

IX — PLANT GROWTH REGULATORS

The 2010 North Carolina Agricultural Chemicals Manual is published by the North Carolina Cooperative Extension Service, College of Agriculture and Life Sciences, N.C. State University, Raleigh, N.C. These recommendations apply only to North Carolina. They may not be appropriate for conditions in other states and may not comply with laws and regulations outside North Carolina. These recommendations are current as of November 2009. Individuals who use agricultural chemicals are responsible for ensuring that the intended use complies with current regulations and conforms to the product label. Be sure to obtain current information about usage regulations and examine a current product label before applying any chemical. For assistance, contact your county Cooperative Extension agent. The use of brand names and any mention or listing of commercial products or services in this document does not imply endorsement by the North Carolina Cooperative Extension Service nor discrimination against similar products or services not mentioned.

Readers may use the Adobe Acrobat Bookmarks feature to navigate this chapter or scroll down through the pages of the chapter. To use Bookmarks, click on the Bookmarks icon on the left hand side of the page, then click on a table of contents entry.

Growth Regulators for Cotton	524
Guide for Use of Defoliant on Cotton	524
Harvest Aids and Preharvest Desiccants.....	526
Growth-Regulating Chemicals for Apples	527
Growth Regulators for Floricultural Crops in Greenhouses	529
Growth Regulators for Woody Ornamental Crops	545
Sucker Control in Flue-Cured Tobacco.....	546
Yellowing Agents for Flue-Cured Tobacco	547
Sucker Control in Burley Tobacco.....	547
Growth Regulators for Processing Tomatoes	548
Growth Regulators for Peanut	548
Growth Regulators for Turfgrasses.....	549

PLANT GROWTH REGULATORS
GROWTH REGULATORS FOR COTTON
K. L. EDMISTEN, Crop Science Department

TABLE 9-1. GROWTH REGULATORS FOR COTTON

Purpose	Chemical and Formulation	Amount of Formulation Per Acre	Remarks
To suppress excessive vegetative growth	mepiquat chloride (various brands) 0.35 lb/gal	0.5 to 1 pt	Base rate and timing on field conditions. Most consistent results occur when applied to cotton that is at least 24 in. tall at early bloom (5 to 6 white blooms per 25 ft of row). A follow-up application may be warranted 10 to 14 days later if excessive growth continues.
	mepiquat pentaborate (Pentia)	0.82 lb/gal 4 to 24 fl oz	When early season conditions promote excessive prebloom growth, mepiquat chloride may be applied at the rate of 0.125 to 0.25 pt beginning at match head square (first square 0.125 to 0.25 in. in diameter). Repeat applications can be made when regrowth occurs. Follow label directions. Mepiquat chloride will consistently suppress vegetative growth. Other benefits may include easier scouting, better insecticide coverage, less boll rot, earlier maturity, easier defoliation, and more efficient use of ground sprayers and low drum pickers. Yield response is inconsistent.
	cyclanilid 1.4 lb/al + mepiquat chloride 0.73 lb/gal (Reign SC)	2 to 3 fl oz	Use the 2 fl oz rate if applied at match-head square and the 2.5 to 3 oz rate on applications following match-head square.
To stimulate boll opening and enhance defoliation	ethephon (Boll-D) 6 lb/gal (Ethephon) 6 lb/gal (Prep) 6 lb/gal (Super Boll) 6 lb/gal	0.66 to 1.33 qt	Use higher rate during cool weather. Prep boll opener will accelerate boll opening and enhance the activity of defoliant. It will not stimulate boll maturity. Micronaire may be reduced if Prep is applied to cotton that is less than 60 percent open.

For more information, see Extension publication AG-417, *Cotton Information*, which is available at your county Cooperative Extension center.

GUIDE FOR USE OF DEFOLIANTS ON COTTON
K. L. EDMISTEN, Crop Science Department

Apply defoliant when at least 60 percent, preferably 70 to 75 percent, of the bolls are open and the remaining bolls expected to be harvested are mature. A boll is mature enough for defoliation when it is too hard to be squeezed between thumb and fingers, when it is too hard to be sliced with a sharp knife, and when the seed coats turn light brown. Apply defoliant in a volume of 12 to 25 GPA by ground or at least 5 GPA by air. If a second application is needed, consult label for rates. (click for accessible table)

