NC STATE UNIVERSITY
Floriculture Research

GROWING TIPS FOR SNOW PRINCESS

RESEARCH-BASED PRODUCTION RECOMMENDATIONS

PW PROVEN WINNERS®

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GROWING TIPS FOR SNOW PRINCESS™

LOBULARIA HYBRID

Snow Princess™ is an exciting new *Lobularia hybrid*. It is an extremely vigorous plant that has a growing habit similar to a vegetative petunia. It does not behave like a seed Alyssum. Consumers love the plant because of its flowing mass of white flowers.

Growers may find greenhouse production to be challenging. Its aggressive growth pattern means that it can overwhelm other plants in a mixed container and it requires frequent irrigations. Because of the unique characteristics of Snow Princess™, there is a need for additional greenhouse cultural information. Solutions to both of these challenging characteristics were investigated and can be solved with the incorporation of some simple cultural techniques.

This guide summarizes a series of experiments conducted at North Carolina State University which determined optimal fertility rates, pH ranges, nutritional disorders, physiological disorders, and insect problems. Appreciation is expressed to Proven Winners and Fine Americas for project funding. This guide provides detailed information of Best Management Practices for successfully growing Snow Princess™ *Lobularia hybrid*.

PW PROVEN WINNERS®

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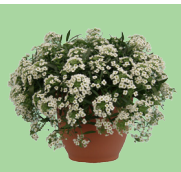
QUICK TIPS

SNOW PRINCESS™ LOBULARIA HYBRID



Key Tips

Do NOT water stress the plants. Do NOT use Judo® insecticide. Use plant growth regulators to manage growth and irrigation frequency.

SCHEDULE
The planting and timing information for early spring and fall finish.

Pot Size	Plugs Per Pot	Weeks to Finish
4-5”	1	4-5
6”/Gallon	1	5-6
8”	2-3	6-8
10-12”	3	8-10

TEMPERATURE
Rooting Out: B (65-72^{O}F or 18-22^{O}C)
Growing On: A (55-65^{O}F or 13-18^{O}C)
Holding: B (50-60^{O}F or 10-16^{O}C)

LIGHT
Provide high light levels [6,000 to 10,000 foot candles (60,000 to 100,000 Lux)]. Lower light levels will promote stretch.

IRRIGATION
Snow Princess™ is a vigorous plant and must be frequently irrigated if no plant growth regulators are applied. Water stress leads to lower leaf yellowing and loss. Use PGRs as an irrigation management tool.

FERTILITY (pH AND E.C.)
Provide a balanced N-P-K fertilizers with all the macro- and micronutrients.
Target pH Range: 6.0 to 6.5
Rate:150 to 200 ppm N.

Target E.C. Range	
Measurement Method	Target Range (mS/cm)
1:2 Method	0.5 to 1.2
SME	1.2 to 2.5
PourThru	1.8 to 3.75

PINCHING
Pinch newly arrived plugs if not already done. Pinching a second time will help control growth and encourage a round shape. Pinching is a must if plant growth regulators are not used. Pinching will delay flowering by ~7 days.

GROWTH CONTROL
A negative DIF can be used.
Do not use water stress to manage growth.

Preplant liner soaks: 4 to 8 ppm Piccolo® (paclobutrazol) or 0.5 to 1 ppm Concise® (uniconazole).
Foliar sprays: 75 to 100 ppm Piccolo® or 20 to 25 ppm Concise®.
Substrate drenches: 2 to 4 ppm Piccolo® or 1 to 2 ppm Concise®.
Rates based on North Carolina growing conditions, review the details in the PGR section.

PESTS
Sporadic caterpillar feeding (Diamondback moth) and leafminers.

Petal drop may impact (*Botrytis*) plants growing below hanging baskets.

PROBLEM SOLVER

SNOW PRINCESS™ LOBULARIA HYBRID

Below are the most common problems encountered with Snow Princess™.	
Problem	**Possible Cause(s)**
Crown leaves yellow and brown	Water stress between irrigations **[Page 3]** Low fertilization rates **[Pages 7, 15]**
Excessive stem stretch	Lack of pinching **[Page 19]** Low light Lack of plant growth regulator application **[Page 19]**
Continual wilting	Lack of plant growth regulator application **[Page 19]** Lack of growth management
Sudden die back of the growing tips	Avoid Judo® applications **[Page 18]**

Problem	Possible Cause(s)
Thick, distorted plant shoots, no flowers	Avoid Judo® applications **[Page 18]** Herbicide drift Boron deficiency
Lower leaf purple color-ation	Cold growing temperatures Phosphorus deficiency **[Page 15]** Root rots Overwatering
Interveinal chlorosis of the new growth	Iron deficiency induced by high substrate pH levels (>6.5) **[Page 12]**
Holes in leaves	Caterpillar feeding Flea beetles Slugs

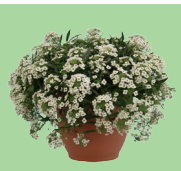
Problem Solver: Disorders reported for Snow Princess™ Lobularia and seed alyssum

Disease	Insect	Nutritional	Physiological
*Pythium**	Diamondback moth	Nitrogen deficiency	Water stress – lower leaf yellowing and necrosis
Rhizoctonia*	Leafminers	Magnesium deficiency	Low temperature stress – lower leaf purpling
Botrytis*	Leafhoppers**	Phosphorus deficiency	Frost/Freeze damage
Downy mildew*	Tarnish plant bug**	Iron (high pH)	Insecticide phytotoxicity – flowering ceases, distorted growth
Club root*	Slugs**	Boron deficiency	PGR overdose - flowering ceases, distorted growth
Fasciation*	Harlequin bug**	Sulfur deficiency	Leggy growth – low light
	Cyclamen mite*	Low EC	Stretched growth – no 2nd pinch
		High EC	Stretched growth – need PGRs

** Listed for seed sweet alyssum, not specifically 'Snow Princess'*
*** Observed with 'Snow Princess' in landscape plantings*

FERTILIZATION RATE AND E.C.

SNOW PRINCESS™ LOBULARIA HYBRID



We posed the question of what is the optimal level of fertilizer to use when growing Snow Princess™?

To answer this, we transplanted 84 cell plugs into 5-inch round pots containing Berger BM6 on February 3rd. We irrigated different sets of plants with: 50, 75, 100, 200, 300, or 400 ppm N. The fertilizer used was Proven Winners Professional 14-3-14 with minors, formulated for low alkalinity water with FeEDDHA.

