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THE NEUSE STARTS HERE

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"The Neuse Starts Here" is the message on an aqua blue arrow-shaped sticker that is passed out at meetings where the proposed rules for this nutrient sensitive watershed are discussed. The stickers are now seen on many bathroom walls around the NC State Campus. I guess bathrooms are where they are supposed to be pasted to remind everybody living in the watershed that we all are a part of the problem and a part of the solution too. It's the actions we take to reduce nitrogen deposition into the Neuse that will make the difference. We need to employ practices such as planting vegetative strips where runoff flows. Other practices include calibrating fertilizer spreaders and not exceeding recommended rates of fertilizers when applying to lawns, landscape beds and crops.

Why the Neuse? The Neuse river watershed is totally from start to finish in North Carolina; "Ours to Wreck" I guess. The Neuse is unique due to its history, world wide media attention and because the proposed rules are the first anywhere in the U.S. that will require non-point sources including agriculture to make changes. Some rivers have certainly had songs written about them but few have had a book that discusses trouble between state agencies and scientists with titles such as "And the Waters Turned to Blood". The story line has a mysterious villain called *Pfiesteria*, that has been coined the "Cell from Hell". If you are ever bored while surfing the net just search for one of these terms and you will get plenty of sites to visit. Interviews about the Neuse and *Pfiesteria* have hit People Magazine, U.S. News and World Report and several talk shows. There has even been discussion of a movie starring Jodi Foster.

Flow rate in the Neuse as it enters the estuaries is the major difference between the Neuse and rivers such as the Cape Fear which rapidly flows from it's mouth to the ocean. In 1887, a law was passed prohibiting throwing dead animals into the Neuse and it's tributaries. In 1951 a survey was initiated to study the river and in 1959 a report found the water down stream in the river to be low in quality. Eutrophication (low oxygen, and algal growth) were problems in the 1970's. In 1983 the river was classified as a Nutrient Sensitive Watershed. In 1993 a basin-wide

management plan was developed. In 1995, three fish kills caught the news media and legislators attention. In 1995, the N.C. Environmental Management Commission (EMC) was directed to come up with a plan to reduce nutrient loading in the Neuse estuaries. Public hearings were held on the proposed rules in 1996 and the rules were approved by the EMC in December 1997.

To my knowledge nothing is really certain regarding implementation. However, the rules were forwarded to the Rules Review Commission in January 1998. It is assumed that rules very similar to those approved by the EMC will be enacted sometime this summer, probably in August 1998, regardless of General Assembly action or inaction. If rules for the Neuse are enacted, implemented, and some degree of success is accomplished, there is no secret that the other 16 watersheds in North Carolina will most likely see similar practices introduced within 5 to 10 years. Many other states are also closely watching and have attended Neuse River Conferences so a lot of changes could be upcoming in watersheds across the country. Lots of efforts, jobs and operating capital are being directed at the Neuse to create positive results. For starters, 10 Neuse River Regional Extension agents and 10 Soil and Water Conservation agents will be or have been hired to assist in educational programs, research and demonstration projects. Their job will be to help identify and implement best management practices (BMP's) to meet a 30% (of 1991–1995 levels) nitrogen loading goal.

Extensive comments received on the proposed rules during public hearings in 1996 resulted in changes in the revised rules. Industries, municipalities and agriculture will be required to make the greatest efforts in reducing nitrogen loading in the Neuse River watershed. All discharges of more than 0.5 million gallons daily will have to optimize their facilities for nitrogen reduction. New facilities for waste treatment must cut nitrogen levels from current permit levels of 10 mg/L (ppm) to 3.5 mg/L and from 2.0 mg/L phosphorus to 1.0 mg/L P. One of the most likely techniques available to cities and industries to accomplish this will be construction of wetland areas to serve as vegetative filters and reduce nitrogen before it is discharged off-site. Storm water treatment from new construction will have considerably more environmental requirements for sediment retention systems and 50 foot undisturbed and continuous riparian buffers will be required along any natural conveyance. Ten cities and five counties will be required to retrofit storm water nutrient discharge systems. They will use techniques such as reducing channeling through riparian areas and establishing wetland filters for storm water nutrient reduction.

Consistent throughout all hearings and meetings regarding this nutrient sensitive watershed has been the .0233 rule: Protection and Maintenance of Riparian Areas. "Intermittent streams, perennial streams, lakes, ponds and estuaries as indicated on the USGS 1:24,000 scale topographic maps require riparian buffers to be maintained. If no riparian buffer exists, then sheet flow and avoidance of channeling and erosion should be achieved. Livestock ponds and irrigation basins are exempt as well as man-made conveyances (ditches: but subject to review). If ditches do create channels through riparian areas, nutrients, sediment loss and sheet flow rather than channeling through the riparian area should be achieved to the fullest extent possible. The protected riparian area is defined by two zones. Zone 1 is an undisturbed area of forest vegetation beginning at the top of the bank and extends landward 30 feet on all sides of the water body. This zone consists of natural vegetation, with minimal soil disturbing activities and no fertilizer application. Some tree removal activities would be allowed. Zone 2 is a 20 foot area described to consist of dense ground cover composed of herbaceous and woody species. Limited harvest of timber, nuts and fruits is allowed in this zone but limited soil disturbance and no fertilizer application are limitations in this area. Dispersal of runoff in sheet flow into the riparian area is required."

The .0238 rule is the Agricultural Nitrogen Reduction Strategy. Agriculture has been given a goal to achieve a collective reduction of 30% total nitrogen from the 1991–1995 nitrogen loading concentrations. Agriculture is being held responsible for what is actually a total rural contribution including nitrogen from septic tanks. Septic tanks are the only primary source of nutrients not specifically covered in the Neuse River plan. There is no mandate that nitrogen from septic tanks be reduced to the 30% level previously mentioned. Even though septic tanks may be major contributors to nitrogen pollution, apparently further regulation seems too difficult except under local conditions.

