Irrigation of Field Grown Nursery Stock

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This presentation will highlight common irrigation distribution problems in container nurseries and discuss "Best Management Practices" which improve irrigation efficiency. Well design irrigation systems save water supply resources, electrical power used to pump irrigation supplies and reduce handling practices required to capture and recycle irrigation supplies. Additional information and presentations related to this subject can be found on the NCSU Nursery Science Website.

Design your irrigation system while planning your field layout and planting strategy. Plot where main lines will be laid. Determine the best direction for field planting rows based upon topography, wind direction and soil characteristics.

Assess the field nursery site for best design and layout of the field nursery. Consider topography of the site. Nursery rows should be planted on contours with rows running across slopes. Main irrigation lines should be installed in ground at the ends of fields. Pressure compensation emitters may be required if elevations are significant running across slopes. Nursery rows should be laid out at appropriate distances for market sized plants. Aisles and roads should be planted with turf type grasses when fields are to be planted in fields with slopes. Erosion prevention techniques should be planned including sediment retention structures and rip rap where erosive channels could develop. Irrigation resources should be planned for field production sites where irrigation structures or wells are conveniently located for irrigation.

Surface water supplies and pump stations need to be conveniently located close to fields and must be considered in planning strategies for layout of the field nursery.

Surface water from rivers or ponds requires costly sand media filters to prevent plugged emitters in low volume drip irrigation systems. Consequently, surface water can be used with overhead irrigation systems with less expense for filtration and irrigation system design compared to drip irrigation systems.

Wells as a source of water for irrigation is generally a cleaner water supply but may require specific types of filtration or treatment. Water quality tests are required to determine irrigation suitability. Sediment or turbidity can be a problem in shallow wells. Bicarbonates and iron are common mineral impurities in well water sources. Location of water sources and water quality knowledge are major considerations for the planning the layout and development and costs related to starting a field nursery.

Electricity may or may not be available at field nursery sites. Drip irrigation systems only require small motors and low volume pumps as seen on the left of this slide, therefore availability for electrical service is preferred. In comparison, over head hose real and gun systems are often powered by large diesel motor driven pumps and can be operated in remote areas without electrical service.

Large hose pull and over head gun irrigation systems require a power source and pump that can supply as much as 250 gallons per minute at 80 psi for overhead irrigation of nursery fields. The entire field is irrigated as compared to drip irrigation which only applies water down crop rows.

Water supplies must be substantial since at least an acre inch (27,000 gallons of water per acre) is applied during each irrigation cycle. An estimate of the quantity of water available from a surface water supply such as a pond can be calculated. Measure or estimate the surface area and average depth of the pond [Length x Width x Depth = _ cu. ft. or the Area of a circle (π x r^2) x average depth = cu. Ft.] . The volume in cubic feet multiplied by 7.5 [number of gallons of water per cubic foot] equals the approximate storage volume of pond.

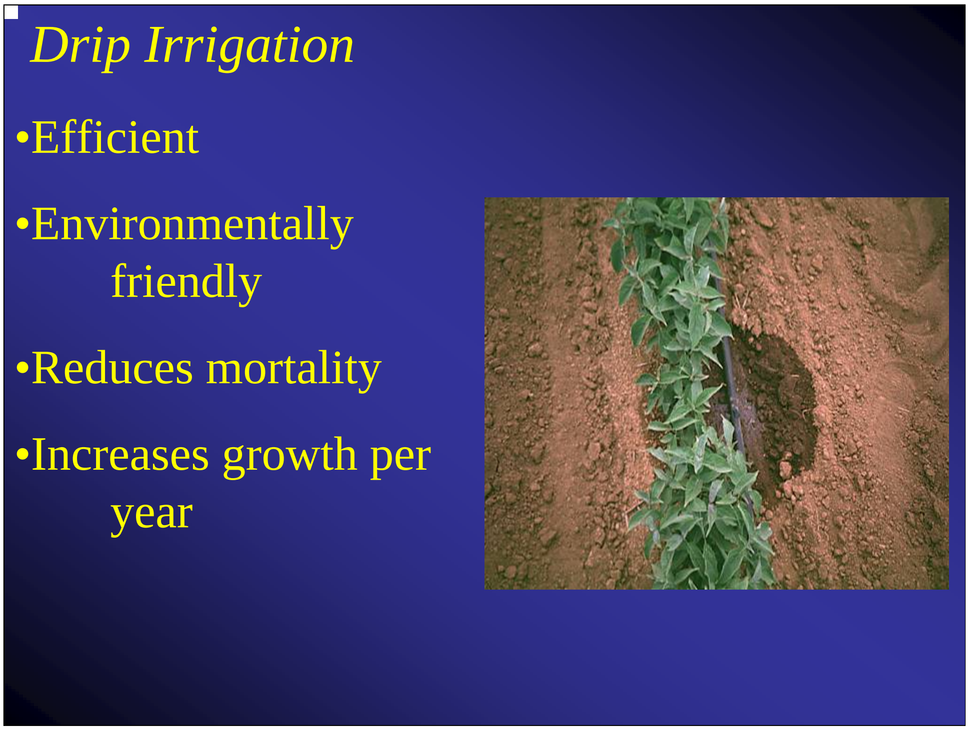
Irrigation main lines should be buried in fields for overhead and/or low volume irrigation systems. Hook up terminals should be conveniently located for distribution of irrigation to production rows. Irrigation layout and design should allow for draining main lines to avoid freeze damage during winter months.