TABLE 9-2. GUIDE FOR USE OF DEFOLIANTS ON COTTON

Chemical Name	Brand Name and Formulation	Amount of Formulation Per Acre	Remarks
carfentrazone	Aim (2 lb/gal)	1 to 1.5 oz	Aim, like other herbicidal defoliant, can cause desiccation; however, the desiccation appears to be more transitory than that achieved with some of the other herbicidal defoliant. Aim appears to desiccate mature morningglories very well, and it does not seem like the addition of ethephon-type products is needed to improve morningglory desiccation. The label recommends a minimum of 10 gal per acre for ground applications and the use of oil concentrate at 1% by volume (1 gal per 100 gal of spray solution). Do not use crop oil concentrate with Aim in mixtures with CottonQuik. Aim can be tank mixed with other defoliant products if boll opening or regrowth control is desired. Lower rates may be needed in defoliation mixtures.
ethephon + cyclanilide	Finish (6 lb/gal)	1.33 to 2 pt	Use higher rates in cool weather. Finish is defoliant and boll opener. Finish also provides regrowth control. Terminal regrowth control is stronger than basal regrowth control. Finish will provide acceptable regrowth control in many situations. In situations where extended regrowth control is needed (in the 20- to 28-day range), Dropp or Roundup would provide more acceptable regrowth control. Finish performance may benefit from the addition of a low rate of a standard defoliant in situations where cotton is actively growing with juvenile growth. Use compatibility agent when mixing with Def 6 or Folex.
glyphosate	Roundup	24 to 32 oz	Based on limited trials in N.C., Roundup provides effective regrowth control. Roundup provides very little defoliation and should be used in combination with a defoliant. Experience in N.C. is limited to tank mixes with 1.5 pt of Def or Folex per acre. Although Roundup prevents regrowth, it will not defoliate juvenile growth that may occur prior to defoliation. Roundup also provides some weed control when defoliating weedy cotton. Roundup will not provide regrowth control on Roundup Ready cotton.
mono (N,Nimethylalkylamine) salt of endothall	Accelerate (0.52 lb/gal)	1.0 to 1.5 pt	Accelerate may be added to Def or Folex at 1.5 pt per acre to speed leaf drop by approximately 25 percent during the first few days of defoliant activity. The rate of leaf drop after 7 to 10 days has generally not been improved with Accelerate. Always add Accelerate to organic phosphates (Def or Folex) previously tank mixed with water.

TABLE 9-2. GUIDE FOR USE OF DEFOLIANTS ON COTTON

Chemical Name	Brand Name and Formulation	Amount of Formulation Per Acre	Remarks
pyraflufen-ethyl	ET (0.2 lb/gal)	1.5 to 2.5 oz	Like all herbicidal defoliants, ET can cause desiccation, although the desiccation tends to be transitory compared to some herbicidal defoliants. ET should help with desiccation of morningglory and other weeds listed on the herbicide label. ET can be mixed with other harvest-aid materials to provide boll opening or regrowth control. Consult the label for additive recommendations. In general, the use of a crop oil concentrate at 0.5% by volume is recommended. Do not use crop oil concentrate with ET in mixtures with CottonQuik. Use lower rates in warm weather.
flumiclorac-pentyl	Resource (0.86 lb/gal)	4 to 6 fl oz	Resource is a herbicidal defoliant that, like all herbicidal defoliants, can cause desiccation, although the desiccation tends to be more transitory than with some herbicidal defoliants. Under ideal defoliation conditions (warm, sunny days), add a NIS at 1 qt per 100 gal of spray solution. Under dry or cool weather, use a methylated seed oil (MSO) or aganosilicone spray solution. Apply in a minimum of 10 gal per acre for ground applications and a minimum of 5 gal per acre for aerial applications. Do not use flood jet or air induction nozzles. Resource can be tank mixed with other products if boll opening or regrowth control is desired. Resource only needs a 1 hour rain-free period. Preharvest interval (PHI) is 7 days.
fluthiacetmethyl	Blizzard (0.91 lb/gal)	0.5 to 0.66 fl oz	Blizzard is a PPO-inhibitor herbicidal-type defoliant. Experience with Blizzard has been limited in North Carolina. It can be tank mixed with ethephon-based products. Similar to other PPO-inhibitor defoliants, Blizzard should be very useful in desiccating juvenile foliage and as a second application prior to harvest. Add a crop oil concentrate or surfactant to tank mixes containing Blizzard according to label directions.
N-phenyl-N,1,2,3-thiadiazol-5-ylurea	Dropp (50% WP) Free Fall (50% WP)	0.2 to 0.4 lb	Dropp is very effective at regrowth suppression. However, the activity of Dropp is reduced a greater extent by cool weather than the activity of Def 6, Folex, or Harvade. Dropp requires the longest rain-free period of any of the defoliants—24 hr. Follow label directions and safety precautions.
N-phenyl-N,1,2,3-thiadiazol-5-ylurea and 3-(3,4-dichlorophenyl)-1,1-dimethylurea	Dropp Ultra (75% WP)	0.1 to 0.25 lb	Dropp Ultra is a mixture of Dropp and Diuron. Dropp Ultra may cause desiccation under very hot conditions, especially with high humidity. The addition of other defoliants is not recommended except for Prep or generic ethephon products. The addition of crop oil concentrate may improve performance in cooler weather. The addition of silicon surfactants is not recommended with Dropp Ultra.
	Ginstar (1.5 lb/gal)	0.4 to 1 pt	Ginstar is a mixture of Dropp and Diuron with an emulsifier that makes it more likely to desiccate than Dropp Ultra. Do not use Ginstar if temperatures are over 90° F. The addition of other defoliants is not recommended except for Prep or generic ethephon products. Ginstar rates should not exceed 10 oz per acre in N.C. except under very adverse conditions.
1-aminomethanamide dihydrogen tetraoxosulfate and ethephon	FirstPick	1.75 to 3.5 qt	Use higher rates in cool weather. The 2 qt rate is recommended for most situations. Use a low rate of a standard defoliant with FirstPick unless the cotton is well cut-out with no juvenile growth.
tributyl phosphorotrithioate	Def 6 (6 lb/gal)	1.33 to 2 pt	Use lower range of rates if crop is well matured as indicated by yellow- or red-tinged foliage or when temperatures are warm. Use higher recommended rates when plants are still green and actively growing or in dry weather or cool weather; needs a 2 hour rain-free period. Follow label directions and safety precautions.
tributyl phosphorotrithioate	Folex (6 lb/gal)	1.5 to 2 pt	See above remarks.
2,3-dihydro-5,6-dimethyl 1,4 dithiin 1,1,4,4-tetraoxide	Harvade (5 lb/gal)	0.5 pt	The addition of 1 pt of crop oil concentrate per acre is necessary for acceptable results. Rainfall within 6 hr may reduce activity. Results similar to those from Def 6 or Folex. Follow label directions and safety precautions.