The plants were given a second pinch on February 12th. Five plants from each of the fertilization rates were sampled after 2, 4, and 6 weeks of growth. We measured plant height, diameter (measure at the widest point and then turned 90 degrees for a second measurement), PourThru pH and electrical conductivity (E.C.), and dry weight. A single consolidated leaf tissue sample of the most recently matured leaves was taken per treatment for foliar nutrient analysis. The amount of growth (height, diameter, and dry weight) for each fertilization rate was calculated over time by a growth index equation.

What we found.

Plant growth was maximized with fertilization rates between 132 to 250 ppm N (Figure 1). Substrate E.C. levels are provided in Figure 2. Over time, when 300 and 400 ppm N was applied, the E.C. levels increased. Accumulations indicate that the plant was not utilizing all of the fertility provided and the fertilization rates were excessive. Photographs of the plants at finish are contained in Figure 3. The proportion of blooms to leaves was very good with 100 ppm N. Plant growth was maximized with 200 ppm N. Plants grown with 50 and 75 ppm N were smaller and lacked fullness. Plants fertilized with 300 and 400 ppm N were stunted because of excessive E.C. levels.

Recommendations.

Snow Princess™ plants grew very well with fertilization rates between 132 and 250 ppm. This corresponds to the following recommended target E.C. levels.

Target E.C. Range	
Measurement Method	Target Range (mS/cm)
1:2 Method	0.5 to 1.2
SME	1.2 to 2.5
PourThru	1.8 to 3.75

Figure 1. The calculated growth index after 6 weeks of growth for Snow Princess™ Lobularia grown with 50, 75, 100, 200, 300, or 400 ppm N.

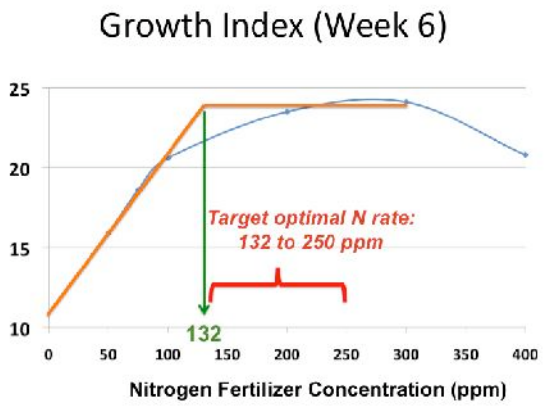


Figure 2. Electrical conductivity (E.C.) values over time for Snow Princess™ Lobularia grown with 50, 75, 100, 200, 300, or 400 ppm N.

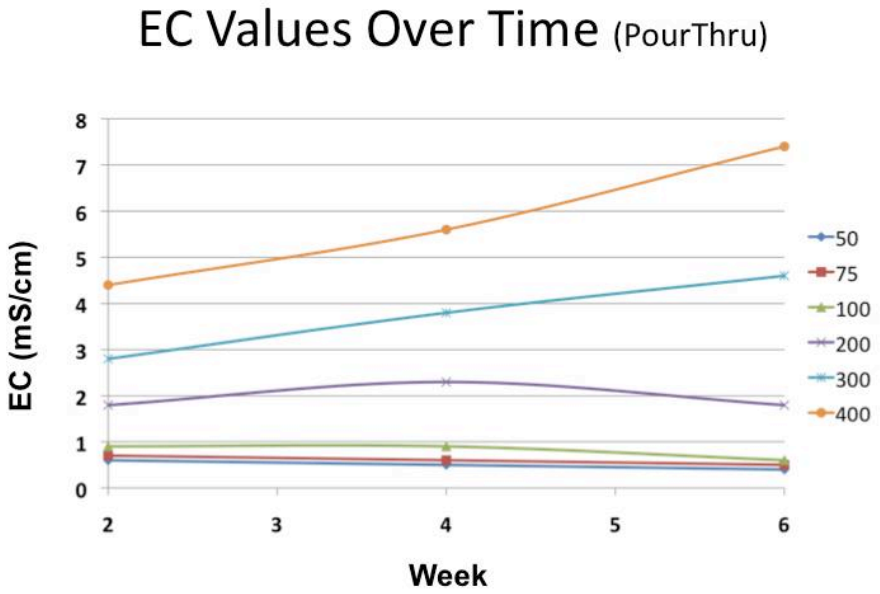
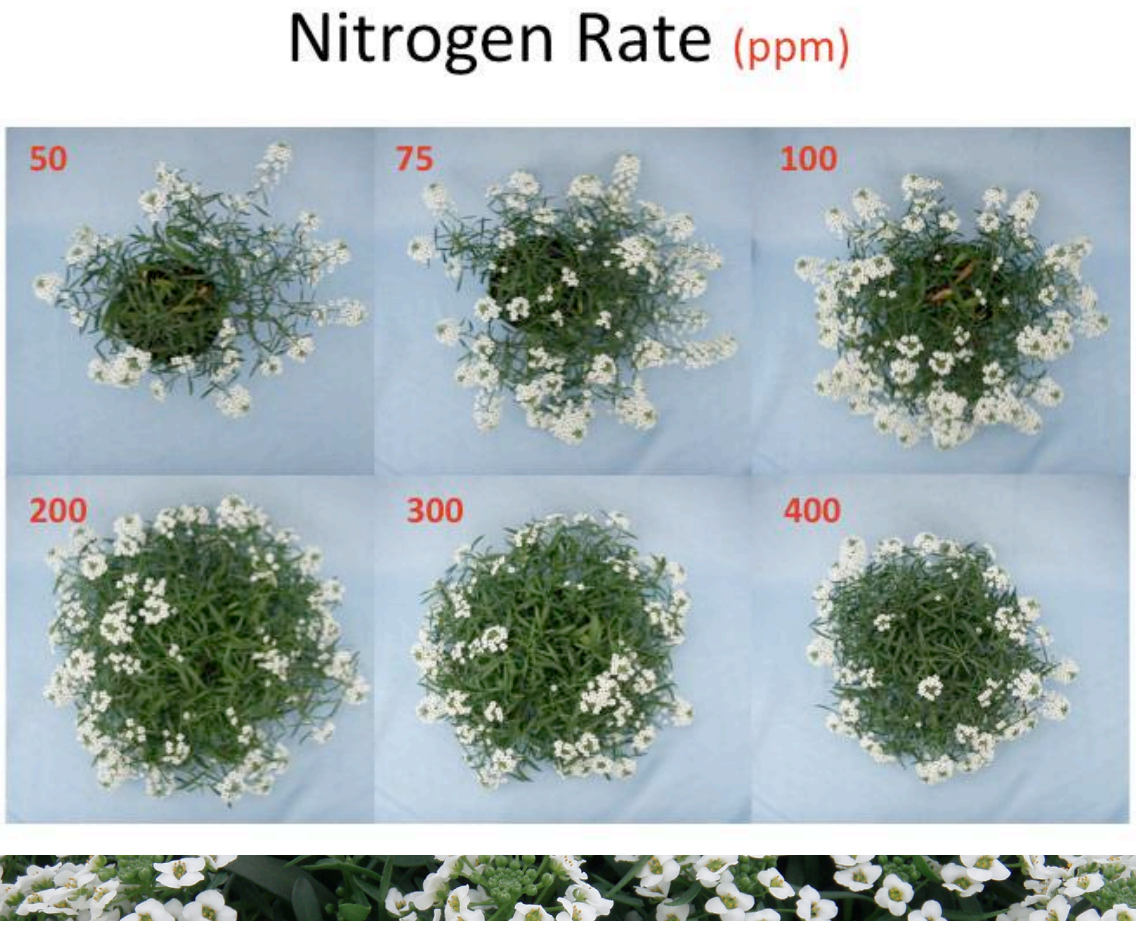
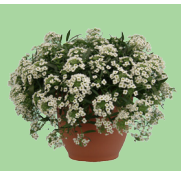