Agricultural operations are given two options under the .0238 rule. The first option is to sign up and participate in a collective local strategy for agriculture nitrogen reduction. The second option requires the implementation of standard Best Management Practices. Greenhouse and nursery growers will generally have to take Option One. The "standard" Best Management Practices recognized for agriculture currently are limited to riparian buffers and/or nutrient management plans and/or water control structures used in irrigation management plans. Although all of us recognize a whole set of Best Management Practices for the greenhouse industry that relate to nutrient and water management, they currently would not qualify as standard BMP's. We as an industry, all of us, will be involved in a large educational effort to illustrate and discuss our BMP's with state and local committees that will conduct the Option One local strategy for nitrogen reduction.

The .0238 rule creates a Basin Oversight Committee. Membership in the committee will be one representative from the: ① Division of Soil and Water Conservation, ② USDA- Natural Resources Conservation Service, ③ N.C. Department of Agriculture, ④ N.C. Cooperative Extension Service, and ⑤ Division of Water Quality (DEHNR); and one member with environmental interests, one member representing agriculture and one member of the scientific community related to expertise in water quality. Memberships will be 5 year terms. The responsibilities of this committee are extensive including: accountability of methodology, approving BMP's, calculating separate total N loading, tracking progress, allocating nutrient budgets to local strategy reduction committees, and writing accomplishment reports. Local Strategy Advisory committees are also created with this rule. Membership of these committees will be composed of local county or watershed members of the same agencies and at least two local farm representatives. Members will serve 5 year terms at the pleasure of the Environmental Management Commission and Soil and Water Conservation Commission. Duties of the local committees are also extensive. They will conduct a sign up for the local nitrogen reduction strategy during the first year of implementation of these rules. They will develop local strategies and a matrix of BMP options which account for stream order, flood plain width, regional variations in soil type and topography. The local strategies will specify the name and location of participants in the "local strategy". They will list BMP's of each plan; estimate nitrogen reduction; and schedule BMP implementation, operation and maintenance required to attain a 30% N reduction. This committee will prepare annual reports listing BMP's implemented, costs, estimated nitrogen loading reduction. The report will be submitted to the Basin Oversight Committee.

Greenhouse operators along with other farming operations who sign up the first year to be a part of the local strategy must commit and implement any contracts or agreements with the local committee to reduce nitrogen loading by 30% within 5 years. Participants in the local strategy cannot withdraw during the five year period or they will be required to meet more stringent standard BMP's.

There are approximately 150 wholesale greenhouse and nursery operations in the 17 counties of the Neuse watershed (Figure 1).

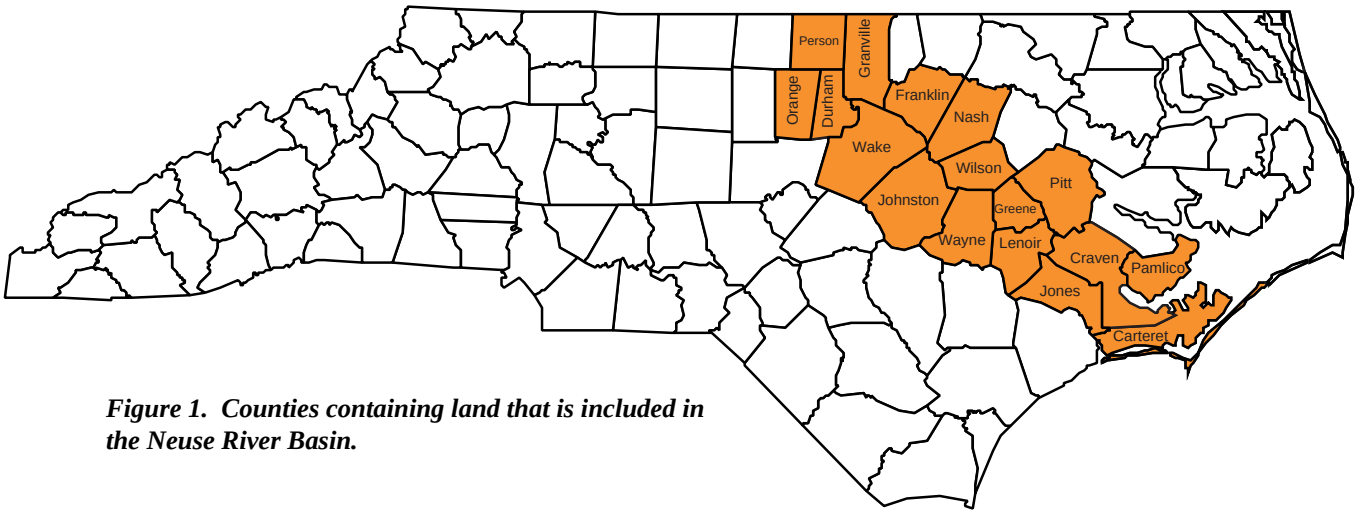

Figure 1. Counties containing land that is included in the Neuse River Basin.

Several counties including Craven, Durham, Franklin, Johnston, Lenoir, Pitt, Wake, Wayne and Wilson have many greenhouses and nurseries that are a large part of the agricultural economy. Some greenhouse and nursery owners may find it in their best interest to get involved with their local committees, either by seeking membership, or sharing information about the uniqueness and environmental stewardship practices used by our industry with members of the local committee.