For more information, see Extension publication AG-417, *Cotton Information*. This publication is available from your county Cooperative Extension center.

HARVEST AIDS AND PREHARVEST DESICCANTS

K. M. JENNINGS, Horticultural Science Department

All crops. Maximum coverage of plants is essential for adequate chemical desiccation. Dense vine growth and/or heavy weed growth necessitates use of maximum permitted rates and high spray gallonage per acre. Observe instructions for use of wetting agents.

Potato desiccation. Vine destruction in North Carolina has usually been accomplished by mechanical methods immediately before digging. Several chemicals are also available for preharvest destruction. All of these chemicals must be used in advance of digging. Vine killing with chemicals often aids skin set, depending upon maturity of the crop. Inhibition of heat sprouts has also been observed with chemical vine killing. Browning of the vascular ring of potato tubers sometimes occurs after using vine kills.

TABLE 9-3. HARVEST AIDS AND PREHARVEST DESICCANTS

Crop	Chemical and Formulation	Amount of Formulation Per Acre	Pounds Active Ingredient Per Acre	Precautions and Remarks
CHILI PEPPERS	Sodium chlorate (3 lb CHLORATE) 3 L (Defol 750) 7.5 L	1 to 2.5 gal 1.6 to 4 qt	3 to 7.5	Processing chili peppers only. Apply in 5 to 15 gal of water by aircraft or in 20 to 40 gal of water by ground rig 10 days before harvest. Consult with processor before applying. See label for further instructions.
DRY BEANS*	paraquat (Firestorm) 3 SL (Gramoxone Inteon) 2 L	0.8 to 1.3 pt 1.2 to 2 pt	0.3 to 0.5	Apply paraquat for weed and bean desiccation. Apply when the crop is mature and at least 80% of the pods are yellowing and mostly ripe with no more than 40% (bush-type beans) or 30% (vine-type beans) of the leaves still green. Add nonionic surfactant at 1 qt per 100 gal spray mix. Do not apply when weather conditions favor spray drift. Do not harvest or graze for at least 7 days after application. Make ground application in at least 20 gal of water per acre.
DRY BEANS, SOUTHERN PEAS, GUAR BEANS	sodium chlorate (3 lb CHLORATE) 3 L (Defol 750) 7.5 L	2 gal 3.2 qt	6	Apply 6 lb a.i. per acre of sodium chlorate approximately 7 to 10 days before harvest to facilitate harvest. Do not graze livestock on treated fields or feed treated fodder or forage to livestock. See label for further instructions.
POTATO	diquat (Reglone) 2 L	1 to 2 pt	0.25 to 0.5 lb	Desiccation of potato vines. Apply at least 7 days before harvest in 20 to 100 gal of water per acre with ground equipment or 5 to 10 gal of water per acre with aerial equipment. If vine growth is very dense, make a second application 5 days after the first application. Do not apply to drought-stressed potatoes.
	glufosinate (Rely 200) 1.67 SL	1.8 pt	0.38	Desiccation of potato vines. Use sufficient water for thorough coverage of potato vines. For best results, apply at the beginning of the natural senescence of potato vines. Where crop canopy is dense, better coverage will be achieved with the higher spray volumes. Apply in 20 to 100 gal of water per acre with ground equipment or in 5 to 10 gal per acre with aerial equipment. Do not apply to potatoes grown for seed stock. Do not harvest potatoes earlier than 9 days after application.
	sodium chlorate (Defol 750) 7.5 L	3.2 qt	6	Apply 6 lb a.i. per acre 10 days before harvest. DO NOT apply under conditions of extreme heat during the middle of the day.
SUNFLOWER	paraquat (Firestorm) 3 SL (Gramoxone Inteon) 2 L	0.8 to 1.3 pt 1.2 to 2 pt	0.3 to 0.5	Apply when sunflower seeds reach maturity (when seed moisture is 35% or lower). For many varieties, this corresponds to the time when the back of the heads are yellow and bracts are turning brown. Do not graze treated areas or feed treated forage to livestock. Do not apply within 7 days of harvest.
	sodium chlorate (3 lb CHLORATE) 3 L (Defol 750) 7.5 L	2 gal 3.2 qt	6	Apply 6 lb a.i. per acre of sodium chlorate 7 or more days before harvest of sunflower. Do not graze livestock on treated fields or feed treated forage to livestock within 14 days of application. See label for further instructions.
TOMATO	paraquat (Firestorm) 3 SL (Gramoxone Inteon) 2 L	1.6 to 2.5 pt 2.4 to 3.75 pt	0.6 to 0.94	Desiccation of crop and weeds after final harvest. Broadcast over the top of plants following harvest. Add a nonionic surfactant at 1 pt per 100 gal spray solution. Apply in a minimum of 40 gal spray solution.

* Sweet lupin, white sweet lupin, white lupin, grain lupin, adzuki beans, asparagus beans, black beans, broad beans, field beans, garbanzo beans, kidney beans, lablab beans, lima beans, moth beans, mung beans, navy beans, pinto beans, rice beans, tepary beans, urd beans, wax beans, blackeyed peas, chickpeas, cowpeas, crowder peas, southern peas, catjang, and guar.