Overhead moveable pipe sprinklers systems may require 50 gpm

One advantage of moveable aluminum pipe irrigation systems is that they can be used for multiple crops or multiple fields. A disadvantage is that they cannot be in all fields at one time, therefore during drought periods all crops may be moisture stressed but only crops that are located where the irrigation system is located receive irrigation. Conversely, drip irrigation is installed in fields for the production cycle of duration and can be operated on a scheduled cycle so that all crops are irrigated during drought periods.

Over head irrigation systems apply water to the entire surface area of a field. Consequently, weed seed germination and weed management requirements are increased compared to drip irrigated field nurseries where irrigation is only applied down crop rows.

Permanent mains have been installed for drip irrigation of field stock. The irrigation system can remain in place for the duration of the 3 to 7 year production cycle. Irrigation layout and design should allow for draining main lines to avoid freeze damage during each winter.



Drip irrigation is a very efficient method to irrigate field grown nursery crops. For new liners, drip irrigation can reduce mortality not only because water is applied to the root zone, but also because it is in place and can be operated when needed in contrast with many overhead irrigation systems such as hose pull or aluminum pipe irrigation systems which must be set up before operation. Delays in applying irrigation can me less growth or higher mortality of crops.

- Where long distribution lines are required or when the field has uneven terrain, pressure compensated emitters can be purchased to provide even distribution of water.

Solid ½ inch polyvinyl plastic tubing is frequently used for drip irrigation distribution lines.

Emitters may range in application rates of ½ gallon to 5 gallons per hour depending on soil type and infiltration rates. Rate of irrigation application is design to reduce surface pooling and runoff over the surface of the soil.

One or two drip emitter buttons are installed in the solid drip tubing adjacent to tree stems. For sandy soils, spray emitters may be used rather than drip emitters to wet a larger surface area since sandy soils may have very high infiltration rates and limited lateral spread of irrigation when drip emitters are installed.

Buttons or spray emitters installed in drip tube requires considerable labor and may prove to be more expensive and less convenient than buying irrigation tubing with factory installed emitters.

Spray emitters inserted into drip distribution lines or spray stakes connected with spaghetti tubes to the distribution line provide a wider distribution pattern for sandy soils where infiltration rates may be too rapid to provide lateral movement from drip emitters.

For very large nursery stock, some nurseries may use spray stakes to apply irrigation to larger areas that correspond to the root distribution of the trees being irrigated.

In line drip irrigation emitter tubing has become a standard for field production since labor for installation of drip buttons is no longer required. In line emitter drip tube can be purchased with various spacing of emitters such as 12, 18 or 24 inch spacing between emitters and flow rates from ½ gallon per hour to 5 gallons per hour, based upon spacing of nursery crops and soil infiltration rates.

Drip tubing shown in this picture applies 0.6 gallons per hour. Emitters are spaced at 24 inches along the drip tubing.

In line drip tubing applies water along the drip tube creating a wet zone down the length of the drip tube.

Drip tube applies water down the length of drip tube in the nursery row. The wetting front spreads across the nursery row and downward into the root zone of the field grown nursery crops. Irrigation should be applied until the irrigation wets to a depth of the root zone, minimally 6 to 12 inches deep in the field soil depending on the depth of the top soil and root growth. A shovel can be used to dig between trees to determine the depth of wetting to determine the amount and time of irrigation required to sufficiently irrigate crops.

Bark amended beds and drip irrigation produces fast root and top growth compared to field soil only

Nursery beds created by incorporating organic amendments such as pine bark, yard wastes and composts create moisture and aeration characteristics similar to container production but high root zone temperatures and wide fluctuations of moisture levels experieced by container grown plants is avoided. Drip or low volume spray stake irrigation systems are ideal for bed production of nursery crops.

Drip irrigation requires clean water to avoid plugging of tiny emitter orifices. Well water is generally considered to be a cleaner water supply than surface water. Wells may be free from sediment and particulates, however minerals such as iron and bicarbonates can cause plugging and may require treatment for use in drip irrigation systems.

A sand separator and a screen filter are required for removing sediment from this well water supply before the water can be used in a drip irrigation system.

Drip Irrigation

- Drip provides the ability to FERTIGATE with irrigation, placing fertilizer at the roots of crops in the row.
- Fertigation is an environmentally conscious method to raise field grown nursery stock

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Fertigating Field Grown Nursery Crops

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Fertigation is the process of applying water soluble fertilizers to plants through a drip or trickle (low volume) irrigation system. Drip or trickle is the only irrigation system available that applies fertilizer solutions efficiently enough to be used in field nurseries. While it is possible to inject fertilizer into overhead systems, problems with fertilizing areas other than crop plants plus potential nutrient runoff make fertilizing through these systems impractical. Because drip irrigation systems depend upon tiny openings for the delivery of water to plants, totally soluble fertilizers must be used as well as fertilizers that will not precipitate to form solids in the irrigation lines. Otherwise lines will become clogged. All irrigation systems through which any chemical is applied must be equipped with proper backflow prevention. Not only is this a good idea, it is the law.