Figure 3. Plant growth of Snow Princess™ Lobularia grown with 50, 75, 100, 200, 300, or 400 ppm N. Photograph taken after 6 weeks of growth.



RECOMMENDED TISSUE NUTRIENT VALUES

SNOW PRINCESS™ LOBULARIA HYBRID



With the optimal fertilization rate study, we had a second question: what are the recommended leaf tissue analysis ranges for Snow Princess™?

To answer this, we took a single consolidated leaf tissue sample of the most recently matured leaves for foliar nutrient analysis for each fertilization rate. Based on the growth index equation, we plotted the tissue values over time for plants grown with 100 and 200 ppm N

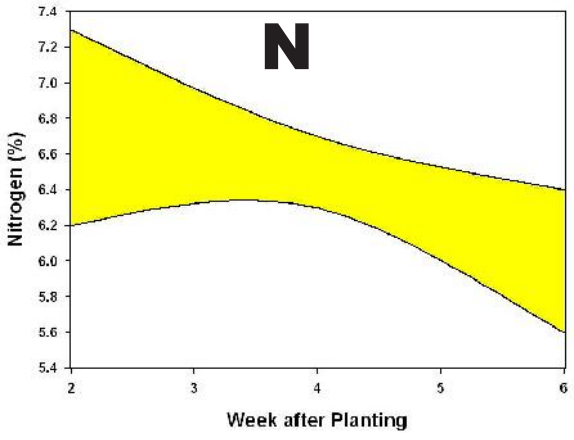
What we found.

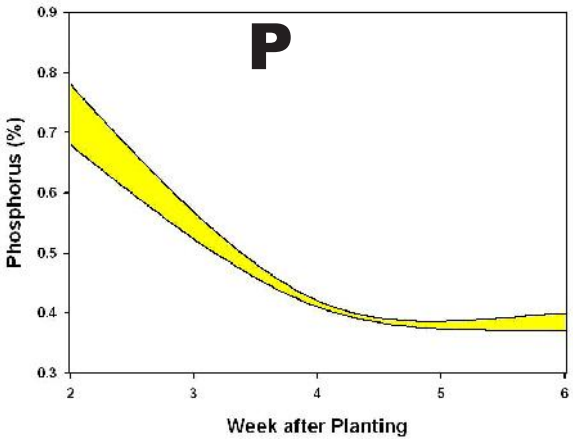
The series of graphs provide the recommended ranges for actively growing Snow Princess™ plants. Graphs are provided for N, P, K, Ca, Mg, S, B, Cu, Fe, Mn, Mo, and Zn.

Recommendations.

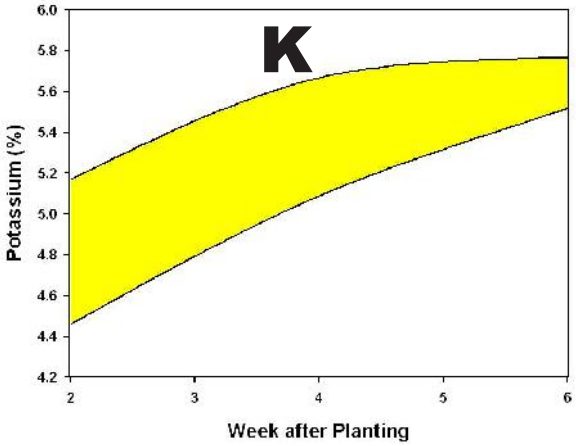
If nutritional problems arise with Snow Princess™, the graphs can be used to help determine what is considered "adequate" tissue levels for optimally grown plants over time.