The greenhouse and nursery industry may be able to take advantage of the Neuse River Rules. Although about 15 nurseries in North Carolina specifically grow wetland crops, it would seem that there will be more demand for various wetland and aquatic plants than can be met. Cities, DOT, industry and agricultural operations may choose constructed wetlands as their primary method of reducing nitrogen loading. Aquatic plant production areas at nurseries and greenhouses can take the form of constructed wetlands. Irrigation runoff from beds and houses can be directed via sheet flow into collection basins. The canals can be wide and lined with 6 mil plastic and ground cloth. Trays or pots filled with wetlands plants can be set across the canal bottom. Stream flow velocity and depth can be controlled using a weir or gate just before it enters the collection basin. Most aquatic plants grow well in 4 to 6 inches of water. A large variety of herbaceous and woody wetland species could be produced.

The greenhouse and nursery industry will obviously have to use BMP's to comply and reduce nitrogen loading in the Neuse river basin. The SNA Best Management Practices Notebook arrived just at the right time for greenhouses and nurseries in the Neuse river basin. This publication is well written and has impressed all of the members of agencies that I have provided copies to. (The same agencies mentioned below that will form the Basin Wide Oversight Committee and Local Advisory Committees). EPA Region IV followed the development of the manual and provided input so we feel that the BMP Manual does have merit. Most of the BMP's in the manual are focused on improving irrigation efficiency, reducing volume and managing irrigation runoff, sediment control, and good fertilizer and fertility practices. If you have not purchased a copy of the manual, the NC Association of Nurserymen has copies for sale. If you have not had time to look at a manual consider scheduling some time to read through it; these BMP's can save you money whether you are in the Neuse River Basin or not. An NCAN committee, composed of nurserymen with businesses in the Neuse river basin developed a list and credits for BMP's in 1996. This document may also be useful as a review of what practices

are good environmental and economic BMP's. I am currently recommending that greenhouses and nurseries in the Neuse River Basin begin putting together a notebook on their BMP's they practice or could practice. Collecting runoff samples routinely, say monthly and having them analyzed might also be useful in the future. If the rules are implemented as they currently are written, every nursery and greenhouse in the Neuse river basin will host a local committee some time within three years after enactment and will need to demonstrate and show local committee members the BMP's that are in place or can be put into place. However, nurseries and greenhouses in the Neuse River Basin should probably not invest a lot of expense implementing improvements immediately. Make a notebook on BMP's; record keeping and monitoring is enough for now. Local committees may require specific changes, and these changes may qualify for cost share monies, so don't get in a hurry to make capital investments into BMP's just yet.

From discussions that I have attended recently, I feel our BMP's address and provide techniques that will reduce nitrogen loss from greenhouse and nursery operations. Certainly, catch basins provide the best means of reducing nutrient loss. However, I have now realized that they are not 100% effective. The reason is that catch basins catch surface water, but are only partially effective for protecting shallow ground water. Much discussion about riparian buffers and water control structures revolves around shallow ground water. Water control structures which keep winter water tables high in fields facilitate denitrification in the ground water 18 to 36 inches below the surface, particularly in fields in the lower coastal plain. Riparian buffers are effective in lower, middle and even upper coastal plain areas because tree roots provide a carbon source to feed denitrifying bacteria which reduce nitrogen in the water before it reaches the streams. Certainly growing beds and greenhouse floors that have a plastic lining under gravel or ground fabric prevent nitrogen from getting into shallow ground water below beds and greenhouses. If the drainage ditches are wrapped with the same plastic and fabric they too would prevent N deposition. Our capture basins could be lined, but a better alternative on new construction of collection basins might be to make sure they are not located on the property line or close to a stream edge. Locate them at least 50 feet in front of these boundaries. The overflow then could be sheet flow directed through a wetland area and should appease any concern regarding nitrogen contamination of shallow ground water.

Another consideration as we go through this process is that if changes need to be made at greenhouse and nursery operations to reduce runoff, funding may be available. The cost of constructed wetlands, development of riparian buffers, or creating sheet flow from first order ditches may be eligible for cost share money. The EMC has proposed that commercial fertilizer products be levied to provide cost share money. Up to $47 million dollars may be available for agricultural cost share projects in the Neuse River Basin. As much as 75% of the cost of some projects may qualify for support. Once installed, the BMP's must be maintained through the life of the contract. Most cost share monies will be administrated by the Division of Soil and Water Conservation, which has offices in every county.

One more rule, .0239 : Nutrient Management also affects the greenhouse, nursery and landscape industries. This rule requires nutrient management training or development of nutrient management plans for any applicators or businesses including row and vegetable crops, floriculture, ornamental and greenhouse production areas (not total land area) that comprise at least 50 acres. The first option, training, will be developed by the Division of Water Quality and N.C. Cooperative Extension Service. The training and the certification will be much like pesticide applicators training and recertification. Successful completion of a test will be required for certification. This training will be mandatory for any operation or person that applies fertilizer

to over 50 acres of production area. If training is not completed within 5 years, a nutrient management plan will be mandatory for each location or business comprising the 50 acres. This nutrient management plan format has not been developed for the greenhouse and nursery industry, but it will follow a format designed for other agricultural commodities.

So when will we know the Neuse is fixed? Nitrogen levels in the Neuse will be monitored over the next 5 years. Years with high rainfall and high flow levels will be compared to years from 1991 to 1995 with high flow. Low flow years during the next 5 years will be compared to low flow years between 1991 and 1995. Reductions will be noted but populations of flora and fauna will also be used to assess the river's health and degree of recovery.

