields as well as growing nursery crops. Growing cover crops may be one of the most important management tools to improve soil quality. Use of cover crops on soil that would otherwise be barren particularly during the first year of production and during the last year of production can significantly reduce soil loss. Cover crop rotation should also be considered. Planting hybrid sudan grass in large fallow areas during summer months followed by planting dwarf barley as a winter cover crop can reduce sediment and nutrient loss. Grasses and small grains can also be used in a double cropping system. Small grains can be sown in the fall then killed with herbicide or plowed in before they produce seed in the spring (Table 1). Sorghum-sudan hybrids and even corn are commonly used as the summer cover crops. Sudan grass is mowed at least twice to prevent seed formation, then plowed under in the fall.

Covering the surface of the ground has a direct effect on reducing soil loss, and numerous other benefits occur when cover crops are used during field production. However, increases in the organic matter of soils may not be one of the benefits as most nursery professionals may assume. One of the most important physical property improvements is increased size of soil aggregate fractions in the 1-2 mm size range. An increase in the larger aggregates facilitates water infiltration and retention and provides a better biological habitat and a better rooting environment. Direct links can be demonstrated between the number of resident fungivores and macropredators and cover cropping practices. Fungivores regulate the rate of nutrient mobilization while macropredators density has been correlated with pest control. Arthropods and earthworms also appear to be stimulated by cover cropping. Deposition of green manure cover crops on soil surfaces has been shown to support high populations of mites which are bio-control agents. Results of the studies have indicated that regular incorporation of organic residue is needed and that these improvements can be lost quickly under conditions of frequent tillage.

Vegetative filter strips between the production site and surface waters are considered best management practices for reduction of off site movement of soil and nutrients. To be effective, filter strips should have no less than 70% surface cover and be at least 12 feet wide. Cool season grasses used as filter strips are most effective during critical erosion periods in fall, winter and spring seasons when rain is frequent and during excessive storm run-off events. Use of filter strips reduce turbidity and collect sediment and nutrients by trapping and binding of fertilizer to the vegetative matter in the filter strip.

Field nurseries often are located on land with gentle slopes where sediment loss potential is high, particularly if vegetation is sparse. The use of stormwater ponds and wetlands as natural filters can be used to provide even greater retention of sediment and nutrients than can be accomplished with filter strips. However, depending on surface cover, slope and environmental factors, such sediment retention basins require cleaning possibility as often as every 2 years.

Selection of best management cultural production practices also reduce soil and nutrient losses from field nurseries. Fertilizing and irrigation practices can have great direct and in-direct effects on soil and nutrient losses. Cover crops as well as nursery crops require plant nutrients, therefore under fertilizing can reduce growth and coverage, increasing soil loss. Over application of fertilizer can result in environmental impacts. To implement an appropriate fertility program, soil testing is mandatory. Application of any animal wastes, sludges, or cover crops should be considered by soil sampling after any supplements have been incorporated into the field soil. Thereafter, all nutrients applications should be incorporated into the field soil according to soil tests. Dolomitic limestone for pH adjustment and as a calcium and magnesium source should be incorporated as specified on the soil test. Phosphorus should also be incorporated into the soil at rates specified as well as potassium and any minor element supplement required. If nitrogen is required as indicated on the soil test, generally 50 pounds of nitrogen per acre can be incorporated as a pre-plant supplement to provide nitrogen for the first year requirements of field stock.
Higher rates of nitrogen may actually reduce root growth. In subsequent years, only nitrogen should be required for plant growth if other nutrients were applied as indicated on the soil test. Nitrogen fertilizer application rates are usually based upon pounds of nitrogen per acre.