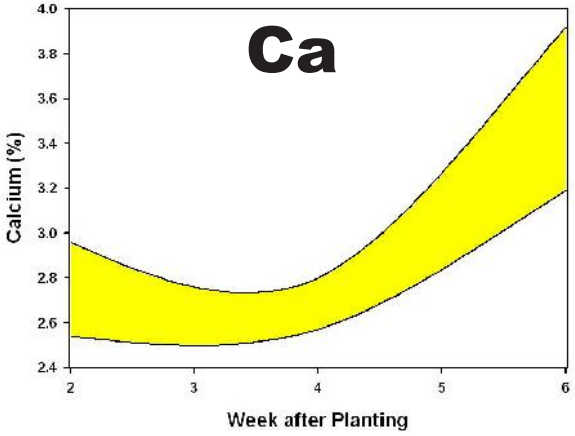
Tissue Values Over Time

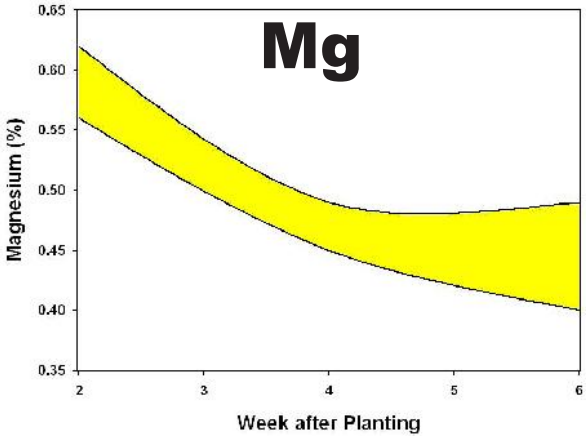


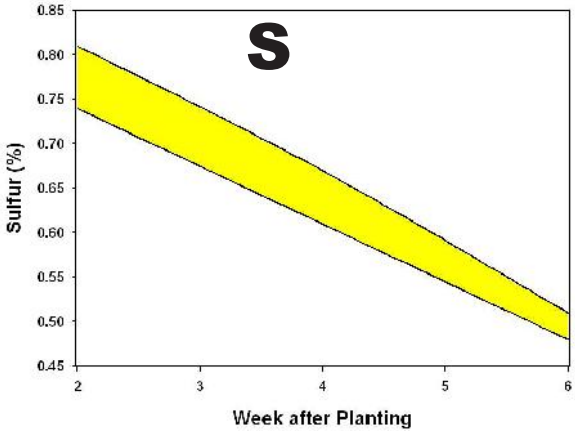


Tissue Values Over Time

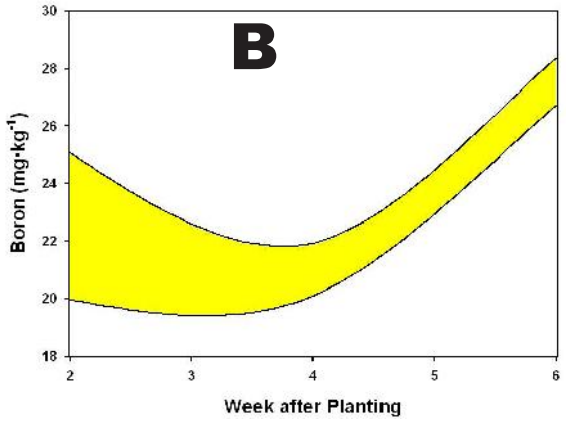


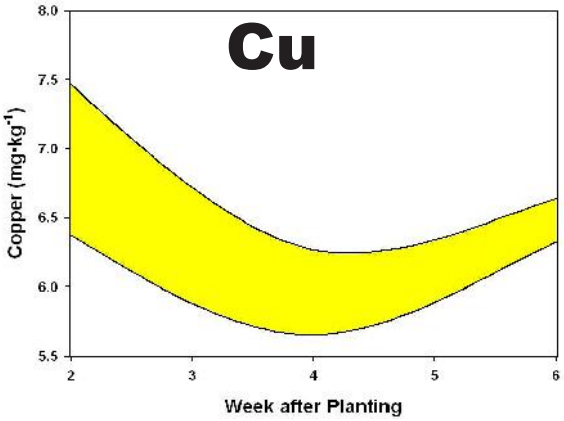


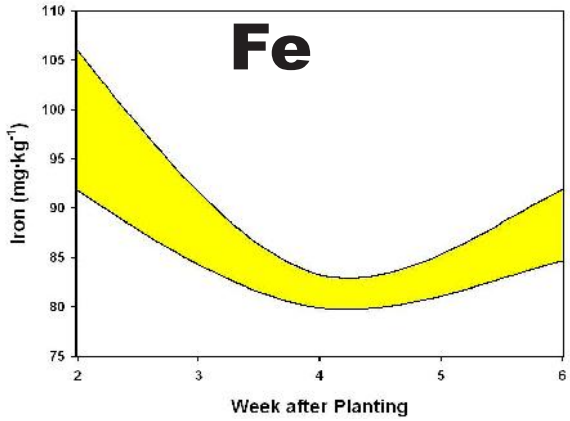


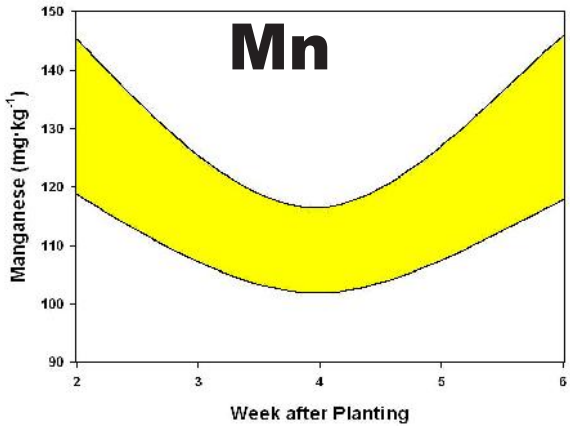


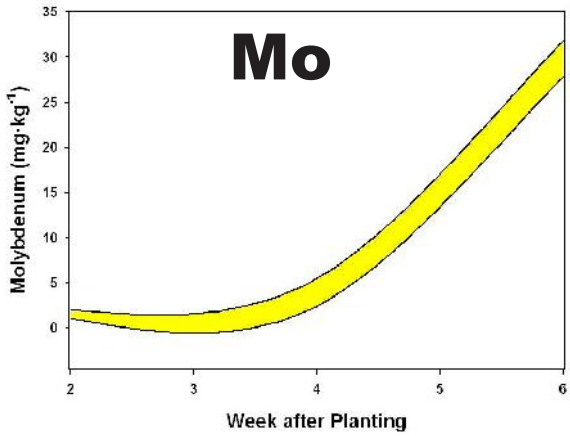
Tissue Values Over Time

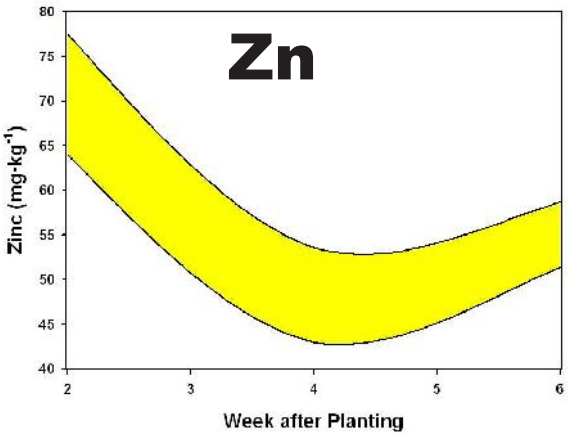












RECOMMENDED PH RANGE

SNOW PRINCESS™ LOBULARIA HYBRID

What is the recommended pH range for growing Snow Princess™?