To the best of my knowledge, these are the issues and the status of the Neuse River Nutrient Sensitive Watershed proposed rules. It will be important for nursery and greenhouse professionals to **get involved** at the local and even possibly the state level. We are a very different type of agriculture than production of field crops or livestock. Most people, particularly people who will be on committees as representatives of government agencies have only limited knowledge related to nursery and greenhouse production. It is time that our green industry is better known since farm crop receipts for nursery and greenhouse in North Carolina are **second** only to tobacco; and we are the **fourth** largest agricultural industry in our state behind swine, poultry and tobacco. I do not feel these rules will be extremely adverse to our industry. As an industry, we are regarded as good stewards of the environment and we have many good BMP's already in place. We just have to demonstrate and talk about our best qualities.

Calendar of Events

Event	Date	Time	Location and contacts
Southeast Greenhouse Conference and Trade Show	Wednesday–Saturday 25–27 June		Palmetto Expo Center, Greenville, S.C. Contact Charles Hall at 800.453.3070 for further information.
NCCFGA Board Meeting	Friday June 26	1:00 pm to 2:00 pm	At the SGCTS in Greenville, S.C. Contact Bonnie Holloman for further details at 919.779.4618.
NCSU Bedding Plant Field Day	Wednesday 29 July	9:00 am to 3:30 pm	Horticulture Field Laboratory, Raleigh, N.C. Contact Bonnie Holloman at 919.779.4618 for further details.
NCCFGA General Membership Meeting	Wednesday 29 July	3:50 pm	McKimmon Center, Raleigh, N.C. Call Bonnie Holloman for further details.
NCCFGA Board Meeting	Wednesday 29 July	4:15 pm	McKimmon Center, Raleigh, N.C. Contact Bonnie for further details.

GREENHOUSE BMP'S: NOT JUST FOR BREAKFAST ANYMORE

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Each year, growers throughout North Carolina and the rest of the U.S. must face more and more environmental issues. Federal, state, and even local regulations are addressing concerns such as surface and groundwater contamination, water usage, pesticide usage, solid waste disposal, and energy consumption. Many of these regulations have affected and will continue to affect both business and cultural practices within the greenhouse industry. Ted Bilderback addressed one that hits us at home in the previous article concerning the Neuse River.

Unfortunately, many of us are trying the ostrich routine to deal with this issue. For example, at the 1997 Southeast Greenhouse Conference, Don Wilkerson (Texas A&M University), Ted Bilderback and I put on a 4-hour program on best management practices for greenhouses. We had seven attenders in the room. Thus the title above -- not just for breakfast anymore. It's time for growers to wake up and smell the BMP's.

Most floriculture producers have a deep commitment to the environment. Our products enhance the quality of life for our customers as well as increase the quality of the air we breath. Horticulturists by nature and by training are good stewards of the environment and posses an appreciation for the value of natural resources. The commercial floriculture industry has been a leader in establishing and implementing production practices such as integrated pest management that help protect the environment.

This article was prepared to assist growers in continuing their efforts of environmental stewardship by reviewing the concept of Best Management Practices (BMP's). Through proactive behavior, greenhouse growers can continue to set an example for other facets of agriculture.

What Are BMP's?

Best management practices can be defined as practices, schedules of activities, maintenance procedures, and structural or other management decisions that have been found to be the most effective and practical means to prevent or reduce the discharge of pollutants into the environment *(whew!)*. The scope of BMP's can be expanded from pollution control practices to also include procedures or production choices that address other current environmental concerns such as water conservation and energy use.

BMP's are practices; something you intentionally do or avoid doing in order to positively affect the environment in your business. They are proactive. BMP's are implemented prior to a problem rather than after a problem is observed and some type of "fix" is needed. Think of BMP's as preventative rather than curative treatments.

The BMP philosophy emphasizes environmental stewardship yet it does not sacrifice crop quality. Individual management practices are freestanding rather than a set. In other words, growers can implement as many as possible and still be effective without implementing each and every practice that has been documented.

Safeguarding the environment comes with a price, and producers should be aware of the potential economic impact of implementing BMP's. As you evaluate specific practices you should be asking: ❶ can I afford to implement this procedure; ❷ would my customers be willing

to accept some of the added costs; and ❸ can I afford NOT to implement this procedure?

What Are the Issues / Types of BMP's?

This article concentrates on only three (of many more) major issues that BMP's can address: ❶ surface and ground water contamination; ❷ water conservation; and ❸ alternative resource utilization (use of man-made waste products). Other issues that BMP's can address include solid wastes generation; and energy and natural resource consumption. However, the scope of this article only allows for a few examples of many possible BMP's. An example of a specific BMP addressing water conservation would be: "irrigation should not be based on a fixed daily schedule but based on plant water needs." An example of a BMP addressing water contamination would be: "whenever possible, select 'biorational' pesticides that are less persistent in the environment, less toxic, and / or less mobile in the environment than alternative pesticide choices."

There are two major categories of BMP's that can address the above three issues, structural BMP's and cultural BMP's. The following section outlines types of BMP's that greenhouse owners should consider employer. Remember that this is merely a list (and not a complete list) of BMP's rather than a required set. For more BMP's, refer to the suggested readings section at the end of this article. I encourage each of you to acquire (at the very least) the BMP publication from SNA; you can purchase a copy from the NC Association of Nurserymen (call 919.266.3322).

Structural BMP's

Structural BMP's are recommendations involving physical structures, such as building placement, type of irrigation system used, and ditch / drainage system placement. Four subcategories of structural BMP's are listed below: ❶ site selection criteria; ❷ pest exclusion systems; ❸ runoff prevention systems; and ❹ "closed" irrigation systems.

Site selection criteria. If you are planning on building on a new site, these BMP's should be considered. Many of them are difficult to employ, once a site has been selected and buildings have been placed. Site selection BMP's address issues such as proximity of your buildings and land to aquifers and surface waters; flood plain location and flooding potential on your site; the possibility of using some of the land for effluent distribution; and the potential for on-site effluent containment (a reservoir or wet detention basin). Examples of site selection BMP's are: ❶ do not locate buildings or production areas over shallow underground aquifers; and ❷ avoid building or growing on a high risk flood plain.