GROWTH-REGULATING CHEMICALS FOR APPLES

S. J. McARTNEY, M. L. PARKER, and S. M. BLANKENSHIP, Horticultural Science Department

TABLE 9-4. GROWTH-REGULATING CHEMICALS FOR APPLES

Purpose	Material	Amount of Formulation Per 100 Gal	Minimum Interval (Days) Between Application and Harvest	Precautions and Remarks
To improve shape and increase fruit weight of responsive cultivars of apples, such as Delicious, Gala, or Ginger Gold.	N-(phenylmethyl)-1H-purine 6-amine BA and gibberellin A ₄ A ₇ (Perlan) (Promalin)	1 pt	—	Apply between kingbloom opening and full-bloom stage as a fine mist. Do not apply until runoff. Do not apply Promalin later than full bloom because only late blossoms will be affected and early blooms may be chemically thinned. Promalin is approved for tank mix with streptomycin and/or bloom fungicides.
To increase lateral bud break and shoot growth and improve branch angle on nonbearing and nursery trees.	(Promalin) and nonionic surfactant (Perlan)	0.5 to 1 pt/5 gal (250 to 500 ppm) use surfactant at 0.2% or 1.25 oz/5 gal		Apply to previous season's leader growth with thorough coverage when new terminal growth is 1 to 2 in. long or nursery trees have reached the height where branching is required.
To promote lateral branching on current season's terminal growth.	(Promalin) without surfactant	4 oz/5 gal (125 ppm)		Apply to every 8 to 10 in. of terminal growth in conjunction with removal of at least 0.5 of each immature terminal leaf. Do not damage the growing point (Summer Knipping).
To suppress russet formation on Golden Delicious and other russet sensitive varieties.	gibberellin A ₄ A ₇ (Novagib) (Pro-Vide)	20 to 26 oz/100 gal/acre 10 oz/100 gal/acre (15 ppm)	—	Recommended application interval is at petal fall (PF), then 10, 20, and 30 days after petal fall. There is a 40 oz per acre limit per season for Pro-Vide, and an 80-oz per acre limit per season for Novagib. Apply as a fine mist. DO NOT apply until runoff.
To reduce the occurrence of Stayman fruit cracking.	gibberellin A ₄ A ₇ (Novagib) (Pro-Vide)	1 to 2 pt		Apply in 3 to 6 consecutive applications at 3-week intervals beginning 2 to 3 weeks before fruit cracking is expected to occur. Apply at 50% of TRV.
To thin Golden Delicious fruit on trees where a heavy fruit set has occurred and to aid in encouraging annual bearing.	naphthalene-acetic acid (NAA) alone or with a wetting agent, which will double the effective activity	5 to 15 ppm surfactant, if used, is 1 pt/100 gal	—	If trees are weak in vigor, if low temperatures are experienced, or if seed numbers are low, use lower concentration. Until experience is gained in your orchard, use all concentrations of all thinning chemicals only on a trial basis on a few trees. Optimum thinning with NAA is achieved when fruit diameter is 10 mm to 12 mm. Under optimum growing conditions, the best size for thinning usually occurs between 15 to 21 days after full bloom. Applying NAA too early will result in sticking the fruit on rather than removing it. Applying carbaryl (Sevin) to Golden Delicious may cause russet.
To thin heavily set non-spur Red Delicious and Rome, and to aid in encouraging annual bearing.	carbaryl (Sevin) 50WP XLR	1 to 2 lb 1 to 2 pt	—	Apply at 9- to 11-mm average fruit diameter for optimum thinning. Applying carbaryl (Sevin) to Golden Delicious may cause russet.
To thin heavily set spur strains of Red Delicious and to aid in return bloom.	carbaryl (Sevin) 50WP or XLR + naphthalene-acetic acid (NAA)	2 lb 2 pt + 5 ppm	—	Apply at 9- to 11-mm average fruit diameter. Application at larger fruit size to Red Delicious may cause "nubbins" and half-grown fruit to stick on the tree through to harvest. Apply as a dilute spray to runoff.
	carbaryl (Sevin) 50WP or XLR + ethephon (Ethrel)	2 lb 2 pt + 1.5 pt		Apply at 12- to 15-mm average fruit diameter. Apply only as a dilute spray to runoff (for use only on spur strains of Delicious). Applying Ethrel when daily maximum temperatures are 80 F or higher may result in excessive thinning.
To defruit trees too young or too small to begin bearing or where fruit load needs to be eliminated (all varieties).	naphthalene-acetic acid (NAA) + carbaryl (Sevin) 50WP or XLR + ethephon (Ethrel)	5 to 10 ppm + 2 lb 2 pt + 2 pt	—	Apply dilute at 8- to 10-mm average fruit diameter. Caution: This will temporarily suppress vegetative growth.
Post-bloom thinning agent for cultivars such as Gala, Fuji, Spur Red Delicious	N-(phenylmethyl)-1H-purine-6-amine (Exilis) or (MaxCel)	16 to 48 oz/acre 48 to 128 oz/100 gal	86 days 86 days	1 to 2 applications when king fruit are 5 to 10 mm in diameter. Do not apply more than 296 oz/acre/season. Do not tank mix with NAA. 1 to 2 applications when king fruit are 5 to 15 mm in diameter. Do not apply more than 308 oz/acre/season.
	+ Carbaryl (Sevin) 50 WP or XLR	2 lb 2 pt		