To answer this, we grew Snow Princess™ plants with a fertilizer solutions containing 200 ppm N. We provided one set of plants with only 200 ppm N, another set we added sulfuric acid to acidify the solution and the third set had Limestone F added to make the solution basic.

We also conducted a follow-up study by adding Limestone F to 13-2-13 Cal-Mag and Proven Winner 14-3-14 Low Alkalinity Water fertilizer with the added FeEDDHA.

What we found.

Adding sulfuric acid caused the substrate pH to drop rapidly. At pH 4.75, plant damage occurred as lower leaf yellowing (Figure 4). At pH 4.0, symptoms of leaf yellowing progressed to necrosis. Eventually the plants died.

Adding Limestone F caused a gradual rise in the substrate pH to 7.75. Intervienal chlorosis of the upper leaves developed (Figure 5). This was the typical symptom of high pH induced iron deficiency. Snow Princess™ plants seem to tolerate higher pH levels better than most plants.

In a follow up study the added FeEDDHA in the Proven Winner 14-3-14 Low Alkalinity Water fertilizer provided an extra degree of safety against high pH induced iron chlorosis. Symptoms occurred at pH levels 0.3 units higher than when 13-2-13 Cal-Mag was used.

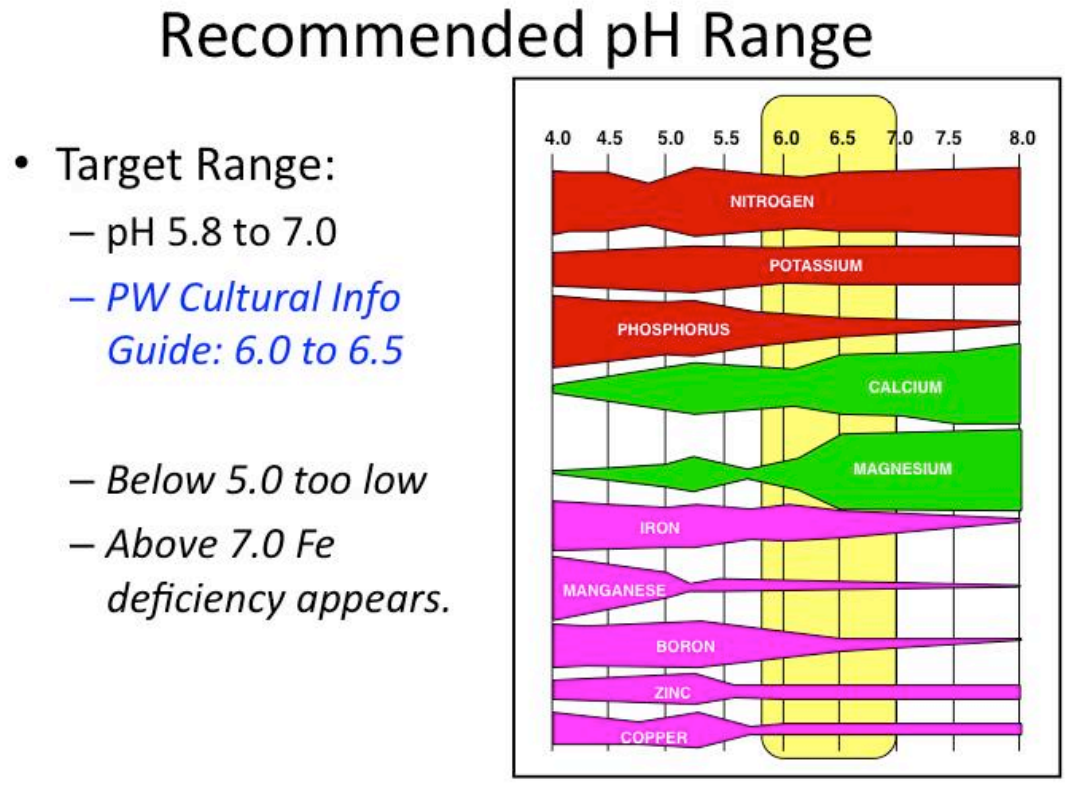
Recommendations.

The target pH range for growing Snow Princess™ is between 5.8 and 7.0. For an added degree of safety, it is recommended that the plants be grown between 6.0 and 6.5 (Figure 6).

Figure 4. Plants grown with 200 ppm N and sulfuric acid to acidity the substrate. Lower leaf yellowing appeared at pH 4.75. Necrosis and plant death followed at pH 4.0.

Figure 5. Interveinal chlorosis appeared above pH 7.0.

Figure 6. The recommended pH range for Snow Princess™ is between 5.8 and 7.0. No pH related disorder symptoms were observed between pH 6.0 and 6.5.



COMMON NUTRITIONAL DISORDERS

SNOW PRINCESS™ LOBULARIA HYBRID

What are the common nutritional disorders of Snow Princess™?

To answer this, we grew Snow Princess™ plants in the North Carolina State Nutrient Disorder System. We grew plants with a complete fertilizer solution to have a normally grown control. Sets of plants were also grown in a fertilizer solution minus the element being studied. The elemental deficiencies we induce were nitrogen, phosphorus, potassium, sulfur, iron, and boron.

What we found.

Nitrogen deficiency was the quickest symptom to appear as a lower leaf yellowing (Figure 7). This symptom is very difficult to distinguish visually from drought stress. The other useful information which will aid in a diagnosis will be plant stunting and by conducting a test for E.C. levels to determine if it is low.

Phosphorus deficiency appeared in two forms (Figure 8). The classical symptom of lower leaf purpling occurred when the plants were grown with no P and over irrigated. When growing conditions and temperatures are optimal, P deficiency begins as a dull green coloration and the plants are compact. Lower leaf drop will occur with advanced symptoms.

Potassium deficiency should rarely be seen. Most fertilizers contain both N and K, thus lower leaf yellowing from the lack of N should appear first. For potassium deficiency, symptoms began on the lower leaves as a yellowing of the growing tips (Figure 9). Later gray spots appeared and the necrosis developed along the leaf margins. The symptoms progressed up the plant over time.