Pest exclusion systems. One way of reducing the potential for release of pesticides into the environment is to find alternative means of pest control rather than applying pesticides. Practices such as screening and utilizing quarantine areas in your greenhouse are examples of pest exclusion systems. Examples of pest exclusion system BMP's are: ❶ screen open vents on greenhouses to prevent entry of flying pests and weed seed; ❷ attach a screened antechamber onto greenhouse entries to help reduce pest transfer from outside into the greenhouse; ❸ establish pest quarantine areas where newly received material is examined for infestations; and ❹ avoid pest-attracting apparel, such as yellow and blue clothing *(is clothing a structure or a cultural practice?)*.

Runoff prevention systems. Runoff includes effluent (water / fertilizer solution used for irrigation) as well as storm water that drains from buildings and paved areas. Ideally, all drainage water should be contained on site (no runoff from property boundaries). Examples of runoff prevention system BMP's are: ❶ grade construction sites for erosion control and planned precipitation collection; ❷ establish vegetative buffer zones (vegetative filter strips of sod or other plants that remove sediment, nutrients, and other pollutants from runoff by filtration, deposition infiltration, absorption, and decomposition); ❸ construct a wet detention

basin to store effluent and reuse for irrigation purposes; ❹ utilize natural or constructed wetlands as an effluent filtration unit; ❺ disperse nutrient-rich effluent onto utilization fields (crops such as oats that will absorb and scrub nutrients out of the effluent); and ❻ pump effluent through a bioreactor or biofiltration system to remove nutrients and other chemicals prior to effluent discharge.

Closed irrigation systems. A truly "closed" irrigation system does not allow any water or fertilizer solution to escape from the production facility into the environment. Containment and recirculation of effluent is an excellent technique to prevent runoff of any kind. The following irrigation systems are examples of closed irrigation system BMP's: ❶ ebb and flood tables; ❷ recirculation delivery troughs; and ❸ flood floor + sump (a catch basin to hold solution between irrigations) delivery. It is possible to dramatically reduce the potential for runoff by using quasi-closed systems that are not completely closed, yet contain all effluent on-site. The following quasi-closed irrigation systems are considered BMP's, when used in conjunction with a wet detention basin: ❶ individual catch pans; ❷ closed tray systems; and ❸ solid floor production areas with directed drainage.

Cultural BMP's

Cultural BMP's are practices used in the production of plants; how you grow your crop and cropping decisions made during production. Three subcategories of cultural BMP's are listed below: ❶ substrate management practices; ❷ pest management practices; and ❸ the optimization of the production environment.

Substrate management practices. One way of reducing the potential for runoff is to reduce the number of irrigations and the amount of leaching during production. The substrate you select can have an effect on the watering requirements of your crop. The mix you choose and how you manage it can (how water and fertilizer are applied) can affect runoff potential from your greenhouse. Examples of substrate management BMP's are: ❶ grow in "tighter" mixes that have greater water holding capacity than alternative mixes; ❷ decrease the leaching fraction of irrigation events to reduce effluent volume; ❸ make fertilizer applications based on nutrient monitoring and plant needs rather than temporal scheduling; and ❹ utilize man-made waste materials such as coir fiber and composted yard wastes in substrates rather than relying solely on somewhat limited (bogs do regenerate with time) natural resources such as peat moss.

Pest management practices. The concept of integrated pest management has been preached and practiced for years in the greenhouse industry, but it never hurts to review environmentally friendly pest management practices. The following are examples of pest management BMP's: ❶ scout and monitor pest populations or incidence of diseases for judicious timing of pesticides; ❷ employ cultural practices rather than sole reliance on pesticides for pest and disease control (e.g., practice good sanitation to reduce the potential of diseases in the greenhouse); ❸ integrate biological controls when appropriate into your pest management program; and ❹ when pesticides are required, use biorational pesticides with lower toxicities than alternative pesticides.

Optimization of the production environment. Just as pest exclusion can reduce the need for pesticides, so can proper environmental controls during production. In many cases, the environmental conditions can directly affect the potential for production problems (and subsequently pesticide applications and crop quality). Examples of production environment optimization BMP's are: ❶ supply adequate spacing for plants during production (better spacing = more light and lower relative humidity = less need for chemical height control and less disease potential); ❷ use DIF as an alternative to chemical height control when possible; and ❸ employ night ventilation and reheating for reduction of relative humidity (lower

relative humidity = less disease potential and less need for chemical control).

Closing Comments

This article does not contain an exhaustive listing of BMP's. It does give you concrete examples and a starting point for development of a total BMP production plan. Review your current practices. List the best management practices currently employed at your business. Evaluate ones that you have not implemented and incorporate as many as you can.

One final note about BMP's and environmental stewardship: brag about your efforts! A positive attitude will be noticed by employees. When you show concern, the attitude will be transferred to those around you. If we don't talk about our industry in a positive light, who else will do it for us?

Suggested Readings

Anonymous. 1992. Water quality action manual for greenhouse and nursery operations. Horticultural Water Alliance. (*This publication is the result of a joint effort between the: Society of American Florists, American Society of Nurserymen, Professional Plant Growers Association [Bedding Plants International), and Roses, Inc. The manual seeks to answer the most important question a grower can ask: "what can I do?" Beginning with guidelines on how to conduct a thorough environmental audit of your operation and facilities, the manual provides recommendations for the most environmentally sound approaches to greenhouse and nursery production.*)

Bailey, D.A. 1997. Height control of commercial greenhouse flowers. NC State University Hort. Info. Lflt. #528. (*This publication outlines biological, physical, as well as chemical control measures for height control of floricultural crops. It lists alternatives to using chemical height control in an effort to convey best management practices for height control of crops. The publication is available at http://www2.ncsu.edu/floriculture/*)

Bailey, D.A. 1997. Best management practices for plant growth regulators. NC State University Hort. Info. Lflt. #529. (*Not all pgr's used in floriculture are height control chemicals. This publication details BMP's for use of all plant growth regulators labelled for use in the greenhouse. It is available at http://www2.ncsu.edu/floriculture/*).