TABLE 9-4. GROWTH-REGULATING CHEMICALS FOR APPLES

Purpose	Material	Amount of Formulation Per 100 Gal	Minimum Interval (Days) Between Application and Harvest	Precautions and Remarks
To thin Stayman, Rome, McIntosh, Jonathan, or Gala.	carbaryl (Sevin) 50WP or XLR or naphthalene-acetic acid (NAA) OR carbaryl (Sevin) 50 WP or XLR + naphthalene-acetic acid (NAA)	2 lb or 2 pt or 5 to 10 ppm OR 1 to 2 lb or 1 to 2 pt + 2.5 to 5 ppm	—	Apply dilute at 9- to 11-mm average fruit diameter.
To increase return bloom for the following season, especially on heavily cropped trees.	naphthalene acetic acid (NAA)	5 ppm OR 2.5 ppm + surfactant	—	After the chemical fruit thinning activity window is past (typically six weeks past petal fall) use biweekly applications of NAA in the next three to four cover sprays. (This is typically two in June and two in July for Southeastern U.S. apple-growing areas.) These NAA applications may be tank mixed in pesticide cover sprays.
To reduce vegetative growth and to reduce later season tree canopy volume and density for improving pesticide efficiency.	prohexadione-calcium (Apogee)	3 to 6 oz + 1 pt surfactant	45	Apply as a sequential application every other week beginning at 1 to 2 in. shoot growth using 3 oz per 100 gal or apply as a sequential monthly application beginning at 1 to 2 in. of shoot growth using 6 oz per 100 gal. Do NOT tank mix with calcium nutrient sprays; but can be mixed in pesticide cover sprays. Do not apply more than 99 oz of Apogee per acre per season.
To aid in preventing preharvest fruit drop.	naphthalene-acetic acid (NAA)	8-32 fl oz per acre	4	Apply at anticipated start of fruit drop. One application will normally prevent fruit drop for 7 to 10 days. If necessary, repeat application can be made at weekly intervals. Apply when temperature is 70 F or higher for maximum effectiveness.
To aid in delaying the onset of preharvest fruit drop before loosening begins.	naphthalene-acetic acid (NAA)	5 ppm applied as 4 weekly sprays beginning 4 weeks before anticipated harvest	4	Preloading with the low rate of NAA is a more effective drop control program than waiting to use a higher rate as the fruit begins to loosen. Preloading may also increase return bloom of Golden Delicious and Red Delicious.
To delay preharvest fruit drop and maturity to allow time for added fruit size increase.	aminoethoxyvinylglycine or AVG (ReTain)	Apply one 333-g pouch (50 g a.i.)/acre plus Silwet L-77 or sylgard surfactant at 0.1% (13 oz/100 gal) at 4 weeks before anticipated normal start of harvesting of untreated fruit	7 days	This is the most effective stop-drop control program; however, fruit maturity and harvest date will be significantly delayed. DO NOT apply AVG to plants under stress. Delay AVG application until 2-3 weeks before normal harvest in hot years.
To control suckers from the ground around the trunk of apple trees.	naphthalene-acetic acid (NAA), ethyl ester (Tre-Hold sprout inhibitor A-112)	Use 10,000 ppm concentration (10 oz/1 gal)	—	Apply when new sucker growth is 4 to 12 in. long. Apply as a low-pressure, large droplet, directed spray with hand-held equipment. A thorough application, giving complete wetting and coverage, is necessary for good results. DO NOT allow spray to drift onto tree foliage or fruiting spurs. For best results, cut off woody sucker growth at ground level during the dormant season and treat new sucker growth when 4 to 12 in. long. Do not apply during the period from bloom to 4 weeks post-bloom.
To control water sprout regrowth around pruning cuts.	naphthalene-acetic acid (NAA), ethyl ester (Tre-Hold sprout inhibitor A-112)	Use 10,000 ppm concentration (10 oz/1 gal)	—	Apply with a cloth or brush as a localized application to the pruning cut and surrounding bark anytime after pruning and before growth starts in the spring. DO NOT spray Tre-Hold up in the trees. DO NOT allow Tre-Hold to contact buds or fruiting spurs. Tre-Hold use in the tree is not recommended when green growth is present. One to 4 pt of light-colored latex (water based) paint may be added per gallon to mark completed application. Thorough application, giving complete wetting and coverage, is necessary for good results.
To aid in controlling scald on stored apples.	diphenylamine (DPA)	1,000 ppm; Amount/100 gal depends on formulation purchased	—	Apply as a dip or spray to harvested fruit. For maximum effect, uncooled fruit should be sprayed or dipped as soon after harvest as possible. The longer treatment is delayed after harvest, the less its effectiveness. Fruit should be thoroughly covered; however, fruit should not be dipped over 0.5 min to prevent excess residue. Best control is obtained when fruit and solution are at room temperature.
To maintain apple flesh firmness, reduce scald, and maintain fruit acidity.	1-methylcyclopropene (MCP) (SmartFresh)	Sufficient to achieve 1 ppm	—	This product is a postharvest treatment that is introduced into the atmosphere of a facility or container in which the fruit is held for 24 hr. The amount of product used depends upon the volume (cubic feet) of the treatment container. The facility or container must be airtight for the 24 hours. After 24 hr, the fruit is held in regular cold storage.

GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

B. E. WHIPKER, Horticultural Science Department

This table lists labeled rates of plant growth regulators (PGR) for greenhouse crops. These rates are guidelines based on labeled recommendations, research at North Carolina State University, and recommendations by suppliers. Read the label for a complete listing of precautions. The degree of control can vary by a number of factors, including: plant type, cultivar, stage of development, fertilization program, growing temperatures, and crop spacing. When using a PGR for the first time, it is good to test the rate on a few plants prior to spraying the entire crop. Keep accurate records and adjust rates for your location. Additional information about plant growth regulators is available at <http://www.pgrinfo.com>.

General Recommendations: Plug culture and flat culture have different recommended rates. The rates in this table include recommendations for both plug (lower rates) and flat culture (higher rates). Apply ALL foliar sprays of plant growth regulators using 0.5 gallons per 100 square feet of bench area.

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
ABUTILON	To control plant growth	Cycocel	750 ppm spray (0.81 fl oz/gal)	
AGERATUM	To control plant height	A-Rest	7 to 26 ppm spray (3.4 to 12.6 fl oz/gal)	Plug culture and flat culture differ in recommended rates. The rates shown in this table include both plug (lower rates) and flat culture (higher rates) recommendations. Apply ALL foliar sprays of plant growth regulators using 0.5 gal per 100 sq ft of bench area. Growers should refer to Horticulture Information Leaflet #528, <i>Height Control of Greenhouse Crops</i> , for application techniques and timing for growth regulators on floricultural crops.
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
		Bonzi, Paczol, Piccolo	15 to 45 ppm spray (0.48 to 1.44 fl oz/gal)	
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	
		Sumagic	20 to 30 ppm spray (5.12 to 7.68 fl oz/gal)	
		Topflor	20 to 60 ppm spray (0.67 to 2.02 fl oz/gal)	Based on NC State University trials. Adjust rates for other locations.
AGERATUM, PLUGS	To control plant height	Bonzi, Paczol, Piccolo	5 to 10 ppm spray (0.16 to 0.32 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage.
ALCEA ROSEA	To control plant height	Bonzi, Piccolo, Paczol	30 to 50 ppm spray (0.96 to 1.6 fl oz/gal)	
		Bonzi, Downsize, Piccolo, Paczol	0.12 to 0.24 mg a.i. (1 to 2 ppm) drench for a 6-in. pot; apply 4 fl oz/6 in. pot	
ALTERNANTHERA (Joseph's-Coat)	To control plant height	A-Rest	25 to 132 ppm spray (12.1 to 64 fl oz/gal)	Drench volumes and mg a.i. vary with pot size.
			0.25 to 0.5 mg a.i. (2 to 4 ppm) for a 6-in. pot; (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot	
ALYSSUM	To control plant height	Bonzi, Paczol, Piccolo	40 to 60 ppm spray (1.28 to 1.92 fl oz/gal)	See AGERATUM.
		Sumagic	5 to 25 ppm spray (1.3 to 6.4 fl oz/gal)	See AGERATUM
ALYSSUM, PLUGS	To control plant height	Bonzi, Paczol, Piccolo	10 to 20 ppm spray (0.32 to 0.64 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage.
AMARYLLIS	To control plant height	Bonzi, Paczol, Piccolo	23.66 mg a.i. (200 ppm) drench for a 6-in. pot; (6.4 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
			100 ppm bulb soak (3.2 fl oz/gal)	
ANGELONIA	To control plant growth	B-Nine or Dazide + Cycocel	1,500 to 3,000 ppm B-Nine (0.23 to 0.47 oz/gal) + 750 to 1,000 ppm Cycocel (0.82 to 1.08 fl oz/gal) applied as a tank mix spray	At planting, soft pinch to promote lateral shoot development.
		Sumagic	10 to 20 ppm spray (2.6 to 5.2 fl oz/gal)	
		Topflor	45 to 60 ppm spray (1.5 to 2.0 fl oz/gal)	
ARGYRANTHEMUM FRUTESCENS	To control plant growth	Cycocel	750 to 1,500 ppm spray (0.82 to 1.63 fl oz/gal)	Based on NC State University trials conducted during late spring. A slight phytotoxicity occurred with rates greater than 40 ppm, but damage was quickly hidden by new leaf growth.
		Sumagic	20 to 40 ppm (5.2 to 10.4 fl oz/gal)	
		Topflor	50 to 75 ppm spray (1.67 to 2.5 fl oz/gal)	
ASCLEPIAS	To control plant height	Bonzi, Piccolo, Paczol	30 to 60 ppm spray (0.96 to 1.92 fl oz/gal)	
ASTER	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	See AGERATUM.
ASTER, CUT (Callistephus chinensis)	To promote stem elongation and break dormancy	ProGibb, T&O	50 to 100 ppm spray (0.19 to 0.4 oz/gal)	Make one to three applications during the early vegetative period at 2- to 3-week intervals. Apply when plants are 2 to 6-in. tall.