Sulfur deficiency should only occur rarely, although with Lobularia being in the cabbage family it would have a higher demand for S. The initial symptoms began with the upper leaves developing an overall yellowing (Figure 10). As symptoms progressed, the overall yellow coloration moved downward over the entire plant. Sulfur deficiency, overall yellowing starting with the top growth, can be distinguished from iron deficiency which develops as an interveinal chlorosis of the new growth (see Figure 5).

Boron deficiency should also only occur on rare occasions. The initial symptom is that flowering stops (Figure 11). All flowers fail to form petals and then all flower development stops. New growth on the primary stems aborts. Some axillary shoot development begins and the leaves have a twisted appearance. Similar symptoms of tip burn and distorted growth occur when Judo® is applied to Snow Princess™, thus it should be avoided (Figure 12).

Recommendations.

By supplying a balance fertilizer and maintaining adequate E.C. levels and a substrate pH between 6.0 and 6.5, nutrient disorders should rarely occur with Snow Princess™.

Figure 7. The progress of symptoms of nitrogen deficiency with Snow Princess™.

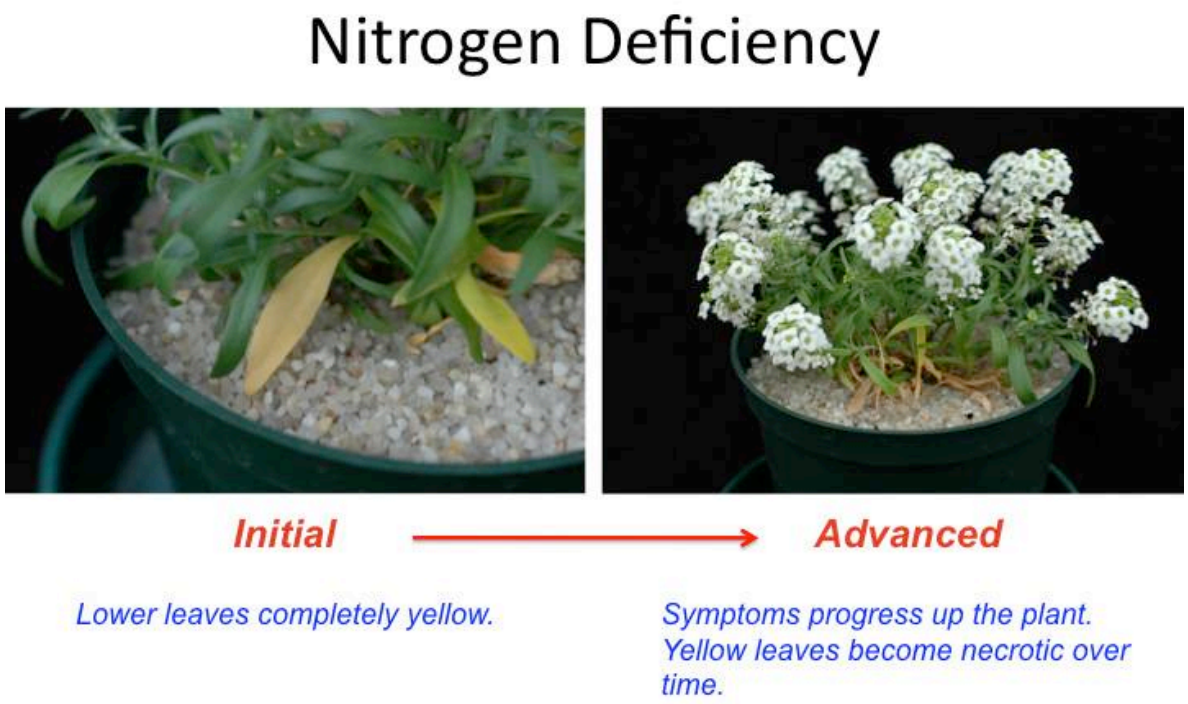


Figure 8. The two common types of symptoms of phosphorus deficiency with Snow Princess™.

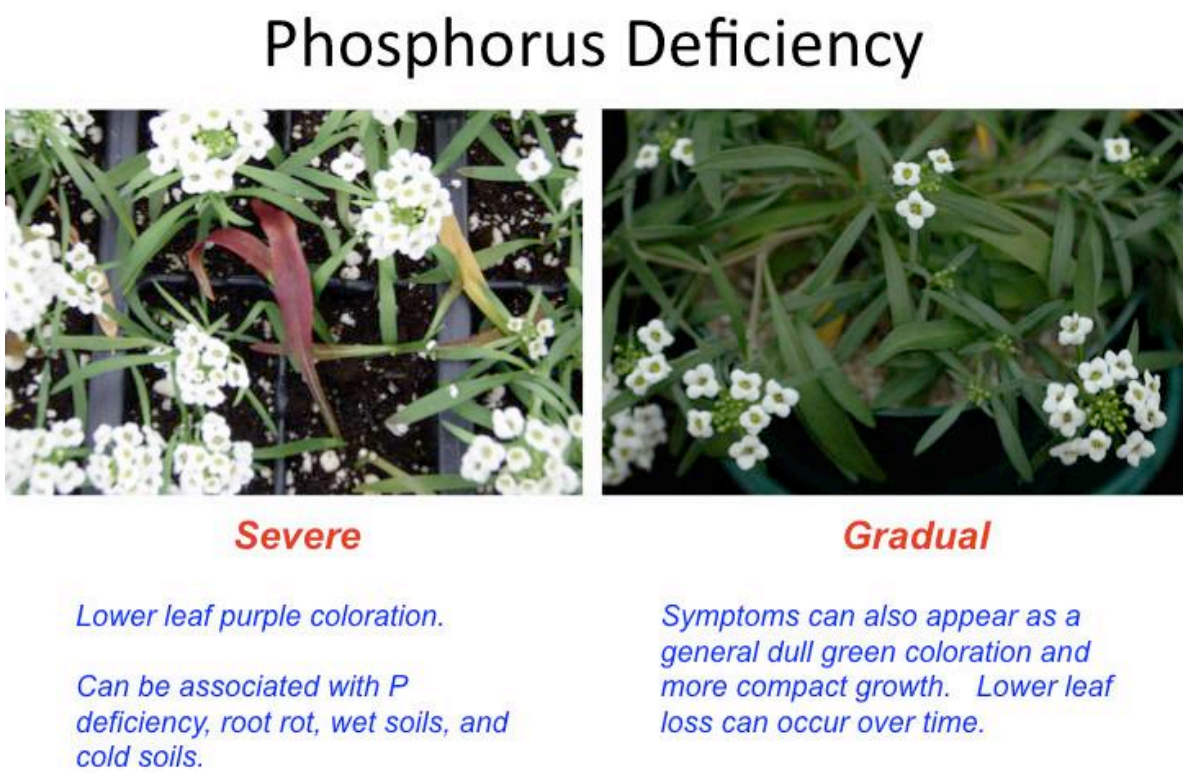


Figure 9. The progress of symptoms of potassium deficiency with Snow Princess™.

