



A Guide for Commercial Production of Vinca



THE UNIVERSITY OF GEORGIA

COOPERATIVE EXTENSION

Colleges of Agricultural and Environmental Sciences & Family and Consumer Sciences

Contents

Introduction	3
Today's new cultivars are more vigorous, predictable, specialized	3
Cultivar selection — there are differences!	4
Commercial Production	5
Production considerations to evaluate before ordering seed or plugs	5
The Art of Growing from Seed	7
Stages 1 & 2	7
Stages 3 & 4	7
Transplant Carefully	8
Avoid Substrate Charge in the Soil Substrate	9
Type of Nitrogen Affects Plant Quality	9
Suggested Fertility Program	9
Nutrient Deficiencies	10
Nutrient Toxicity	11
Water, Soil and Leaf Tissue Analysis	11
Water Quality	12
Soil Type and Management Considerations	13
Soil pH and pH Management	13
Soil Temperature Considerations	13
Height Control	13
Watering — The Art of Vinca Production	14
Provide Optimal Light and Temperature	14
Provide Adequate Air Movement	15
Diseases of Vinca	16
Establish a Disease Prevention Program	16
Root Diseases	16
Foliage Diseases	19
Establish an Insect Control Program	22
Production Considerations	22
Record Keeping Is a Must	22
About Baskets and Decorative Containers	22
Education Is the Key to Selling Vinca	24
The Economics of Vinca Production	25
A Vinca Enterprise Budget	25
Is the Vinca Market Still Growing?	26
References	27
Author Credits	28

A Guide for Commercial Production of Vinca

*Paul Thomas, Jean Woodward, Forrest Stegelin and Bodie Pennisi
The University of Georgia*

Vinca (*Catharanthus roseus*, Family *Apocynaceae*) is one of the top-10 best selling bedding plants in the United States. Once established, it blooms all summer. This plant comes in a wide variety of colors and sizes. Vinca is one of Georgia's best bedding plants for hot, dry, sunny locations with sandy loam or Piedmont clay as a principal soil type. It has performed well throughout the state during periods of drought. If consumers are aware of vinca's cultural requirements and provide proper care, it will perform very well in Georgia landscapes. Given an expanded role as a

basket or color-bowl crop, the potential for sales of this crop is good.

Unfortunately, many growers shy away from increasing production of this bedding plant because of historically poor cultivar genetics and past failures or mistakes. You cannot grow vinca the same way you grow other bedding plants. Vinca is a specialty crop with very distinct requirements. This bulletin will address those requirements and cover a typical production schedule and crop budget.

Today's new cultivars are more vigorous, predictable and specialized.

Vinca has been bred since the 1920s. Cultivars in commercial production up to the early 1990s had many problems, including very weak stems, poor tolerance of wet weather and susceptibility to many diseases. These older hybrid lines of vinca were bred for flower color, not vigor, and tended to be weak-rooted and much more demanding in their environmental requirements, especially when young. New vinca cultivars on the market are more vigorous, and many of the new series are more specialized to regional growing conditions. Each new series has brought forth new colors to add to the usefulness of this bedding plant.

For example: The 'Victory' series has intense, clear colors and a compact growing habit. The 'Heat-Wave' series and the cultivar 'Santa Fe' are promising and also appear to be more tolerant of warm, dry weather than other cultivars and may be a better selection for southern growers. The series 'Tropicana' and 'Pacifica' perform well in seemingly excessive heat and humidity, and are fast becoming a favorite in the south. The 'Medi-





Vinca 'Parasol'

terreanean' series is another good series that is fairly vigorous and performs well in very warm conditions. 'Morning Mist' is a border type vinca with remarkable tolerance to heat, and 'Parasol' is an All American Selection winner that has excellent branching and heat tolerance. The 'Cooler' series performs exceptionally well under relatively cool, bright greenhouse conditions, making it a well-suited crop in the western United States. Some of the newest lines being evaluated at the University of Georgia include the 'First Kiss' series and the 'Garden Leader Splash' series. Landscapers should welcome the arrival of new colors and improved cultivars.

Cultivar selection — there are differences!

There are three classifications for vinca. Each group defines a growing characteristic that may make its use for a particular basket or pot a good experience or a poor one. Be sure you select the vinca with the desired growth characteristics that match your customer's needs.

Creeping Type Vinca spread rapidly, each plant forming a colorful 8- to 10-inch mat across the landscape bed. They grow slowly and are easily contained. Creeping vincas are good candidates for small hanging baskets and odd-shaped decorative containers (as they can be grown oblong or any odd shape with pinching), and they can be used in elevated planters where cascading flowers are desired. They are very effective as ground-covers in very large outdoor planters if the plants receive full sunlight. An example is the Magic Carpet series.

Dwarf Type Vinca have smaller flowers, form denser plants and have a more upright character than the carpet type. Average height for a dwarf type is 10 to 14 inches. Examples include the 'Little' and 'Cooler' series. They make attractive 10-inch and 12-inch hanging baskets and do not flop over like the larger border types do in baskets. However, they are best used in small patio planters and decorative pots, providing a very neat, upright flower display that does not get too big too fast.

Border Type Vinca have larger 2-inch flowers, are more vigorous and form upright mounds 14 to 20 inches tall. The majority of new cultivars for use in the landscape are classified as border vinca. The 'Heat Wave,' 'Tropicana,' 'Victory' and 'Pacifica' series fall into this category. Some authorities firmly place the 'Cooler' series in the border class, as with warm-weather culture they match the other series in plant and flower size. These plants are well-suited for use in large color bowls, large barrels, city planters and large, main-street baskets 15-36 inches in size.

Commercial Production

Our understanding of the growing requirements for vinca has improved. We now know that the environmental requirements for this species are the most stringent of any commercial bedding plant crop. Vinca is best considered a specialty bedding crop just like fall pansies. Success with this crop requires growers to reevaluate their cultural program and make the necessary greenhouse adjustments. Those who implement the growing program changes will see how trouble-free and profitable this crop can be. The secret to growing and maintaining high quality plants is maintaining an optimal root environment. To accomplish this, you must undertake simple but important changes in your growing program.

Production Considerations to Evaluate BEFORE Ordering Seed or Plugs

Origins Suggest Basic Culture Requirements

Vinca (*Catharanthus roseus*) originated in Madagascar, a large island off the African coast, and is adapted to hot, dry or windy slopes, bright sunshine, well-drained soil and prolonged summer heat. The soil fertility is poor and, therefore, vinca is adapted to a low fertility environment. Its roots are nutrient scavengers and will not do well under artificially high fertility levels commonly found in most greenhouses. This species requires dry leaves and flowers to stay disease free. Very humid greenhouse conditions, over-watering, overhead landscape irrigation and prolonged rainfall can affect vinca adversely. Sufficient air movement that allows leaves to dry is crucial.

Preparing the Greenhouse Environment Is the First Step

Most greenhouses need to be modified to produce high quality vinca crops. Vinca requires higher light level and air movement and they have different watering and fertilization require-

ments than the average bedding plant, such as marigolds, begonias and impatiens. Bedding plants that grow well under conditions optimal for vinca include salvia, zinnia, melampodium, cosmos and cleome.

Vinca requires long periods of high light levels and warm growing conditions to produce strong roots. In most parts of the country, light levels in January and February are not conducive to growing this species. Supplemental lighting up to a total of 18 hour days, at 1,200 to 1,500 foot candles (fc), is optimal, but any supplemental light above 200 fc will help. Colder regions of the United States must limit the use of venting so humidity levels are elevated, making the constant use of HAF (Horizontal Air Flow) fans for vinca essential. Twice the number of fans is recommended for this crop than are needed for other bedding plants. There should be a very perceptible air movement across the crop canopy. Vinca are not tolerant of conditions where the soil stays soggy and/or foliage stays wet.

Vinca require warm greenhouse conditions to grow well. Heating the greenhouse to 70 degrees F at night is expensive, but if you wish to grow quality vinca, it is necessary. Bottom heat will greatly improve this crop's seedling growth and accelerate transplant flower production. Installation of in-bench soil warming systems will be a wise investment in northern greenhouses if you consistently have contracts to grow large amounts in January or February. However, a more economic solution is to grow this crop much later in the season. Warmer outdoor temperatures and increased sunlight make production a bit easier. In the south, ordering this crop for transplant in late March and early April is a very sound decision.