Injectors: Almost any system that can inject a solution into a water line can be used to inject fertilizer into a drip irrigation line. However, the injectors that have become most popular are those that are operated by water pressure rather than electronically. For smaller systems, a venturi-type system can be used which draws fertilizer solution from a tank by differential pressure. The most common of these is the "hozon." Nurseries larger than 0.5 acres will probably be better served by systems that use water to drive a piston pump or hydraulics to draw fertilizer solution from a tank because of their far greater capacity and dependability.

Fertilizers: Little research is available as a guide in determining how much or how often fertilizer should be applied to woody nursery crops. Currently, we are suggesting the soil be analyzed and needed nutrients including minor elements, calcium, magnesium, phosphorous and potassium be applied when tilling the soil in preparation for planting. By doing this, the only fertilizer that should be needed will be nitrogen. In areas where soils or special needs of the crop dictate other nutrients are required, they may be used.

Drip Irrigation for Field Grown Nursery Crops

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Drip or trickle irrigation has increased rapidly in popularity since the 1960s, due to improvements in plastics and plastic manufacture, and in the last decade new technology has increased the adaptability and efficiency of low volume/low pressure irrigation. Two major factors have influenced the conversion of nurseries to drip irrigation: (1) Water resources must be used more efficiently as demands on fresh water increase, and (2) Research has demonstrated that some crops can be produced more rapidly, with greater uniformity and less plant loss during the first year and more roots

more efficient in supplying water to roots and will result in a greater number of roots being produced in an area where they will be harvested and sent to the customer. When irrigating through drip irrigation, water is delivered very gradually, at rates approximating 1 gal. per hour per emitter rather than the gallons per minute delivered by some overhead systems. For this reason, drip must be run for a longer period of time than overhead to adequately irrigate a crop. Water is delivered through small tubing at low pressures so that clogging of the system by any kind of suspended particles is much more likely to occur.

Factors to consider: When deciding to use drip irrigation, ask yourself what you expect from the irrigation system. By asking a few questions before you purchase and install a system, major expenses, frustrations and disappointments can be avoided. For example, if you expect to get frost protection from irrigation, drip irrigation will not work. If you expect to feed liquid fertilizers or pesticides through

Drip irrigation systems provide an efficient and environmentally friendly method for fertilizing field grown nursery stock since water and nutrients are deposited at the root system and are not likely to contribute to nutrient loading of public watershed if the drip system is operated correctly.

Wells as an irrigation source in field nurseries offer the additional opportunity to apply fertilizer through the irrigation system [called fertigation]. Soil tests are recommended at the beginning of each production cycle. The field is amended according to the nutrient requirements indicated in the soil test. Therefore, nitrogen may be the only (or primary) nutrient required and can be injected through the irrigation system. Two back flow check valves are required by most states for fertigation practices.

Water treatment may be required for irrigation sources that have high bicarbonates or other mineral impurities. Sulfuric acid requires injection pumps specifically designed for injection of acids. A water analysis is required to determine the amount of sulfuric acid required to neutralize the bicarbonate levels to prevent plugging of drip emitter orifices.

Components for irrigation of field grown nursery stock may include a well, a backflow preventer, an irrigation controller, a sand separator filter and inline screen filter, pressure gauges in front and behind filters, a fertilizer stock tank, a fertilizer injector, main lines, and distribution lines with in line emitters for application of water and fertilizers at the root zone of plants in each row.

A liquid fertilizer stock tank and injector can be installed for application of fertilizer via the drip irrigation system.

Liquid Fertigation Application

- Apply 1/2 rate of N/ year as Dry Granular Fertilizer
- Rate= 750 plants / A x 1 oz N / A/yr =750 oz N/A
  - If use Ammonium Sulfate (21-0-0) = 750/ 0.21 = 3571 oz/16 oz/ lb = 223 lbs/A/yr
  - If Fertigate 5 times / year = 223 lbs NH_4SO_4 / 5 = 56 lbs in stock solution /irrigation

Steps for application of fertilizer through the irrigation system include calculating the amount of fertilizer to be applied per growing year based upon the number of plants per acre (versus a standard rate such as 200 lbs of N per acre which does not account for planting densities such as 750 plants per acre compared to 1250 plants per acrea). In this example ammonium sulfate is used for fertigation. Ammonium nitrate which previously was frequently used for fertigation is difficult to purchase. Although ammonium sulfate is somewhat less soluble than ammonium nitrate, ammonium sulfate is a reasonable alternative for fertigation.

Because drip irrigation applies water only to the root zone of the nursery crop, roots tend to concentrate within this wet zone.

Digging drip irrigated nursery stock is often easier than overhead or un-irrigated nursery stock. Since more roots are harvested the survivability after sale may be higher.

Plants irrigated by drip irrigation tend to concentrate roots in the irrigated zone and result in more roots harvested compared to over head irrigation.