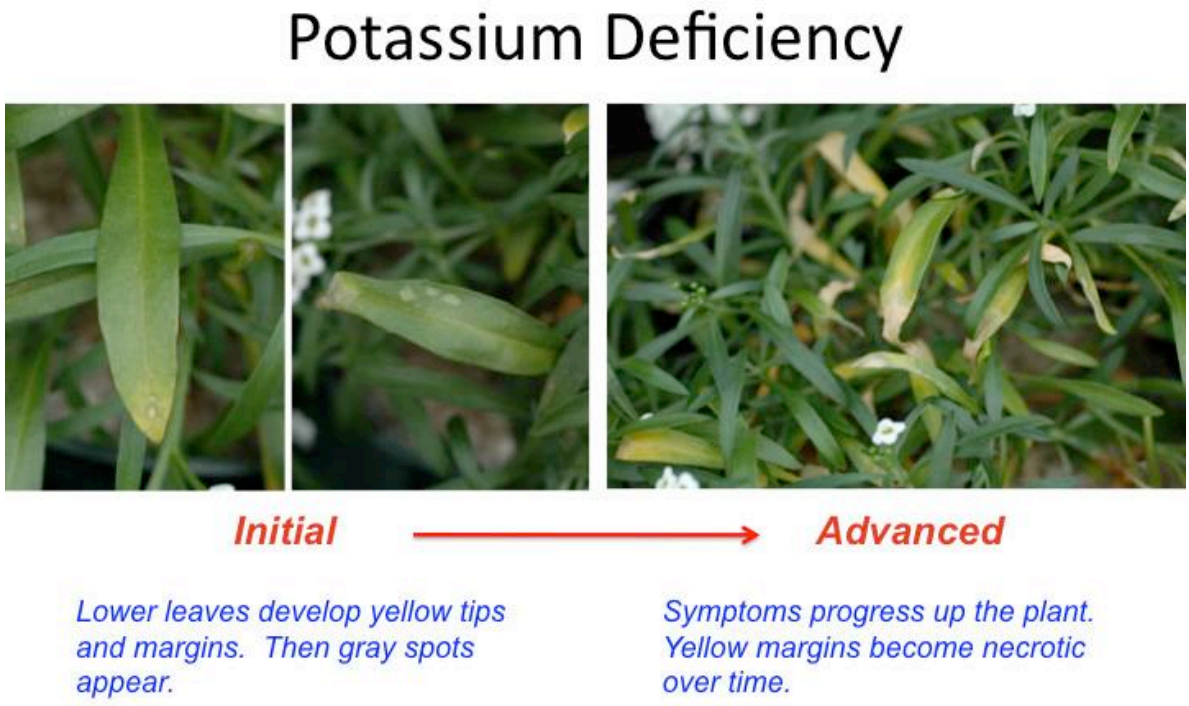


Figure 10. The progress of symptoms of sulfur deficiency with Snow Princess™.

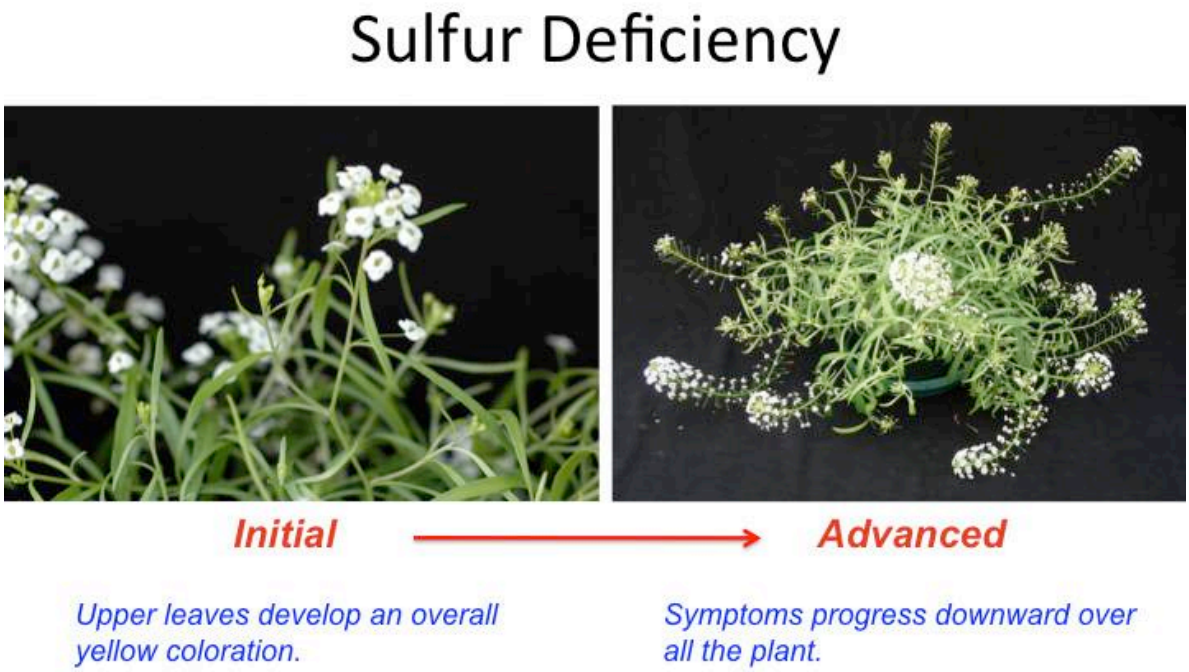
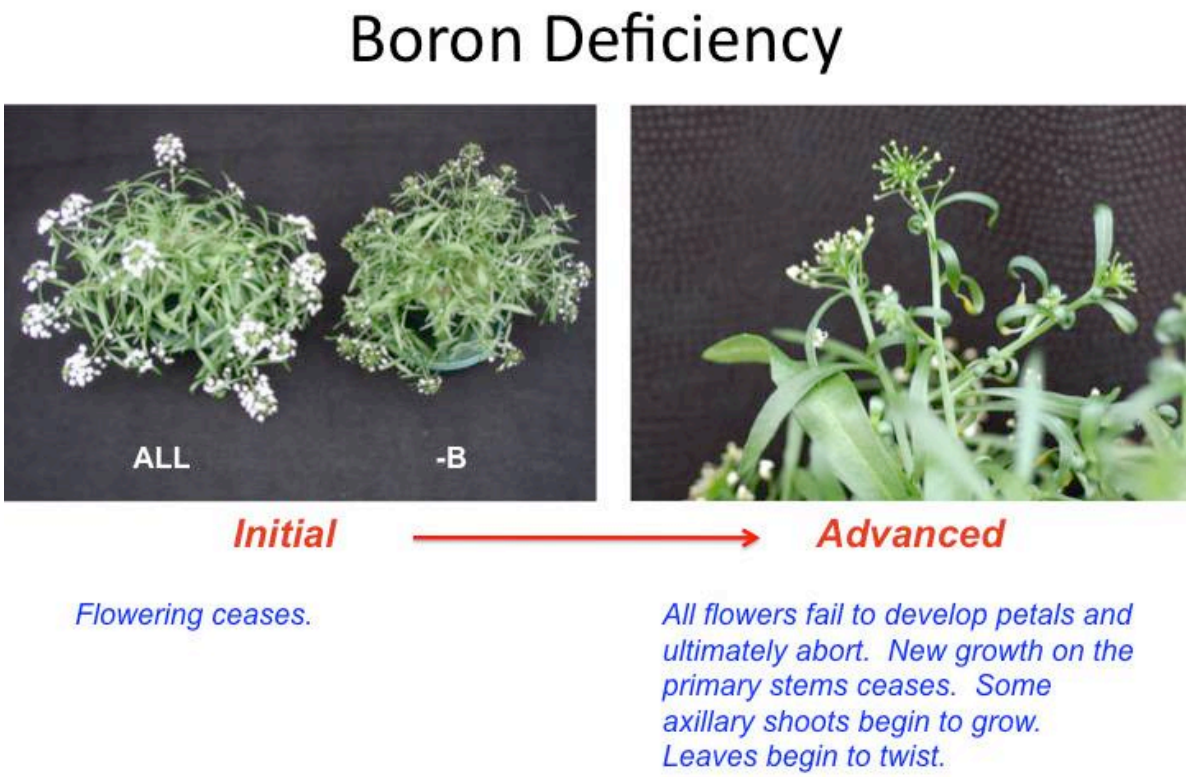