These greenhouse modifications cost money. However, the additional cost of a customized house for vinca and other warm-season annuals is

offset by reduced losses and on-time production of high quality plants. Doing so for your entire crop of bedding plants does not make sense economically, and mixing impatiens, for example, with vinca never works well. We recommend growing this crop in a specially modified greenhouse where the environment can be maintained efficiently. Most growers involved in the production of large numbers of decorative pots or hanging baskets set aside one Quonset section just for vinca.

Crop Production Schedules

Because vinca has so many uses, many different schedules can produce a quality crop depending on the container you choose to use. The chart below provides some basic schedules. These are general estimates, as each greenhouse and production program can affect the speed of development.

Table 1. Suggested production schedules for Vinca

Note: The term “North” refers to the northern United States including colder growing regions of the southern Appalachian Mountains, and the term “South” refers to the southern United States, primarily referring to the Piedmont and coastal areas.

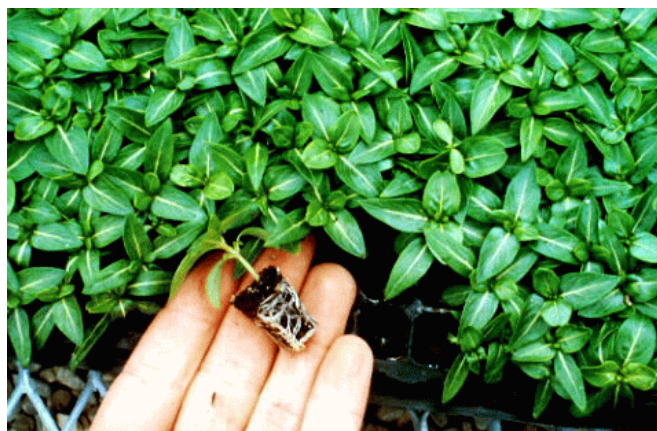
Vinca Use	Planting Date***	Plants/ Unit	Finish Time
Hanging Basket – 12"	North: 2/1 South: 3/15	6 5 or 6*	16-18 weeks 7-9 weeks
4" Pot** Landscape Installation	North: 3/1 South: 2/15	1 1	10-12 weeks 8-10 weeks
4" or 6" Pot Retail/GC Market	North: 2/15 South: 2/15	3 1 or 3*	14-16 weeks 8-12 weeks
Bedding Flat Retail Market	North: 2/15 South: 2/15	1 1	12-14 weeks 10 weeks
Color Bowls (Using 72 plugs or flat material)	North: 3/1 South: 3/15	2/5" space 1/5" space	10 weeks 8 weeks

* Using vinca at this density allows a 2-week reduction in bench use; this density requires nitrate-based fertility and careful temperature control to avoid stretching.
 ** Note the delay in production due to later use of crop by professional landscapers. This difference is usually 3-4 weeks later than retail market peak. Also note that plant should be in bloom with 4-5 fully developed flowers.
 *** Assumes an April 1 wholesale shipping date for the South, a May 1 wholesale shipping date for the North, a May 15 landscape installation date for the South and a June 1 landscape installation date for the North. Adjust your schedule according to your local market.

When Growing Vinca from Plugs, Timing Is Everything!

How early in the spring you order and plant vinca plugs can be a source of poor performance. Trying to plant too soon in the season may cause production delays and poor quality crops. In Georgia, January-planted plugs will take 10 to 15 weeks to be ready for sale, with increased risk of problems depending on the weather. Plugs planted in late March will take only 5 to 8 weeks to grow to proper sale stage due to increased sunshine and temperatures. Local weather conditions strongly influence vinca production. In the north, especially cloudy areas such as those in Pennsylvania and Michigan, it may take 18 to 22 weeks to produce a crop (where supplemental lighting and bottom heating have not been provided). In all cases, keeping night air and soil temperatures above 75 degrees F will yield a rapid crop turnover.

Growers purchasing plugs sometimes complain that vinca is often shipped with little or no root. Professional plug growers have a difficult task. Inspect purchased plugs thoroughly. Accept poorly rooted plugs and you accept all future risk, which will be greatly enhanced by poor root systems. Be selective with vinca plugs and don't order for early delivery. Early plug shipments can easily be chilled to near freezing. Shipping or holding vinca plugs at temperatures of 50 degrees F may cause serious chilling injury. Chilled plugs may recover nicely if allowed to warm up slowly over a day or two without stress. If you suspect



chilling, keep plants slightly moist, or “on the dry side,” and place them in an area with good air movement and out of bright sunlight.

If receiving plugs, transplant plants within 24 hours for best results. Water the plug trays an hour or two before transplant. Likewise, holding plugs in coolers while catching up with transplanting is not recommended. Be sure your crew makes planting vinca plugs a priority.

Plug Size Makes a Difference

The smaller the plug, the longer it takes to produce a mature crop. This holds true of most bedding plants. With vinca, the larger plug sizes also have an advantage in that the increased amount of root system greatly improves survival and

regrowth after transplant. The development of a strong root system after transplant is essential for success. Most growers purchase 512s or 288s for spring bedding production. However, growing small vinca plugs under cool condition in February limits how fast a root system will develop. Put a small 512 plug in a 4-inch pot where the soil is likely to stay wet due to the small root system, and you will increase the chances for disease and root damage due to over-watering. Purchasing larger plugs, such as 144s, provides more root development in relation to the pot it is planted in and reduces the time it takes for roots to grow throughout the new media. Larger plug sizes perform better, grow quicker and are essential for early spring crops started in February.

The Art of Growing from Seed

Growing vinca from seed is difficult and you can experience significant losses from disease. Vinca seed are small, yielding about 28,000 seeds per ounce. However, if you wish to grow vinca from seed, the following is how professionals handle the process.

Stages 1 & 2

Germinate and grow vinca seedlings in the highest porosity peat-lite plug-mix you can get. Maintaining proper moisture levels in smaller soil volumes can be very difficult, so most growers single-seed the crop into plug trays no smaller than 288s. Cover seeds lightly with a medium-grade vermiculite to hold the humidity close to the seed.

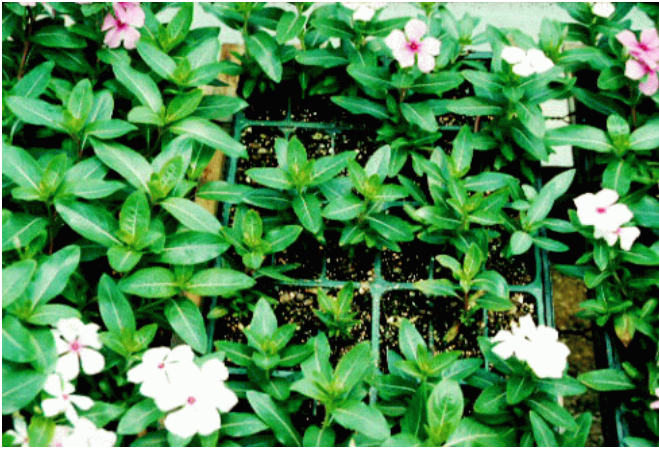
Seeded trays are usually misted until wet and then placed in a warm, dark room until germination begins. Keep stage one seedlings very moist by frequently misting the trays. Heating mats are often used to maintain soil for the next 6-7 days until radical emerges in most of the

seeds. Germination rates of 80 to 90 percent are common under these conditions.

During Stage 2, while the cotyledons are expanding, keep the humidity high and reduce soil temperature to 72 degrees F. You can apply a 50 ppm solution of fertilizer, preferably a nitrate based product such as 15-2-20, at this time. Begin to dry out the soil slightly and never allow the soil to be visibly dry. Keep the soil salt concentration, electrical conductivity (EC), below 0.75 and don't hesitate to leach if you feel salts are building up or if an excessive amount of fertilizer was accidentally applied.

Stages 3 & 4

Between 14 and 21 days, while the true leaves are expanding, it is important to reduce soil temperature slightly again, to 68 degrees F to 72 degrees F for 7 to 10 days, or until most seed has germinated. Supplemental lighting (500-1000 fc) for four additional hours beyond natural daylight hours can speed up development of emerging



Irregular growth due to poor handling

seedlings during cool, cloudy periods. Leaves usually develop between 7 and 15 days after cotyledon emergence. At this time you may increase the fertilizer rate to 75 ppm. Use high nitrate fertilizers such as 15-2-20 at this stage to prevent stretch. Keep the EC below 1.0. If stretch occurs, you may use a plant growth regulator (PGR) to hold the plugs at this stage (PGR use is discussed under “Height Control” on page 13). Allow a total of 5 to 8 weeks for seedling development in the plug tray prior to transplant.