Wilkerson, D.C., B.M. Drees, D. McWilliams, and J.M. Sweeten. 1991. Water management guidelines for the greenhouse industry: a guide for protecting and conserving our natural water resources. Texas Agr. Ext. Service Bul. Hort 4-5. (*This guide provides information on how to establish a variety of cultural and structural BMP's for the production of greenhouse crops. Also included are procedures for conducting an in-depth environmental audit and techniques for developing a long-range environmental plan for your operation.*)

Yeager, T., C. Gilliam, T. Bilderback, D. Fare, A. Niemiera, and K. Tilt. 1997. Best management practices: a guide for producing container-grown plants. Southern Nursery Association. (*This guide provides growers with valuable information on the "how-to's" of establishing best management practices. It was a cooperative effort among states throughout the Southeast. Growers can select from 120 listed site-specific BMP's to develop a voluntary environmental stewardship plan. Copies can be purchased from the North Carolina Association of Nurserymen. Call 919.266.3322 for ordering information.*)

SWEETPOTATO WEEVIL UPDATE

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The following memo was sent to our Department from Gene Cross of the North Carolina Department of Agriculture, Consumer Services Plant Industry Division, Plant Protection Section. From reading the memo, it looks like ornamental sweet potato producers may need to have certification (that plants are weevil-free) to ship sweet potatoes into North Carolina, depending on where they originated. Also, it looks like there can be no shipment into or out of New Hanover and Brunswick Counties. Please read the following memo and make sure you are in compliance:

From: Gene Cross
Re: Sweetpotato Weevil

Given its unique foliage color and ability to thrive in North Carolina's summer temperatures, the ornamental sweet potato is destined to become a desirable addition for annual planting beds. The introduction of ornamental sweet potatoes into North Carolina landscapes will provide a potential pathway for the introduction of the Sweetpotato Weevil *(Cylas formicarius elegantulus)*. Currently, North Carolina ranks number one in the production of sweet potatoes in the United States. The introduction and spread of this injurious insect threatens all major commercial sweet potato growing areas of the state. The weevil is considered to be a major destructive pest of sweet potatoes in many areas of the Southern United States. Damage to the crop occurs when the weevil tunnels within mature sweet potatoes. Feeding and tunneling by the weevil imparts a bitter flavor to the sweet potatoes rendering them unmarketable. The larvae also tunnel in sweet potato vines; however, this damage does not cause measurable losses in yield. The physical appearance of the sweet potato is also damaged by adult feeding, oviposition, and emergence holes. The current distribution of the sweetpotato weevil in North Carolina is isolated. Known populations of the insect are restricted to small areas in New Hanover and Brunswick Counties and survive on local populations of seaside morning glory. Due to the risk of spread, these areas are quarantined and **the planting of sweet potatoes and other regulated plants in these areas is prohibited.** Populations of the weevil do not currently occur in sweet potato producing areas of North Carolina. All sweet potato fields in North Carolina are trapped on a yearly basis to ensure any introductions are detected and eliminated at an early stage. Other states including Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina, and Texas have documented weevil populations. To protect North Carolina's valuable sweet potato crop, **exterior quarantines** have been imposed by the North Carolina Department of Agriculture and Consumer Services, Plant Industry Division. **The movement of sweet potato roots and plants from regulated areas is prohibited.** Additionally, **the vines or roots of other *Ipomoea* species are restricted into and within North Carolina. This quarantine directly affects the movement of ornamental sweet potato plants from regulated areas into and within North Carolina. Ornamental sweet potato plants originating in regulated areas are prohibited entry into North Carolina and stop sales will be issued. Ornamental sweet potato plants originating outside regulated areas are enterable; however, the importer must obtain a certificate indicating the plants were produced in a sweet potato weevil free area.** This certificate must

accompany the movement of plant material into the state. **Failure to provide adequate certificates may result in the issuance of a stop sale, destruction, or having the material returned to the shipper.** Questions relating to the regulation of ornamental sweet potatoes in North Carolina may be directed to your local NCDA&CS Plant Protection Specialist or to the NCDA&CS, Plant Industry Division Office at 919.733.0461 or 1.800.206.9333.

The descriptions of the various life stages of the sweetpotato weevil are listed below and diagrammed in Figure 1:

Adult -- This ant-like snout beetle is about 6 mm long. The head and wing covers are metallic dark blue and the thorax and legs, bright red-orange.

Egg -- Each white or pale yellow egg is inserted into a shallow hole in the vine. Broadly oval and about 0.6 mm long, the egg is slightly narrower at the attached end. The dark head of the larva becomes visible inside the egg, just before hatching.

Larva -- The fat, legless, slightly crescent-shaped larva has a dirty white to gray body and a pale brown head. When fully grown it is about 9 mm long.