Figure 11. The progress of symptoms of boron deficiency with Snow Princess™.



TIP DEATH AND DISTORTED GROWTH

SNOW PRINCESS™ LOBULARIA HYBRID

What causes catastrophic meltdown of the growing tips and later distorted growth with Snow Princess™?

We gained first hand experience of a total meltdown of Snow Princess™ after a tank mix of insecticides were applied. Symptoms occurred 2 days after the application during the heat and humidity of the summer.

Because it was a tank mix, we spoke to the chemical companies and the most likely product to cause this problem was Judo® (spiromesifen). We conducted a second experiment in which Judo® was applied at the label rate (1.2 ml/gal). This occurred after the weather had turned cooler.

What we found.

With the cooler weather, the plants were totally symptomless until 15 days after the application. Then tip die back occurred quickly over a 24 hour period (Figure 12). All new growth then ceased for two weeks and once the new growth began it was distorted. The symptoms could be mistaken as 2,4-D herbicide drift or advance boron deficiency (Figure 11).

From garden observations, normal growth appeared after 8 weeks. Plants had a profusion of new growing shoots. While the extended time before normal growth resumes makes trying to correct the problem economically infeasible, as a last resort growers may experiment with shearing back the plants and applying a fertilizer such as 20-10-20 to try to stimulate normal growth.

Recommendations.

Avoid applications of Judo® to Snow Princess™.

Figure 12. The progress of symptoms of Judo® spray damage on Snow Princess™.

GROWTH CONTROL WITH PGRS

SNOW PRINCESS™ LOBULARIA HYBRID

What rate of PGRs control growth of Snow Princess™?

A series of experiments were conducted to determine the optimal foliar spray and substrate drench rates of Piccolo® (Paclobutrazol) and Concise® (Uniconazole).

In addition, we decided to investigate the effectiveness of both Piccolo® and Concise® preplant liner soaks.

What we found.

Snow Princess™ is a vigorous plant and growth management is required (Figure 13). Snow Princess™ was very responsive to the PGR applications.

Preplant liner soaks of 4 to 8 ppm Piccolo® (paclobutrazol) or 0.5 to 1 ppm Concise® (uniconazole) produced compact plants (Figue 13). Once growth reaches the side of the pot, foliar sprays of 75 to 100 ppm Piccolo® or 20 to 25 ppm Concise® or substrate drenches of 2 to 4 ppm Piccolo® or 1 to 2 ppm Concise® can be used.

These rates are based on North Carolina growing conditions. So make adjustments for other growing areas. For instance, more northern growers will want to experiment with half rates.

The use of plant growth regulators (PGRs) greatly improve plant quality, produced more compact plants, and increased the water use efficiency of Snow Princess™. The incidence of drought stress was significantly reduced when PGRs were used. This avoided the need to constantly irrigate the plants and eliminated the lower leaf yellowing. Plants with optimal rates of PGRs applied performed very well in the landscape. They reached a plant diameter of around three feet.

Recommendations.

Substrate drenches were more effective than foliar sprays with Snow Princess™. Plants were more compact.

Liner preplant soaks have the advantage of being applied to the plugs before transplanting. We found that the second pinch was not needed when preplant liner soaks were used and the plants bloomed 7 to 10 days earlier. A second pinch may be used as a method of delaying the crop.

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Figure 13. Preplant liner soaks of both Piccolo® and Concise® effectively controlled growth of Snow Princess™. Rates of 4 to 8 ppm Piccolo® (paclobutrazol) or 0.5 to 1 ppm Concise® (uniconazole) were optimal.

Figure 14. Foliar sprays and substrate drenches of both Piccolo® and Concise® effectively controlled growth of Snow Princess™. Once growth reaches the side of the pot, foliar sprays of 75 to 100 ppm Piccolo® or 20 to 25 ppm Concise® were effective. Substrate drenches of 2 to 4 ppm Piccolo® or 1 to 2 ppm Concise® can also be used.