The greenhouse environment you select for “growing-on” the plugs after transplant is also critical. Keep light diffuse and overall levels moderate — or more specifically, between 2000-2500 fc for plugs. In early season, prolonged cloudy conditions may require supplemental lighting after sunset or before sunrise to maintain adequate growth. Four hours of light at 1500 fc provided via “High Intensity Discharge” (HID) lamps is optimal. However, vinca responds to much lower light levels using incandescent bulbs, etc. Do the best you can to increase the hours of light when growing an early spring crop. Keep the EC below 1.00 mmhos/cm for seedlings at all times. Fertilize using 75 ppm of a high-nitrate, complete fertilizer upon removal of plug trays from the germination environment. Two weeks into transplanted seedling development, increase fertility to 125 ppm.

Vinca plugs do poorly if grown wet, and therefore we recommend “growing them on the

dry side of moist.” However, new seedlings do not respond well to even a few hours of drought under high light intensities. This is especially true of 2-week-old seedlings. Since we are recommending growing on the dry side of moist, there is very little room for error. It is critical that you monitor plug moisture hourly. The medium should **never** be dry. Even at 75 ppm, fertilizer salts concentrate and can cause root damage. It is a fact that vinca roots are slow to grow and seedlings almost never recover from severe soil moisture stress. One afternoon of slight stress under high light levels will delay a vinca seedling’s growth 1 to 2 weeks. Hourly scouting is essential.

Transplant Carefully

Many bedding plants are tolerant of rough treatment during transplanting and will grow out of root ball abuse. Vinca, however, is not one of them. A very common problem is irregular growth in a flat due to rough handling. Manual transplanting by crews unaware of the fragile nature of vinca’s roots is the most common cause.

If your vinca is growing very irregularly, inspect the transplanted plug. If it has a “J” hook appearance, where the plug was smashed on one side, with dead root tips and/or no root hairs a week after transplant, your crew has likely improperly handled the plug, pushing it in sideways and/or forcing it down into the soil with their thumbs. Once damaged, the roots rarely regain vigor and potential disease penetration is increased. Vinca is ideally suited for automatic transplantation. If you can’t automate, you must educate! Have your staff dibble a small hole in the soil first and then set the plug in gently. Vinca transplanting cannot be rushed.

Be watchful of the soil depth of plugs at transplanting. Exposed plug root balls act like wicks and draw water and salts, which can accumulate and desiccate the roots. Scouting your new transplants for shallow planting or planting too deeply can prevent a major problem from occurring later.



Root burn from excess slow release fertilizers

Avoid Substrate Charge in the Soil Substrate

Vinca does poorly if soil solution fertility levels are higher than 1.0 mmhos. High soluble salts inhibit root growth. Remember, root growth is the key to top quality vinca. Transplanting immediately into warm soils with a high level of substrate charge (fertilizer added by the manufacturer) on a sunny day doubles the stress on the roots. Likewise, transplanting plants into a soil with high substrate charge and then maintaining them under cool, wet conditions will also cause loss of roots. It is best to begin by using a low- or no-charge soil. Your soil manufacturer can tell you whether or not the soil has a fertilizer charge in it. If you cannot determine if this is the case, a soil test through your local Cooperative Extension

Service will identify if fertilizers are present. Test first when in doubt! If you use a charged soil, leach at transplant. This is accomplished by gently watering every 20 minutes for three cycles to flush out the excess fertilizer. Once the plugs' roots begin growing vigorously, you can fertilize with 50 ppm of a 15-2-20 high-nitrate fertilizer for two weeks. After a few new leaves have expanded, the rate can be increased to 125 ppm.

Type of Nitrogen Affects Plant Quality

Researchers have documented that vinca do not like elevated levels of ammoniacal nitrogen (>25 ppm) or phosphorus (>20 ppm) in the soil. In the south, especially, long term (4- to 6-week) exposure to ammoniacal nitrogen concentrations as low as 50 ppm can strongly inhibit root growth in established plants and will promote stem stretch under warm, moist soil conditions. Know your fertilizer product and how it interacts with your soil. Ammoniacal nitrogen or slow-release urea used in some commercially prepared soil mixes can impart levels as high as 200 ppm NH_4^+ .

There is also strong evidence that phosphorus plays an important role in how fertilizers affect plant growth. Using fertilizers low in phosphorus has been shown to reduce the incidence of stem stretch when plants are grown in warm weather. Not coincidentally, most nitrate-based fertilizers designed for vinca are also low in phosphorus.

Suggested Fertility Program

When establishing new plugs in a new soil, irrigate with a solution of 50 ppm 20-20-20. The high ammonia content will reduce the time the seedling needs to recover and take hold onto the new container. However, cease ammoniacal fertilization once the seedling root system begins to grow and hold the new soil. For the remainder of the production cycle, use fertilizers such as 15-2-20, or a rotation of one application of 125 ppm "20-10-20 with trace elements" for every two applications of 100 ppm calcium nitrate.

Table 2. Suggested fertility programs for Vinca grown in soil-less medium

Fertilizer Type	Rate (in ppm)	Frequency
20-10-20* – Pulse	100	Once a week – cool weather Twice a week – warm weather
20-10-20* – Continuous	65	
15-2-20* – Pulse	125	Once a week – cool weather Twice a week – warm weather
15-2-20* – Continuous	100	
Calcium Nitrate – Pulse	100	Every third fertilization

* This program assumes that these products contain a balanced trace element component.

Nutrient Deficiencies

Vinca is very susceptible to iron deficiencies as well as low nitrogen levels. It is also very sensitive to nutrient toxicities and general over-fertilization. Learning to recognize these symptoms will help manage production problems before they become serious and delay the crop. Recent research at North Carolina State University (Campbell, *et. al.* 2001) has clearly defined the deficiency symptoms listed below. Images are available on the NC State website:

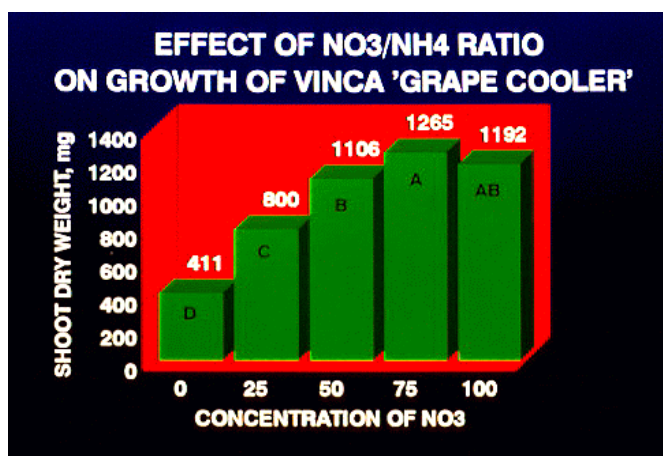
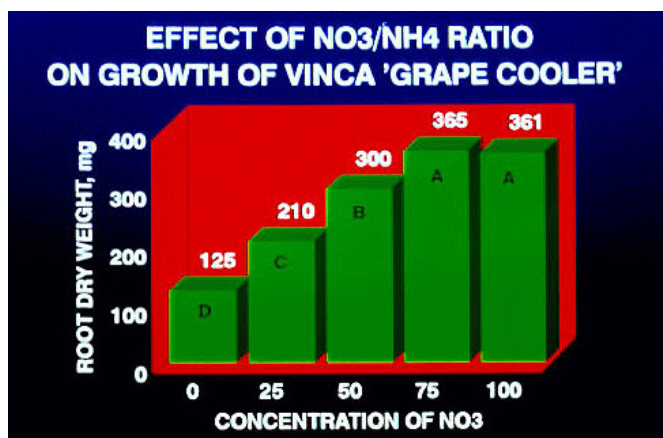
http://www.ces.ncsu.edu/depts/hort/floriculture/crop/crop_bp.htm

Nitrogen: Nitrogen deficiencies are surprisingly common. Vinca express nitrogen deficiencies through a gradual yellowing of the leaves. This yellowing pattern is very distinct, with very strong veinal chlorosis; specifically, the veins turn bright yellow and the leaf space between the leaves remains green. Eventually the entire leaf turns yellow. Crop delays due to nitrogen deficiencies can be significant.

Potassium: Potassium deficiencies are very rare and are manifested as curling down of lower leaf tips, so the leaves resemble an umbrella. Necrotic spots can develop on the leaves between the veins if the deficiency is severe.

Phosphorus: Phosphorus deficiencies also are rare and may not be easily diagnosed visually. The early stages of deficiency are expressed as a leaf darkening or a development of a deep green cast. The most severe symptom is a slight yellowing of the entire plant with concurrent leaf droop. A purplish or bluish tinge along the leaf interior is visible in some cases.