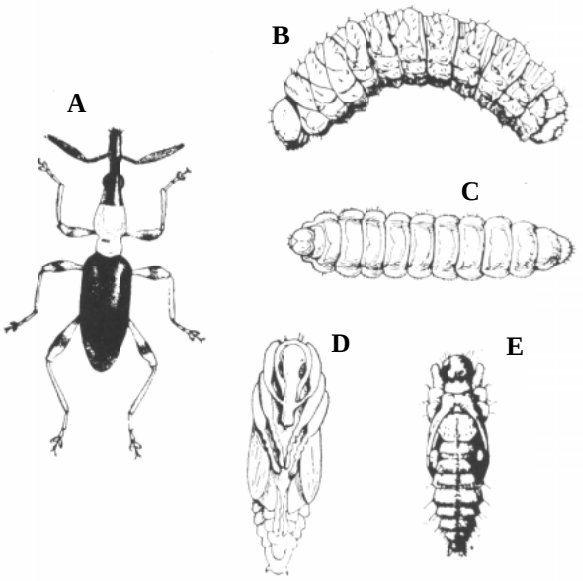

Figure 1. Sweetpotato weevil. A, Adult. B–C, Larvae. D–E, Pupae.

Pupa -- When newly formed, the pupa is the same color as the larva and about 5 mm long. Before transformation to the adult, the eyes, wing pads, and legs turn dark brown and the rest of the body is pale yellow. The last abdominal segment has two outward and backward curved tubercles.

EFFICACY OF A-REST, BONZI, AND SUMAGIC ON GROWTH OF TUBEROUS-ROOTED DAHLIAS

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Tuberous-rooted dahlias can have excessive size relative to the container they are grown in, and chemical plant growth retardants (PGRs) may be required for height control. De Hertogh and Blakely (1976) recommended applying substrate drenches of A-Rest at 0.25 to 2 mg active ingredient (a.i.) per pot, 10 to 14 days after potting the tubers for height control. Whipker et al. (1995) found no significant reduction in plant height of 'Golden Emblem' tuberous-rooted dahlia with Bonzi drench concentrations of up to 1.9 mg a.i./pot or with Sumagic drench concentrations up to 0.47 mg a.i./pot. This study was conducted to determine the effectiveness of higher concentrations of A-Rest, Bonzi, and Sumagic as a chemical height control for tuberous-rooted dahlias.

Experimental Design

Dormant tubers of 'Golden Emblem' (a tall variety) and 'Red Pigmy' (a shorter variety) dahlias were potted into 6 inch standard round plastic pots on 12 March. The root substrate contained 1 field soil : 2 sphagnum peat : 2 perlite (by volume) and was amended with (per cubic yard of mix) 24 oz. $Ca(H_2PO_4)_2$, 16 oz. KNO_3, 16 oz. $MgSO_4 \cdot 7H_2O$, 8 lbs. ground dolomitic limestone and 2 oz. Peter's fritted trace elements No. 555. Plants were fertilized at each irrigation (ppm) with 201 N, 46 P, and 200 K. Greenhouse day/night set points were 75/65 °F. The plants were grown under natural day length. Fifteen plant growth retardant (PGR) substrate drench treatments (mg a.i./pot) were applied 13 days after potting by using 4 ounces (118 ml) per pot: A-Rest at 0.5, 1, 2, 4, and 8; Bonzi at 1, 2, 4, 8, and 16; Sumagic at 0.125, 0.25, 0.5, 1, and 2; and an untreated control. A completely randomized design of eight single-plant replications of each cultivar was used. When the first inflorescence opened, the number of days from potting until flowering, leaf canopy height measured from the pot rim to the top of the foliage, flower height above the foliage, total plant height, and plant diameter (measured at the widest dimension and turned 90°, and averaged) were recorded.

Results and Discussion

The majority of total height control achieved by the use of PGRs was primarily due to a reduction of inflorescence height, rather than leaf canopy height. Bonzi, A-Rest, and Sumagic at all concentrations significantly reduced 'Red Pigmy' total plant height by >21% when compared to the untreated control. 'Red Pigmy' is a less vigorous cultivar, with the untreated control plants being 17.1 inches high. Marketable potted plants were produced with Bonzi concentrations of 2 to 4 mg, 0.25 to 0.5 mg of Sumagic, or 0.5 mg of A-Rest (Figure 1).

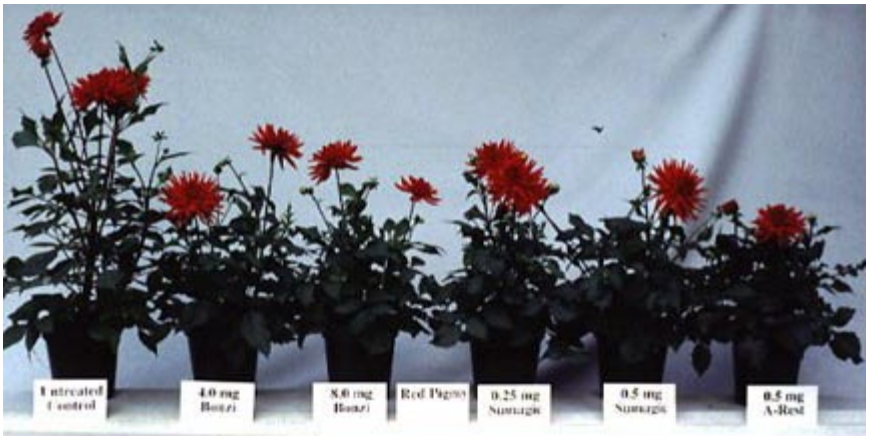

Figure 1. The effect of (left to right) Bonzi at 4 and 8 mg, Sumagic at 0.25 and 0.5 mg, and A-Rest at 0.5 mg on growth of 'Red Pigmy' pot dahlias grown in 6 inch standard pots.