An area rate recommendation for a field grown nursery would result in the same amount of fertilizer being applied to a field with 450 trees at wide spacing as a field with 1360 trees at close spacing. A better method of determining how much nitrogen to apply in subsequent years after planting is to recommend rates on a per plant basis. Therefore, nitrogen should be applied in at the rate of 0.5 to 1.0 ounces of nitrogen per plant for the second year of producton. If field grade fertilizers are applied, this rate should be applied in split applications, applying 2 two-thirds of the rate before bud break in spring and one-third in June. The third and later years, rates may be increased to 1.0 to 2.0 ounces per plant depending upon the vigor of the species of nursery crop. The fertilizer can be applied in a band as a side dress, but the rate accounts for the number of trees rather than the area of the field. Rates should not exceed 100 to 200 pounds of N per acre per year.

Drip irrigation is a low volume, low pressure system and does not cause irrigation water run off from fields as can occur with large irrigation guns. The biggest advantage of using drip irrigation is that water is placed at the root system of the crops in rows. A large benefit is that weeds are not germinated by water distributed over large areas as with overhead irrigation. Widely distributed water increases weed pressure. Less weed competition can increase the effectiveness and reduce costs of pre-emergent herbicides and directed post-emergent herbicides management programs, which also reduces the need for frequent tilling. Since drip irrigation is in place and it can be used regularly to keep plants growing. Less pruning to re-establish leaders in trees is an advantage of irrigating crops when they need water. On new field stock, it may make the difference between few or moderate to large loss of new liners.

Drip irrigation also provides a very efficient and environmentally safe method for fertilizing field grown nursery stock. The amount of fertilizer to use when fertigating is determined by applying one-half what would be applied top-dressed with granular fertilizers. Less fertilizer can be used to actually produce more growth because of the increased efficiency of fertigation. More fertilizer is likely to get to the plant when fertigating than when granular fertilizers are spread on the soil surface.

For example: If you have a crop with 1200 plants per acre that would normally get 0.5 oz. of nitrogen per plant, you would use half this (0.25 oz N/plant). Further calculations are as follows:

1. The number of plants per acre multiplied by the amount of fertilizer needed equals the amount of fertilizer needed per acre.

   1200 plants/acre X 0.5 oz. N/plant = 600 oz. N per acre.

2. One-half of 600 oz. is 300 oz. of Nitrogen (600/2 = 300). If the source of nitrogen is ammonium nitrate (34-0-0), approximately 900 ounces of ammonium nitrate per acre (300 oz of N divided by 0.34N in ammonium nitrate equals 882 oz) is required.
   Since there are 16 oz./pound, that's about 56 pounds of ammonium nitrate (900/16=56) are required to fertigate 1200 plants.

3. Fifty-six pounds of ammonium nitrate is to be applied over a period of eight weeks. Therefore, 1/8 is applied each week. To determine how much to apply, divide the total by the number of times fertilizer is to be applied. (56 divided by 8 equals 7). Dissolve seven pounds of ammonium nitrate in water then inject this nitrogen stock solution through the irrigation system.

Fertigation Procedures:

1. Fully charge the irrigation system. When the system is fully charged, water should be coming out of the emitter farthest from the injection point. Record the amount of time required from when the irrigation is turned on until water is flowing from the farthest emitter, then add a couple of minutes safety margin. Using this figure each time you fertigate can save time walking to the end of the system each time you fertigate.

2. Begin injection. The length of time required to inject the fertilizer should be at least as long as it took to fully charge the system.

3. After all fertilizer solution is injected, run the system for at least as long as it took to charge the irrigation system so you are sure all fertilizer solution has been flushed from the system. This is a good time to walk the system to make sure emitters are not clogged.

Table 1. Choices that Could be Planted for Cover Crops

Species	Seeding Rate bushels/acre pounds/acre	Weight pounds/bushel	Planting Date
Barley	2.0	48.0	Aug.-Oct.
Rye (annual)	1.5	56.0	Aug.-Oct.
Ryegrass (annual)	2.0	24.0	Aug.-Oct.
Oats	1.5	32.0	Aug.-Oct.
Buckwheat	1.5	45.0	Aug.-Oct.
Wheat	25.0 lbs./A	60.0	Aug.-Oct.
Crimson Clover	20.0 lbs./A	60.0	Aug.-Oct.
Sorghum-Sudan	25.0 lbs./A	50.0	April-May