Magnesium: Magnesium deficiencies are common and easily recognized by a chlorosis beginning at the lower leaves, then spreading upward on the plant. Within the leaf, the chlorosis spreads from the outer edges inward to the mid vein.



Each graph represents plants grown with 100 parts per million (ppm) total nitrogen. The percentage of nitrate increases in relation to ammonium as you read from the right. For example, the treatment designated as 50 is a 50/50 mixture of NO₃ and NH₄.

Calcium: Calcium deficiencies are first characterized by the younger leaves turning somewhat glossy, followed by the new leaves. Developing leaves become distorted. Newly maturing leaves may become strap-like and cup downward. Leaves may eventually become necrotic.

Iron: This is the most common deficiency in vinca. Iron deficiency is expressed as a slowly progressing yellowing of the new leaves, spreading rapidly to the entire plant. Often root damage is expressed as an iron deficiency as the plant shuts down. The plants will turn almost yellow if not treated. Check pH, root integrity and your spray records, and get a soil test done before applying iron supplements. Vinca are very sensitive to iron toxicity as well. Be especially careful when using chelated iron sources that have iron-DPTA or iron-EDTA. These chelated sources should be kept below 5 ppm at all times to avoid root stunting. Iron-EDDHA seems not to cause the same root stunting problems. Apply to the product label to determine the form of chelating agent. Application of 1 ppm of iron-EDTA is recommended for vinca that show iron deficiency symptoms.

Copper: Copper deficiencies are rare and easily corrected. Copper deficiencies are expressed as an overall growth stunting, with new leaves turning darker green and becoming slightly distorted. Severe or prolonged deficiency causes leaves that are thin, strap-like but still green. Root growth also is stunted.

Boron: Boron deficiencies may occur in vinca especially if calcium nitrate fertilizer has been used too often. The level of calcium in this fertilizer competes with the boron. Symptoms are expressed as thick and glossy new leaves with the youngest leaves developing a chlorotic appearance. New growth and buds are tight and bunched. Buds and flowers may abort.

Zinc: Zinc deficiencies are rare and easily repaired. According to North Carolina State's

research, axillary bud development is inhibited and new leaves are smaller and thinner, with some distortion. This symptom is so rare it can easily be mistaken for other problems such as short term drought recovery and root damage.

Manganese: Manganese deficiency can occur when soil pH is out of optimal range. Symptoms are similar to phosphorus deficiencies in that the entire plant may be smaller, chlorotic or off-color and dull green. Flowers and leaves are smaller than normal.

Nutrient Toxicity

Fertility overdose

Two stages: A moderate overdose of fertility will cause vinca leaves to turn slightly off-color green, with slowly developing marginal necrosis spreading along the margin. Hot weather speeds up the process. Eventually the plants turn yellow with the dark margins very evident. If the overdose is severe, the plant wilts while turning a dull green and death occurs within 24 hours. Leaching is the only treatment for over-fertilization. The warmer the weather, the more quickly you need to address the problem.

Iron Toxicity: Iron toxicity is expressed as a strong reduction in root growth (Mattis & Hershey, 1992). Leaves are dark green and glossy, but root development may be reduced by nearly 70 percent. Roots can be off-color, stunted and stubby. Plants can regrow normal roots if the soil is leached.

Water, Soil and Leaf Tissue Analysis

The best method for managing plant fertility is through soil testing. The normal ranges for soil and leaf tissue analysis are provided below. Soil and foliar analysis should be done at weeks 2, 4 and 8 to assess pH drift and leaf analysis trends.

Table 3A. Normal foliar analysis ranges for vinca grown in soil-less medium*

Element	Percentage	Element	Parts per Million
N	2.72 - 6.28	Fe	72 - 277
P	0.28 - 0.64	Mn	135 - 302
K	1.88 - 3.48	Zn	30 - 51
Ca	0.93 - 1.13	Cu	6 - 16
Mg	0.32 - 0.78	B	21 - 49
S	0.22 - 0.50	Mo	0.14 - 0.46
Na	0.01 - 0.156	Al	34 - 136

* Source: Plant Analysis Handbook II. M. Mills, ed., MicroMacro Publishing

Table 3B. Normal soil analysis ranges for *Catharanthus roseus* Vinca

Element	Parts per Million
N as NH ₄ ⁺	20 or less (above 40 ppm is a concern)
N as NO ₃ ⁻	160 - 60 ppm
pH	5.4 - 6.2 ppm
EC	1.2 - 2.0 mmhos
P	30 - 5 ppm (lower is better)
K	200 - 40 ppm
Ca	160 - 40 ppm
Mg	100 - 60 ppm
S	(75 - 100 ppm)*
Fe	0.3 - 3.0 ppm
Mn	0.1 - 3.0 ppm
Zn	0.1 - 3.0 ppm
Cu	0.1 - 0.3 ppm
B	0.05 - 0.5 ppm

Values come from soil testing laboratories using the Saturated Extract Method (SME). Source: Modified by P. Thomas from base values obtained from Fafard Analytical Services.

*The requirement for sulfur is not clear in this species. The rate shown is recommended by Michigan State University for general bedding plant production. Sufficient sulfur is found in most commercial fertilizers.

Table 3C. Post-planting amendments for common deficiencies.

Element	Material	Rate (oz./ 100 gal water)	Frequency
Magnesium	Magnesium sulfate	32 oz.	Every 3 weeks
Calcium	Calcium nitrate	32 oz.	Every 3 weeks
Iron	Iron sulfate*	1.0 oz.	1 applic./crop

* Keep iron concentrations at or below 1.0 ppm if using chelated iron source.



Moderate over-fertilization of Vinca

Water Quality

Vinca growers in many parts of the United States have very hard water with pH levels between 8.0 and 9.0. Water sources with a pH level above 7 and high alkalinity are likely to cause a significant pH drift in the growing medium. The alkalinity level has far-reaching implications because of its strong effect on the substrate pH. Of two water sources, one with a pH of 9.0 and alkalinity of 50 (calcium carbonate equivalent), and the other with a pH of 7.0 and alkalinity of 300, the first will raise substrate pH very little, while the second will cause a much higher rise in the substrate pH. Water hardness is not the same as alkalinity but if you have hard water, there is a good chance that high alkalinity is also present. Address water quality issues for successful vinca production before production begins. Both pH and alkalinity are important in making decisions concerning proper water treatment. Have your water tested each January before spring production. In addition to being very sensitive to pH, vinca are known to cause alkaline pH drift in their root environment, so monitoring pH on a weekly basis is important.

Soil Type and Management Considerations

Vinca requires a high-porosity soil mix. This kind of mix can be purchased through most soil distributors, or you can make your own by adding up to 25 percent perlite by volume to your usual soil mix. The proper density and porosity of your greenhouse soil mix is critical to good vinca growth. Adding large amounts of loose organic matter, sand or perlite to heavy peat soils will go a long way toward solving any production problems due to set soils.

There also is the question of whether vinca responds poorly to “green,” “aged” or “uncomposted” bark in the soil mix. Never use green or poorly composted bark as a soil medium for vinca. Published data suggests aged bark mixes do reduce growth to a small degree. This reduction is not sufficient to warrant changing your soil mix as long as you compensate by increasing fertility applications. The use of well-composted bark is allowed, but some growers still report that overall growth in peat-based mixes is better than in bark. If you are having problems with vinca production, this is one possible factor to consider changing. One thing we do know is that peat-based mixes are preferred only if they impart good porosity. There are different qualities of peat and different particle sizes in peat. Using less refined, chunky peat in your mix is preferred over using ultra fine particles. Using perlite or other amendments to increase porosity is essential.

Soil pH and pH Management

Vinca shows rapid micro-nutrient deficiencies when grown in soilless mixes with a pH above 6.3. We suggest adjusting the pH down to at least pH 5.6. Iron is especially difficult for vinca to absorb when pH is higher than 5.8. Sequestered iron and magnesium sulfate as a foliar supplement may be used to green things up if this condition occurs. Soil pH may (usually does) rise for four to six weeks after transplanting. Keep in

mind that, just like pansy, vinca is also susceptible to the disease *Thielaviopsis* (black-root rot) when pH rises above 6.0. Avoid this problem by monitoring soil pH often. Acid-forming fertilizers, iron sulfate or acid-injection into the irrigation system can be used to help improve the situation.