All Bonzi, A-Rest, and Sumagic concentrations significantly reduced 'Golden Emblem' total plant height by >11% when compared to the untreated control. 'Golden

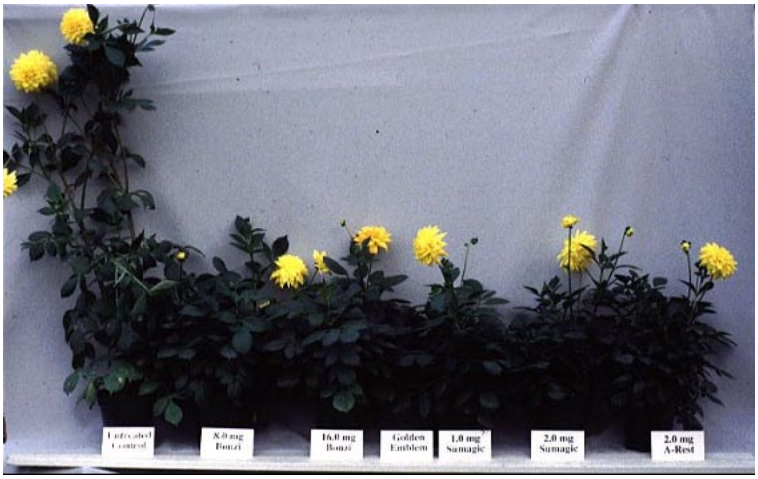

Figure 2. The effect of (left to right) Bonzi at 8 and 16 mg, Sumagic at 1.0 and 2.0 mg, and A-Rest at 2.0 mg on growth of 'Golden Emblem' pot dahlias grown in 6 inch standard pots.

Table 1. Effectiveness of PGR on days from potting until flowering and per pot costs of the PGR treatments for 'Red Pigmy' and 'Golden Emblem' dahlias grown as potted plants. Data averaged over both cultivars.

PGR	Dose mg a.i./pot	Days to to flowering	Cost ($)[z]
Untreated control	—	68.7	—
Bonzi	1	72.3	0.021
	2	68.9	0.042
	4	71.4	0.084
	8	71.6	0.169
	16	69.3	0.338
Sumagic	0.125	69.4	0.021
	1.25	71.8	0.041
	0.5	72.7	0.082
	1	72.9	0.165
	2	75.4	0.330
A-Rest	0.5	74.2	0.112
	1	73.9	0.224
	2	75.8	0.448
	4	77.3	0.897
	8	80.4	1.793
Significance[y]		***	—
LSD (alpha 0.05)		5.2	—

[z]Cost (rounded) based on the use of drench applications of PGRs; costs used were $102 per quart of Bonzi, $78 per quart of Sumagic, and $56 per quart for A-Rest.
[y]*** Significant at P 0.001 for the treatment interaction. Data averaged for both cultivars; n = 16.

Emblem' was the more vigorous cultivar, with a height of 32.3 inches for the untreated control. Marketable potted plants were produced with Bonzi concentrations of 4 to 8 mg, 0.5 to 1 mg of Sumagic, or 2 mg of A-Rest (Figure 2). Even though the plants were 3 to 4 times taller than the pot height of 6 inches, the doses recommended resulted in a minimal amount of leaf distortion, reduction in inflorescence diameter, and delay in the number of days until flowering.

A-Rest and Bonzi are labeled for use on tuberous-rooted dahlias. Sumagic foliar spray rates for dahlias grown as bedding plants are listed on the label. The choice of PGRs to control the growth of tuberous-rooted dahlias should be based on the response of the cultivar and the cost of the PGR (Table 1). The desired control of growth was obtained for the lowest cost by using Bonzi at the cost of 8.4¢ to 16.9¢ per pot for 'Golden Emblem' and 4.2¢ to 8.4¢ for 'Red Pigmy', which was between 25 to 81% less expensive than A-Rest.

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De Hertogh, A.A. and N. Blakely. 1976. The influence of ancymidol, chlormequat and daminozide on the growth and development of forced Dahlia variabilis Willd. Scientia Horticulturae. 4:123–130.

Whipker, B.E., R.T. Eddy, and P.A. Hammer. 1995. Chemical growth retardant application to tuberous-rooted dahlias. HortScience 30:1007–1008.

NCCFGA News

Greetings! As I sit down to write this letter, it is Easter week and the weather outside is clear and sunny. There has definitely not been enough days like this the past several weeks. I ran out of greenhouse space a couple weeks ago, but we continue to transplant and hope the weather breaks soon so I can give the plants the space they need. Let's hope for drier weather and more sunshine as all of us head into the busiest month of the year.

April is once again Floriculture Month in North Carolina by official proclamation of Gov. Jim Hunt. On April 22nd, Bonnie Holloman, Michele Roberts (NCDA), myself and others from our Association will make our annual visit to the Governor's mansion. We will present on behalf of NCCFGA, a variety of floricultural products to Mrs. Hunt for use in and around the mansion. We will also visit the folks at NCDA and try and catch a moment with Commissioner Graham. These visits are important reminders to those in state government of the vital role floriculture plays in the agricultural economy of North Carolina.

April is not a month many of us have time for extra reading, but please take time to read the articles in this issue of the Bulletin. The Neuse River legislation that affects growers in the watershed can and will have an impact on how many of us operate our greenhouses. There is also a notice from NCDA regarding the movement of ornamental sweet potato plants in our state. Skip this letter and read those articles; and the other important information in this issue!

I hope all of you have your calendars marked for June 25–27, 1998. This is when the Southeast Greenhouse Conference is held at the Palmetto Center in Greenville, SC. The trade show will be bigger, the educational sessions are top-notch, the networking and fellowship is fantastic. You need to be in Greenville in late June! The growth of this show has been wonderful and your attendance in South Carolina is important not only for yourself, but for your Association.

I wish all of you the best possible spring season and I will plan to see you at the Southeast Greenhouse Conference if not sooner.

Best Regards,

Joe Stoffregen, NCCFGA President

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