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
ASTERISCUS MARITIMUS (Compact Gold Coin)	To control plant growth	B-Nine, Dazide	750 to 1,500 ppm spray (0.12 to 0.23 oz/gal)	
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 oz/gal)	
AZALEA	To control plant height	A-Rest	26 ppm spray (12.6 fl oz/gal)	
	To promote flower initiation	B-Nine, Dazide	1,500 to 2,500 ppm spray (0.24 to 0.39 oz/gal)	Apply solution when new growth from final pinch is 1 to 2 in. long.
		Cycocel	1,000 to 4,000 ppm spray (1.08 to 4.34 fl oz/gal)	Optimum rates are generally between 1,000 and 2,000 ppm. Two to six multiple sprays may be needed. Make first application when new growth is approximately 2 in. long.
	To prevent flower bud initiation during vegetative growth	GibGro	130 to 850 ppm spray (0.52 to 3.4 fl oz/gal)	Apply two to three sprays at 2- to 3-week intervals.
		ProGibb, T&O	100 to 750 ppm spray (0.4 to 2.8 oz/gal)	Apply a first application beginning 2 to 3 weeks after pinching. Weekly applications can continue for 1 to 2 additional weeks, for a maximum of three total applications.
	For partial or full substitution of cold treatment	GibGro	265 to 1,055 ppm spray (1.06 to 4.2 fl oz/gal)	Spray timing, concentration, and number of applications vary with cultivar as well as intended degree of cold substitution. Consult label for exact recommendations. Not labeled for California.
		ProGibb T&O	250 to 500 ppm spray (0.95 to 1.9 oz/gal)	Spray timing, concentration, and number of applications vary with cultivar as well as intended degree of cold substitution. Consult label for exact recommendations.
	To promote lateral shoot growth on vegetative plants	Off-Shoot-O	Use a 3% to 5% solution (8.6 to 14 fl oz/gal) in greenhouses; use a 5% to 7% solution (14 to 20 fl oz/gal) outdoors. Apply as a foliar spray.	Efficacy is related to relative humidity and temperature. Spray a few plants to check activity prior to treating the entire crop; effect should be visible in about 1 hr. Be certain chemical covers shoot tip. Ineffective if microscopic flower buds are present.
	To increase lateral branching	Atrimmec	3,125 to 6,250 ppm spray (2 to 4 fl oz/gal)	
		Florel	2,500 to 5,000 ppm spray (8 to 16 fl oz/gal)	
To control plant height, reduce bypass shoot elongation, and promote flower bud initiation	Bonzi, Paczol, Piccolo	100 to 200 ppm spray (3.2 to 6.4 fl oz/gal)	To control plant height and promote flower bud initiation, apply after final shaping, when new growth is 1.5 to 2 in. long. To reduce bypass shoot development, apply after bud set, when bypass shoots are barely visible, or about 5 to 7 weeks prior to cooling.	
	Bonzi, Downsize, Paczol, Piccolo	0.59 to 1.77 mg a.i. (5 to 15 ppm) drench for a 6-in. pot (0.16 to 0.48 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes mg a.i. vary with pot size. To control plant height and promote flower bud initiation, apply after final shaping, when new growth is 1.5 to 2 in. long. To reduce bypass shoot development, apply after bud set, when bypass shoots are barely visible, or about 5 to 7 weeks prior to cooling.	
To control plant height	Sumagic	10 to 15 ppm spray (2.56 to 3.84 fl oz/gal)	Apply at 1.5 qt per 100 sq ft of bench area.	
BACOPA SUTERA	To control plant growth	B-Nine, Dazide	750 to 1,500 ppm spray (0.12 to 0.23 oz/gal)	At planting, soft pinch to promote lateral shoot development. Initially try with lower rate.
	To increase lateral branching	Florel	150 to 200 ppm spray (0.5 to 0.67 oz/gal)	
BEDDING PLANTS (Not specifically listed in this table)	To control plant height	A-Rest	6 to 66 ppm spray (2.9 to 32 fl oz/gal); use 15 ppm spray as a base rate and adjust as needed	See AGERATUM.
			0.06 to 0.12 mg a.i. drench for a 4-in. pot; (0.5 to 1 fl oz/gal of drench solution; apply 2 fl oz/4-in. pot)	Drench volumes and mg a.i. vary with pot size.
		B-Nine or Dazide + Cycocel	800 to 5,000 ppm (0.13 to 0.79 oz/gal) + 1,000 to 1,500 ppm (1.08 to 1.63 fl oz/gal) applied as a tank mix spray	It is recommended to use the highest rate of Cycocel that does not cause excessive leaf yellowing, and then adjust the B-Nine rate up and down within the labeled range to attain desired level of height control.
		Bonzi, Paczol, Piccolo	5 to 90 ppm spray (0.16 to 2.88 fl oz/gal). Use 30 ppm spray (0.96 fl oz/gal) as a base rate and adjust as needed.	Conduct trials on a small number of plants, adjusting the rates as needed for desired final plant height and duration of height control. Not recommended for use on fibrous begonia or vinca.
		Bonzi, Downsize, Paczol, Piccolo	0.118 mg a.i. drench for a 6-in. pot (0.032 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench applications are recommended only for bedding plants in 6 in. or larger containers. Not recommended for use on fibrous begonia or vinca.
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	Conduct trials on a small number of plants, adjusting the rates as needed for desired final plant height and duration of height control.
	To control plant height	Sumagic	1 to 50 ppm spray (0.26 to 12.7 fl oz/gal)	Conduct trials on a small number of plants, adjusting the rates as needed for desired final plant height and duration of height control. Apply spray as elongation begins (plant height about 2 to 4 inches).
0.1 to 2 ppm drench (0.03 to 0.51 fl oz/gal)				
To promote plant growth and overcome over-applications of gibberellin-inhibiting PRGs	ProGibb T&O	1 to 25 ppm spray (0.003 to 0.09 fl oz/gal)	Conduct trials on a small number of plants initially using 1 ppm unless previous experience warrants higher use rates. Following assessment of plant response, and if desired results were not evident, reapplication or an increase in rate may be warranted. Consult the label for additional precautions.	