Soil Temperature Considerations

Researchers agree that vinca requires a warm, sunny environment. “Warm” means soil temperatures no less than 70 degrees F. Vinca prefers day air temperatures from 80 degrees F to as high as 95 degrees F. If you attempt to plant vinca in a greenhouse where the soil temperature is maintained below 70 degrees F, you risk what we here in Georgia call “chilly root delay.” To meet these soil temperature requirements, again, growers should dedicate a whole greenhouse to it; adapt a section of the greenhouse for warmer temperatures and use bottom heating devices.

Height Control

Weather and scheduling problems may result in the need for height control techniques. Using a nitrate-based soluble fertilizer such as 15-2-20 gives excellent stretch control unless conditions such as temperature are extreme or problems of crowding or low light exist. Achieve height control by using plant growth regulators (refer to Table 4 for rates). Foliar sprays of B-Nine and A-Rest are recommended for mild stretch and temporary control. For severe problems or when holding a crop is essential, foliar sprays of Sumagic are effective in holding crops under high heat. Bonzi can cause unsightly foliar spots on vinca and is not recommended. When trying to control stretch on plugs, do not use the “spray and chill” technique to hold plugs or plants. Vinca plug trays treated with PGRs and then held around 45-50 degrees F will exhibit very erratic growth for weeks and months to come. Most importantly, be absolutely sure to promote good root development prior to use of any PGR on vinca.

Table 4.

Plant Growth Regulator*	Upper/Lower Label Rates	Application Considerations
Sumagic (uniconazole)	25 ppm to 2 ppm as a spray. Use lower rates first.	Apply to stems. Effect is temperature dependent.
A-Rest (ancymidol)	132 ppm to 32 ppm as a spray application.	Apply 2 to 4 weeks after transplant when well rooted.
B-Nine SP (daminozide)	5,000 ppm to 2,500 ppm as a spray application, 3-4 week intervals.	Apply 2 to 4 weeks after transplant.

* See your local state recommendations and be sure to consult the manufacturer's label before using any plant growth regulator.

You can also use negative DIF on vinca if you live in a northern climate or if local weather conditions in the south will allow for DIF. *DIF* is a term that refers to lowering the early morning air temperature a few degrees (4 to 7 degrees F) to discourage stem stretch. Most plants stretch or grow in the early morning hours and chilling them slows this growth.

Remember, however, that vinca is very sensitive to chilling. Be sure that HAF fans are running to rapidly distribute the cold air and average out the air temperatures during the 2- to 3-hour "cool day" treatments you impart just after sunrise. Try to keep cool-day treatments between 63 and 65 degrees F and never below 55 degrees F. If automated, be sure no pockets of very cold air are generated during the cooling process. Keep in mind that vinca is kept warmer at night, between 70-75 degrees F. This allows some flexibility in the 5- to 10-degree F temperature reduction needed for cool-day treatment and more opportunity to use DIF in late spring, even in the south. Southern growers will receive more benefit from DIF if the crop is shaded a week prior to treatments and light levels are held under 3000 fc.

Watering — The Art of Vinca Production

Like fertility, water application is critical for good root establishment. If the soil has high salts or a heavy fertility is present, low water use can cause salt damage of new transplants' roots. Flooding or desiccating the plant will cause poor root growth. Many employees over-water vinca, seemingly unaware of its needs. We have seen employees watering both established and new vinca transplants at 4 p.m. on a rainy day! This is inviting disaster. Watering vinca is an art and a science. Be sure to train your employees to keep plants on the dry side of moist.



Vinca bed in a lightly shaded Quonset house in late summer.

Provide Optimal Light And Temperature

Vinca do best with high light levels above 2000 fc. We try to grow vinca warm and sunny, but the amount of heat a greenhouse cooling system can handle will affect how much light vinca should receive late in the production season. Air temperature should be under 95 degrees F at the hottest part of the day. Keep night temperatures above 65 degrees F, or the crop growth rate will slow. Temperatures at night below 55 degrees F will cause leaf rolling, chlorosis, leaf drop and sometimes a purpling or bronzing effect on leaf tips. Flowering will also cease if night temperatures stay below 60 degrees F for prolonged periods.

Shade cloth is commonly used to reduce light levels and heat load in the greenhouse. Whether or not to use shading is a tricky decision for vinca. Shade materials with a 45 percent shading effect or above can cause crops that stretch and become leggy. Shading materials with around 35 percent shade or less are best suited. Shading in the southern United States is necessary from late March through June as afternoon temperatures outside the greenhouse can be above 95 degrees F. In the north, shading may only be necessary from late May through June.

Provide Adequate Air Movement

Because vinca is grown under warm, often humid conditions, airflow is critical. Proper use of vents, roll-up sides, HAF fans and other air moving techniques will greatly improve your vinca crop's response to very hot conditions. Greenhouse owners can increase airflow by simply installing additional HAF fans. At least four HAF fans should be running in a 30' x 100' greenhouse. The additional air movement reduces condensation on the leaf surface. Improving air flow through the vinca crop greatly reduces the potential for most foliar disease problems. It also provides an environment where the vinca soil medium can dry out as quickly as possible after watering or fertilizing. **Think air movement.** It is recommended that HAF fans run continuously day and night.

Do not water slightly wilted plants late in the afternoon. Vinca are uniquely adapted to withstanding wilting and temporary drought and will respond well to watering the next morning. Watering late in the afternoon will encourage disease.

Diseases of Vinca

Establish a Disease Prevention Program

Numerous root and foliage diseases affect vinca. Although it may be possible to identify some diseases based upon symptom description, many diseases need to be submitted to a county agent for assessment by a state extension plant disease diagnostic clinic, the University of Georgia Distance Diagnostic program or a private laboratory for diagnosis. This is particularly true for the root diseases, because control with fungicides depends upon accurate identification of the causal organism. For example, fungicides that may control *Pythium* or *Phytophthora* root rot will not control *Rhizoctonia* root rot.

As difficult as disease diagnosis can be, there are, however, very common root rot and leaf spot disease control strategies that apply regardless of which disease-causing organism (pathogen) is actually causing the disease. In general, root diseases can be minimized by avoiding injuring



Aerial *Phytophthora* is a common landscape disease.



A bed of vinca destroyed by *Thielaviopsis*.

plant roots from over watering, poor nutrition, over-fertilization, high soluble salts or poorly draining potting mixes. Foliage diseases can be reduced by avoiding prolonged periods of leaf wetness, reducing humidity levels, and increasing air circulation around plants. The faster the plant foliage dries, the less likely disease will occur.

This section divides common diseases on vinca into two categories: root diseases and foliage diseases. Disease cycles that include how the pathogen survives and spreads are provided when known.

Root Diseases

Vinca can be infected by the usual root rot pathogens including *Pythium*, *Phytophthora*, *Rhizoctonia* and *Thielaviopsis*. All are damaging and can kill infected plants, but *Thielaviopsis*, the cause of "black root rot," is the most serious root disease primarily because it is very difficult to control.

Root rot diseases are typically favored by wet soils either from over-watering, using potting mixes that drain poorly, or placing plant containers on benches or floors where water pools. All root rot pathogens are soil-borne, meaning they survive in soil and debris. They are usually introduced into the production area by poor sanitation practices such as re-using potting media and

unclean containers as well as from plant and soil debris on benches and floors. Anything that moves or contains soil (dirt and debris) has the potential to introduce or spread root rot pathogens including dirt on shoes and on the outside of potting mix bags, tools, hoses and hands to name a few.

Foliage symptoms of root diseases are very similar. Plants often are chlorotic or purplish, wilted, small and weak. A root rot disease cannot be diagnosed by examining only the foliage. The best way to diagnose the root rot disease is to look at the roots.

Black root rot (*Thielaviopsis*)

Symptoms. Vinca infected with black root rot are often stunted and/or wilted and the leaves often curl under much like symptoms caused by other root rot pathogens. The most diagnostic symptom on vinca is leaf yellowing (chlorosis) of infected plants. The chlorosis is often the first symptom seen and is then followed by plant wilting and death. Roots infected with black root rot develop dark spots or bands that are easily seen against the normally white roots or a white background. Early infection is most often seen at the tips of secondary feeder roots, but as the disease progresses the entire root system becomes black and water-soaked. The black discoloration of the roots is due to the production of darkly colored fungal spores within the root. The spores can be seen with the aid of a good (15x-20x) magnifying glass, hand lens or microscope. All stages of vinca growth can be infected and killed. The disease is especially destructive when temperatures are high and potting medium pH is higher than 6.0.

Disease Cycle. Black root rot, caused by the fungus *Thielaviopsis basicola* (also known as *Chalara elegans*), is a widespread and destructive root disease of several annual bedding plants including vinca, pansy and petunia. *Thielaviopsis* survives in soil and plant debris. When healthy roots come in contact with infected roots or fungus spores within infested soil and/or debris, they become infected. The fungus then grows and

multiplies rapidly, producing spores within the infected plants. Spores also can be spread from pot to pot by splashing water. The disease is often introduced into greenhouses from infected plugs. Always examine plugs carefully for symptoms of infection such as uneven growth and poor foliage color before introducing them into production areas. Spores of *Thielaviopsis* can survive on greenhouse benches and plug trays for up to two months and within plant debris under benches for much longer periods of time.

Management. A combination of good sanitation, proper plant care, and fungicides can help reduce black root rot disease development. Use only fresh soilless, pathogen-free, potting mixes. Never re-use potting mixes! Use new containers for each planting and keep all equipment and the planting area clean of old potting media and debris. Avoid water and heat stress and do not over-fertilize plants. In addition, avoid fertilizers high in ammonium as a nitrogen. Adjust the pH of the potting medium to keep it below 6.0, preferably 5.5. Always check your plants regularly for signs of disease and discard infected plants immediately. Preventive fungicide drenches of thiophanate methyl, triflumizole or fludioxonil are recommended to control black root rot. Fungicides can reduce disease spread, but they will not "cure" already infected plants.

Damping-off

Symptoms. Damping-off is the rotting of seeds and newly emerged seedlings by fungi, typically *Pythium*, *Phytophthora* and *Rhizoctonia*. The seed may decay prior to germination or the seedling may rot just below the soil line. Older plants are usually not affected by damping-off, but they can develop root and stem rots caused by the same fungi.

Disease Cycle. Damping-off usually occurs when seeds are planted into contaminated potting mixes and containers or when the potting mix becomes contaminated by poor sanitation practices. Over-watering and excessive overhead

misting during propagation will favor disease development by providing ideal conditions for fungal spore germination and movement, especially for *Pythium* and *Phytophthora*. Low soil temperatures before germination (below 68 degrees F) and high soil temperatures after emergence (above 77 degrees F) also favor disease development. The disease spreads rapidly through overcrowded flats or seed beds, by plant-to-plant contact and water splashing.

Management. Always use fresh soilless potting mixes and sterile flats, trays or pots to start seeds. Practice good sanitation within the greenhouse. Do not contaminate soil or containers by placing them on dirty benches or floors. Damping-off rarely destroys all plants within a flat or plug tray. Usually groups of plants within a tray are affected, which tempts the grower to drench the entire tray with fungicides to eliminate the disease-causing fungus. However, fungicides are not totally effective in eliminating fungi in soil and they will not cure already infected plants. The fungus will survive and may cause root rot in the remaining plants once the concentration of the fungicide declines. Some fungicides can also stunt seedling development. It is best to discard all the plants and soil in a flat and sterilize the flat before re-use when damping-off occurs.

***Pythium* root rot**

Symptoms. Roots infected with *Pythium* appear tan to brown and water-soaked or slimy. The outer root cortex is easily sloughed-off or stripped from the thread-like inner root (stele) when pulled with your fingers. *Pythium* typically attacks the root tips first and then progresses upward within the root system. Lower leaves of infected plants often yellow. *Pythium* also causes damping-off.

Disease cycle. Root rot is caused by several species of *Pythium* including *P. ultimum* and *P. aphanidermatum*. *Pythium* species are very common and they cannot be eliminated from greenhouse production. *Pythium* survives in soil and on

anything that contains soil (hands, shoes, pots, equipment, etc.), as well as in contaminated water sources. Over-watering and excessive overhead misting during propagation will favor disease development by providing ideal conditions for *Pythium* spore germination and movement. The disease is easily spread pot to pot by water splashing or soil movement. High soluble salt concentrations in the potting medium also favors *Pythium* infection by stressing the root system.

Management. See "Damping-off." Fungicides typically used for control of *Pythium* include etridiazole, fosetyl-Al, mefenoxam, and propamocarb.

***Phytophthora* root rot (also see *Phytophthora* aerial blight)**

Symptoms. Infected plants look very similar to any plant infected with a root rot including leaf yellowing or purpling, wilting, stunting and plant death. Infected roots do not typically slough as *Pythium*-infected roots do but are darkly colored and water-soaked in appearance.

Disease cycle. *Phytophthora* typically infects the main roots near the crown and often causes a crown rot. The fungus survives in the soil and in infested plant debris. Warmer, wet conditions favor infection.

Management. Sanitation within the greenhouse is critical for controlling *Phytophthora* diseases. Clean benches and floors of plant debris from previous crops and disinfect propagation and production areas including transplanting equipment and re-used pots or flats. Always use fresh potting media when planting. Never re-use potting media for any reason. Inspect vinca crops each week and discard any pots or flats with infected plants. Avoid over-watering plants and heavy fertilization. Applying etridiazole, fosetyl-Al or mefenoxam as a drench can reduce disease development and spread.

Rhizoctonia crown rot

Symptoms. Infected plants often fall over or break-off at or just above the soil line. Sudden wilting and plant death is caused by light tan to brown cankers that girdle the main stem. Sometimes under warm and humid conditions, the thread-like hyphae of *Rhizoctonia* can be seen suspended between the stems and lower leaves.

Disease cycle. *Rhizoctonia solani* infects vinca at or near the soil line. The fungus survives in soil and infested plant debris. Soil left on benches or containers between crops can harbor *Rhizoctonia*. Warmer, humid conditions favor infection. The fungus does not produce any spores but grows from the soil to plant tissues as thread-like filaments (hyphae). It is spread mostly by plant to plant contact and splashing soil debris.

Management. The same cultural control measures used to reduce other root rot diseases, such as sanitation within the greenhouse, will help control *Rhizoctonia* crown rot. Clean benches and floors of plant debris from previous crops and disinfect propagation and production areas including transplanting equipment and recycled pots or flats. Never re-use potting media and plug trays. Inspect vinca crops each week and discard any pots or flats with infected plants. Also, minimize wetting plant foliage when irrigating as much as possible. Apply as a heavy spray/drench fludioxonil, iprodione, PCNB, thiophanate methyl or triflumizole to reduce disease development and spread. Use according to label directions.

Foliage Diseases

Most foliage diseases of vinca are caused by fungi and are often favored by extended periods of leaf wetness. Watering late in the day so plants go through the evening with wet leaves can increase disease, because most leaf-spotting fungi require a minimum of 8 to 12 hours of constant leaf wetness to infect the plant. If water is not present on the leaf for the required time, then the fungus cannot infect and cause disease.

Also, remove infected leaves and infected plants from the production area to reduce disease spread. That one infected leaf or plant, if left in the tray or greenhouse, can spread the disease to all the other plants. Fungicides can reduce infection of new leaves, but they will not cure already infected leaves. The test for fungicide effectiveness is not whether the existing leaf spots go away (because they never will) but whether new growth is becoming infected. Repeat applications will be necessary to control fungal foliage diseases. Remember, too, that fungicides only control fungi and, to a very limited extent, some bacterial pathogens. They do not control diseases caused by viruses.

Ulocladium and Alternaria leaf spots

Symptoms. The leaf spots caused by the fungi *Ulocladium* sp. and *Alternaria alternata*, are very similar. Both fungi cause small (the size of pin-head, up to 1/8 inch in diameter) brown to black spots on the leaves, stems and petioles of infected plants. Infection typically occurs on the lower leaves first and then progresses upward through the plant. Infected leaves often yellow and fall from the plant until only the youngest leaves at the top of the shoot remain.

Disease Cycle. The leaf spots are favored by warmer temperatures and wet conditions. Low soil fertility also increases disease severity. Numerous fungal spores are produced within the spots that are usually spread by water splashing to adjacent leaves or plants. Infected leaves fall from the plant and it is presumed that the fungus survives within the leaf debris.

Management. Remove severely infected plants to reduce disease spread. Discard or destroy all plant debris at the end of the production cycle or at the end of the season after the first hard frost to reduce pathogen survival. Minimize leaf wetness by avoiding overhead sprinkler irrigation or watering only when plants will dry quickly. Adjust soil fertility and pH to enhance plant growth. If necessary, applying fungicides

including azoxystrobin, chlorothalonil, fludioxonil or iprodione every 7-14 days after leaf spots first appear on lower leaves can reduce disease development and spread.

***Phytophthora* aerial blight**

Symptoms. Sudden flagging of one shoot or wilting of the entire plant are typical symptoms of *Phytophthora* aerial blight. Water-soaked, gray-green lesions are seen at the base of the wilted shoots. This is followed by sunken, reddish brown cankers that girdle the main stem or lateral shoots. Infected plants may die within 1 to 2 weeks following symptom development. A root rot caused by the same fungus can also occur. Some vinca varieties are more susceptible to the disease. The varieties 'Little Bright Eye' and 'Little Pinkie' are less susceptible than 'Peppermint Cooler.'

Disease Cycle. *Phytophthora* aerial blight caused by the fungus *Phytophthora parasitica* is a common and extremely destructive disease on annual vinca, predominantly in the landscape, however, it does occur in greenhouse production. Infection is favored by extended periods of hot, wet weather or conditions. Frequent overhead irrigation and heavy fertilization contribute to disease development.

Management. Sanitation within the greenhouse is critical for controlling *Phytophthora* aerial blight. Clean benches and floors of plant debris from previous crops and disinfect propagation and production areas including transplanting equipment and re-used pots or flats. Always use



fresh potting media when planting. Never re-use potting media for any reason. Inspect vinca crops each week and discard any pots or flats with infected plants. Also, avoid overhead irrigation if possible or minimize wetting plant foliage. Applying azoxystrobin, fosetyl-Al with or without a mancozeb tank mix as a heavy spray/drench ("srench") at least monthly can reduce disease development and spread. Typically two to three applications may be necessary to protect the crop.

Tomato spotted wilt virus (TSWV)

Symptoms. Symptoms of virus infection are variable. Generally, infected plants are often yellow, stunted and distorted, especially in the youngest leaves. Leaves may also show black concentric rings, spots or line patterns. Often there is a purple to black discoloration in a V-shaped pattern spreading from the petiole up the main leaf vein. Blackish lesions that eventually turn into tan to brown cankers may or may not develop in infected stems. Infected plants often collapse due to stem lesions or cankers and are severely stunted. Flowers on infected plants are usually discolored and malformed.

Disease Cycle. TSWV is spread by several species of thrips, in particular the Western flower thrips and tobacco thrips. Immature thrips (larvae) acquire the virus upon feeding on the roots of infected plants. Then following pupation, the winged adults transmit the virus when feeding on a plant. The virus can infect hundreds of plants.

Management. Currently, there is no control for TSWV in ornamentals. Remove and discard infected plants immediately upon detection to reduce plant to plant spread due to thrips feeding. Monitor and control thrips populations within greenhouses. Fine-mesh screening can be used over all openings in the house to prevent thrips entry from possibly infected field crops or weeds. However, supplemental fans will be needed to move air through houses because of the reduced air-flow from the screening.

Botrytis blight (Gray mold)

Symptoms. *Botrytis* blight typically affects weakened or injured plant parts, such as old flowers and leaves or stems damaged by over-fertilization, chemical burn or mechanical injury. Under humid conditions, the fungus produces abundant gray-colored spores on the infected plant part. The cluster of fungal spores gives the affected plant part a gray, fuzzy appearance that can be easily seen with the naked eye or with the help of a magnifying glass or hand lens. Infected flowers often develop pale, water-soaked spots. Tan spots, sometimes with a concentric ring pattern can develop on leaves when infected flower petals lie against the leaf.

Disease Cycle. *Botrytis* blight or gray mold, caused by the fungus *Botrytis cinerea*, is found everywhere plants are grown. The fungus infects weakened plant parts first; then it invades other healthy tissues. *Botrytis* produces abundant spores on infected plant tissues. Estimates are that more than 60,000 spores can be produced on an infected plant piece the size of half a dime. Spores are easily spread by air currents or in water. Any activity within a greenhouse can trigger spore release, including irrigation and pesticide applica-

tions. The fungus survives on and within infected plant debris (including leaves and flowers in a garbage can). Its ability to persist in greenhouses for long periods of time make managing the disease very difficult. High humidity conditions (above 85 percent relative humidity) favor the growth and spore production of the fungus.

Management. Sanitation is critical for controlling *Botrytis* blight. Remove dead or dying tissues from plants and the soil surface, as well as any dead or dying plants. Remove all plant and soil debris from greenhouse benches and floors. Do not throw debris under benches or in walkways, and keep garbage cans covered within the greenhouse. The other critical disease control factor is managing humidity in the greenhouse. Heat and ventilate the greenhouse to prevent high humidity conditions. Venting early in the day when moisture has condensed and before the air is warmed can reduce humidity in warmer months. During cooler months, heat the air in late afternoon and then vent to expel the warmed moist air to the outside and bring in cooler dry air. Fungicides such as chlorothalonil, iprodione and mancozeb also aid in controlling *Botrytis* blight.

Establish an Insect Control Program

One of the true strengths of using vinca in a production plan is that the plants are affected by very few insect groups. In general, the standard recommendations for insect control works very well for vinca. Thrips, spider mites and mealy bugs are the three kinds of insects known to infest

this crop. However, infestations on vinca are readily prevented through proper scouting and sanitation. Consult your local county extension agent or sales representative concerning additional insect control recommendations.

Production Considerations

Record Keeping Is a Must

Use a binder notebook to record everything, including the weather, crop inputs, soil and foliage tests, water tests, lot numbers of products used, transplanting dates and telephone conversations with suppliers. This practice will go a long way toward recording successes and resolving your production problems with vinca. We recommend paying particular attention to recording greenhouse humidity, soil pH and watering events. It takes time, but it may mean the difference between a very disappointing season or a big success in future years. (See Table 5, page 23.)

About Baskets and Decorative Containers

You will find many uses for vinca in the garden center market, and you may be tempted to use every container at hand, but beware — the drainage required to grow and maintain vinca in a container is critical. Avoid very shallow decorative containers if possible. Unless it provides many, many small holes for water release, the “perched water” effect will be extreme and vinca will not survive. For small ceramic and clay pottery without drain holes, use a $\frac{1}{16}$ inch masonry drill and place holes every 2 inches across the pot’s bottom. You can then suspend the planter on gravel within another decorative tray if necessary.

For larger pots and baskets, drainage is still an issue. Make sure that large particles of bark or small gravel are placed at a depth of 2 inches prior to adding the soil and plants. Do not use reservoir-style baskets for vinca. Your staff may be successful in managing the soil water status in reservoir baskets, but your customers will likely not have developed that skill. Remove basket trays during production. Maximize your customer’s success by planning ahead and providing containers that drain rapidly. Obviously, when planting in baskets and shallow containers, a high porosity soil is essential. Adding one part perlite to three parts commercial peat-based mix is adequate. Remember to advise your staff and customers of the highly porous soil so they can address watering properly.

Companion planting in color bowls and large containers is very popular and profitable. They take planning and the same cultural care once placed in the landscape, however. For example, a large 3-foot round city-street planter with tall, blue salvia ‘Victoria’; mid-sized border-type ‘Tropicana Pink’ vinca; short, white nierembergia ‘Mount Blanc’ and trailing blue scaevola ‘New Blue Wonder’ will be spectacular, especially when accented with ‘Silver-Dust’ Dusty Miller. Culture is important for this combination to be successful. Keep fertility low, use a 15-2-20 high nitrate fertilizer and avoid drought or excess watering. Your entire planting will grow slowly and look attrac-

Table 5. Suggested record form to keep on Vinca crop production

	Year 1	Year 2
Amount grown/source/cultivar		
Seed Date/Plug Arrival Date		
Date Planted		
Container & Soil Type, Location		
First Flower		
PGRs Used		
Soil pH/EC (2-3 tests per crop)		
Weather – 1 st four weeks, Humidity		
Weather – 2 nd four weeks, Humidity		
Sale Ready Date		
Actual Ship Dates		
Fertility Program		
Disease/Insect Controls Used		
Watering Schedule		
Customer Feedback		
Other Notes:		

-tive all summer. If excess water or fertility is applied, the scaevola will become overly large, the vinca and nierembergia will stall and/or die, and the salvia will bolt and become thin, brittle or floppy. You can see that educating the final customer is critical. Care sheets that accompany each basket would be helpful.

Education Is the Key to Selling Vinca

Plan Now to Educate Your Customers

Your crop production plan should include developing an information sheet for your customers. If you spend hundreds of hours carefully growing vinca, why turn it loose with a client who knows nothing or little of its needs? Our industry must do a better job informing landscapers, garden center managers and consumers on the cultural requirements of Vinca. They are easy to grow if you know the facts.



The Economics of Vinca Production

A Vinca Enterprise Budget

The budget below typifies the cost of producing and marketing about 2,500 vinca (2 benches of capacity or 160 flats).

Table 6. Estimated variable costs of producing vinca in Georgia, Zone 7, 2002.
Salable Crop = 2,500, 4" pots in flats

Item	Description	Unit	Quantity	\$/Unit	\$/Crop
Materials:					
Plugs	<i>Catharanthus roseus</i> (10 trays delivered, 5% loss)	each	2,880	0.065	187.20
Containers	4" press fill pots (500 per case delivered)	case	6	45.00	270.00
Flats/Trays	18-count for 4" (50-18 count/case delivered)	case	3	28.50	85.50
Root Media	3 cu. ft. bags (delivered)	bag	19	14.00	266.00
Plant Identification Stakes	300/bundle (color printed)	bundle	9	6.00	54.00
Fertilizer	Pansy Vinca Special (20 lb bags, delivered)	bag	8	23.00	184.00
Pesticide/Herbicide	Truban 30WP	bag	28	8.15	228.20
Chemical/PGR	PG Manager	bag	1	83.00	83.00

Machinery/Equipment/Greenhouse:

Greenhouse (standard 30' x 90' complete + 2 rolling carts) [hvac, lighting, irrigation]	\$44.00
Pot Filler (160 - 4" pots/hr capacity)	\$56.00
Truck (2-ton box used, 200-mile driving radius) [driver, fuel, permits]	\$200.00

Labor

Hired	Production	52 hrs @ \$7.00/hr	\$364.00
	Marketing/Administrative		\$200.00

Subtotal	\$2,221.90
Interest on Operating Capital (0.14 @ 12%)	\$37.33
Total Variable Cost	\$2,258.23
Variable Cost per marketable plant (10% production loss = 2,462 salable plants)	\$0.96
Fixed Costs (debt repayment, depreciation, repairs/maintenance on greenhouse and truck) per marketable plant	\$0.12
Total Cost per salable plant	\$1.07

The variable cost per salable plant (from ordering 10 trays or 2,880 plugs and expecting a 5 percent loss upon delivery plus an additional 10 percent plant loss during production and marketing leaves 2,462 marketable plants) is \$0.96. The fixed cost (overhead on property, facilities and equipment actually used in production during the 8-week production period) is 12 cents per plant, for a total cost for production and marketing of \$1.58 per plant.

Table 7. Costs-output sensitivity of producing and marketing Vinca

Number of Plants	Total Variable Costs				
	\$2,034	\$2,147	\$2,260	\$2,373	\$2,486
2,705	\$.75	.79	.84	.88	.92
2,460	\$.83	.87	.92	.97	1.01
2,215	\$.92	.97	1.02	1.07	1.12

Because facilities (capacity, age, cost, use) vary from grower to grower, considering only the variable or direct costs of production and marketing over a 10 percent range above to below the budgeted total variable costs of \$2,258, and a 10 percent variability in output above to below the anticipated number of salable plants (2,462) in the chart above, shows the cost-output sensitivity of producing and marketing vinca. For the anticipated 2,460 plants at a \$2,258 total variable cost, a selling price exceeding \$0.93 is needed to make a penny (1 cent) profit per plant, excluding fixed costs. A 5 percent rise in variable costs with an additional 5 percent plant loss places the break-even selling price (covering variable costs but not fixed costs) at \$1.02 (by interpolation) per plant.

As noted in the budget for the assumed greenhouse and equipment, the overhead or fixed or indirect costs for the 8-week production period using two full benches total 11 cents per 4-inch vinca. These profits occur when selling price exceeds total costs (fixed plus variable) or \$1.08 per plant in this situation portrayed in the enterprise budget.

If the marketing goal is a 10 percent markup (profit above cost), the asking price should be at least \$1.19 per plant (\$1.08 total cost + 10% or 11 cents markup). If the pricing goal is to receive a 10 percent margin (profit as a percentage of selling price), the desired selling price would be \$1.20 per vinca (\$1.20 selling price minus 10% or 12 cents gets the \$1.08 total cost). Using the same total cost, the selling price per plants bulk a 20 percent markup would be \$1.30, where a selling price of \$1.35 is needed to ensure a 20 percent profit margin.

Is the Vinca Market Still Growing?

Given the recent drought years, sales of vinca for the landscape, for specialty baskets and for large city containers is strong and will likely remain strong. New colors, more vigorous cultivars and improved cultural information will increase consumers' success rate. If we pay attention to educating our customers, sales in the landscape market will grow and your customers will experience the joys of a heat tolerant, easy to grow bedding plant. No other bedding plant performs so well in heat and is as versatile as vinca.



References

- Campbell, C.R., B.E. Whipker, D.S. Pitchy, P.V. Nelson, and J.L. Gibson. 2001. **Nutrient deficiencies of Vinca.** *GM Pro Magazine*. March 2001 pp. 36-42.
- Chase, A., and W. King. 1993. **Is your vinca resistant to phytophthora?** *Grower Talks Magazine*, p. 63-69.
- Jacque, D.J., F.R. Gouin, and P.S. Konjoian. 1992. **Nitrate fertilization and root media effects on growth and shelf-life of 'Honeycomb' marigolds and 'Novette Red' impatiens.** *J. Plant Nutr.* 15:569-578.
- Knowles, T.C., B.W. Hipp, and M.A. Hegemann. 1993. **Container medium and slow-release nitrogen fertilizer influence growth and quality of *Salvia farinacea*.** *HortScience* 28:623-624.
- Koranski, D., and P. Karolvich. 1990. **Plugs: Problems, concerns and recommendations for the grower.** 'Grower Talks' On Plugs. Geo. J. Ball Pub. Co., pp. 11-17.
- Mattis, Pamela R., and David R. Hershey. 1992. **Vinca roots need proper iron source.** *Greenhouse Manager Magazine* (GMPro) Sept. 1992 pp. 82-83.
- Mills, H.A., and J.B. Jones. 1996. **Bedding Plants.** *Plant Analysis Handbook II.* Micro-Macro Publishing, Athens, GA. Pp. 192.
- NAU, J. 1991. **Vinca.** *In: G.A. Ball, Jr. (ed.) The Ball Redbook, 15th Ed.* Reston Publishing Co., Reston, VA. pp. 782-783.
- NAU, J. 1993. **Vinca.** *In: G.A. Ball, Jr. (ed.) Ball Culture Guide, 2nd Ed.* Ball Publishing Co. Batavia, IL. p64.
- Thomas, P.A. 1997. **Vinca.** *In: Tips On growing Specialty Potted Crops.* Chapter 25, Ohio Florists Association Tip Series, pp. 125-131.
- Thomas, P.A. 1991. **So what if vinca can't swim!** *Georgia Commercial Flower Growers Assoc. Newsletter.* 1(3):3-4.
- Thomas, P.A. 1992. **Why can't you grow quality vinca?** *Greenhouse Manager Magazine*, December. P. 48-55.
- Thomas, P.A., and G. L. Wade. 1997. **Victory with vinca.** *Greenhouse Grower Magazine*, April p. 50.
- Thomas, P.A., and J.G. Latimer. 1996. **Growth of vinca as affected by form of nitrogen, presence of bark, and type of micronutrients.** *J. Plant. Nutrition* 18:2127-2134.
- Williams, K., and J. Lehmann. 1996. **Vinca: From start to finish.** *Greenhouse Grower Magazine*, June, p. 94.

Author Credits:

Paul A. Thomas is an Associate Professor of Floriculture and Extension Floriculture Specialist at The University of Georgia, Department of Horticulture, 215 Hoke Smith Building, Athens, GA 30602.
706-542-2340.

E-mail pathomas@uga.edu.

Bodie Pennisi is an Assistant Professor of Floriculture and Extension Floriculture Specialist at The University of Georgia, Rural Development Center, Tifton, GA 31794.

229-386-3687

E-mail bpennisi@uga.edu

Forrest Stegelin is an Associate Professor of Agricultural Economy at The University of Georgia, Department of Ag Economics 315 Connor Hall, Athens, GA 30602.

706-542-0850

E-mail fstegelin@uga.edu

Jean Woodward is an Assistant Professor and Extension Plant Pathologist at The University of Georgia, Department of Plant Pathology, Miller Plant Science Building, Athens, GA 30602.

706-542-9046

E-mail jwoodward@uga.edu



Bulletin 1219 / Reviewed April 2009

The University of Georgia and Ft. Valley State University, the U.S. Department of Agriculture and counties of the state cooperating. Cooperative Extension, the University of Georgia College of Agricultural and Environmental Sciences, offers educational programs, assistance and materials to all people without regard to race, color, national origin, age, gender or disability.

An Equal Opportunity Employer/Affirmative Action Organization Committed to a Diverse Work Force