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
BEDDING PLANT PLUGS (Not specifically listed in this table)	To control plant height	A-Rest	3 to 35 ppm spray (1.5 to 17 fl oz/gal)	See AGERATUM.
			Drench plug flats with a 0.5 to 1 ppm solution (0.25 to 0.5 fl oz/gal)	For uniform application, use a subirrigation delivery system. Plug trays should not be excessively dry prior to the subirrigation treatment. Begin application at 1 to 2 true leaf stage.
		B-Nine, Dazide	1,500 to 2,500 ppm spray (0.23 to 0.39 oz/gal)	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and duration of height control. Can be used at the beginning of the first true leaf stage through the finishing stage.
		B-Nine or Dazide + Cycocel	800 to 5,000 ppm (0.13 to 0.79 oz/gal) + 1,000 to 1,500 ppm (1.08 to 1.63 fl oz/gal) applied as a tank mix spray	It is recommended to use the highest rate of Cycocel that does not cause excessive leaf yellowing, and then adjust the B-Nine rate up and down within the labeled range to attain desired level of height control.
		Bonzi, Paczol, Piccolo	1 to 20 ppm spray (0.03 to 0.64 fl oz/gal). Use 5 ppm spray (0.16 fl oz/gal) as a base rate and adjust as needed.	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and duration of height control. Plants should develop one to two true leaves prior to first application.
		Cycocel	400 to 1,500 ppm spray (0.43 to 1.63 fl oz/gal)	Conduct trials on a small number of plants, adjusting the rates as needed for desired final plant height and duration of height control.
			Sumagic	0.5 to 10 ppm spray (0.13 to 2.6 fl oz/gal)
	To promote plant growth and overcome over-application of gibberellin-inhibiting PGRs	Fascination	1 to 25 ppm spray (0.02 to 0.18 fl oz/gal)	Conduct trials on a small number of plants initially using 1 ppm unless previous experience warrants higher use rates. Following assessment of plant response, and if desired results were not evident, reapplication or an increase in rate may be warranted. The most common rates for use are 3 to 5 ppm. SEE LABEL FOR ADDITIONAL PRECAUTIONS BEFORE USE.
BEGONIA, SEED	To control plant height	A-Rest	3 to 15 ppm spray (1.5 to 7.3 fl oz/gal)	See AGERATUM.
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
		Florel	500 ppm spray (1.6 fl oz/gal)	Apply to increase lateral branching, prevent flower initiation and development, and inhibit internode elongation.
BEGONIA, VEGETATIVE	To control plant growth	Cycocel	750 to 1,000 ppm spray (0.81 to 1.08 fl oz/gal)	
BEGONIA, ELATIOR	To increase lateral branching	Atrimmec	781 to 1,562 ppm spray (0.5 to 1 fl oz/gal)	
BIDENS FERULIFOLIA	To control plant growth	B-Nine, Dazide	1,500 to 2,500 ppm spray (0.23 to 0.39 oz/gal)	At planting, soft pinch to promote lateral shoot development.
		Sumagic	1 to 5 ppm spray (0.26 to 1.28 fl oz/gal)	Initially, try with lower rate.
	To increase lateral branching	Florel	300 to 500 ppm spray (1.0 to 1.62 fl oz/gal)	
BLEEDING HEART	To control plant height	A-Rest	65 to 132 ppm spray (31.5 to 64 fl oz/gal) 0.25 to 0.5 mg a.i. drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
BOUGAINVILLEA	To increase lateral branching	Atrimmec	1,562 ppm spray (1 fl oz/gal)	
BRACHYSCOME	To control plant growth	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 fl oz/gal)	
BRACTEANTHA BRACTEATA	To control plant growth	Bonzi, Paczol, Piccolo	20 to 30 ppm spray (0.64 to 0.96 fl oz/gal)	
		Sumagic	10 to 20 ppm spray (2.56 to 5.12 fl oz/gal)	
	To increase lateral branching	Florel	300 to 500 ppm (1.0 to 1.62 fl oz/gal)	
BROMELIAD	To promote flower initiation	Florel	2,471 ppm spray (8 fl oz/gal)	
BROWALLIA	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	See AGERATUM.
BULB CROPS (Not specifically listed in this table)	To control plant height	A-Rest	25 to 50 ppm spray (12.1 to 24.2 fl oz/gal)	
			0.25 mg a.i. (2 ppm) drench for a 6-in. pot (1 oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		Bonzi, Paczol, Piccolo	100 ppm spray (3.2 fl oz/gal)	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and duration of height control.
			1.183 mg a.i. (10 ppm) drench for a 6 in. pot (0.32 fl oz/gal of drench solution; apply 4 fl oz/6 in. pot)	Drench volumes and mg a.i. vary with pot size.
		20 ppm bulb soak (0.64 fl oz/gal)	Soak for 15 min. Conduct trials on a small number of bulbs, adjusting the rate and soaking period (up to 1 hr) as needed for desired final plant height.	

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
BULBS (continued)	To control plant height (continued)	Sumagic	2.5 to 20 ppm spray (0.64 to 5.1 fl oz/gal)	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and length of height control.
			1 to 3 ppm drench (0.26 to 0.8 fl oz/gal)	Drench volumes and mg a.i. vary with pot size. Application should be made when newly emerged shoots are 1 to 2 in. tall.
			1 to 10 ppm bulb soak (0.26 to 2.6 fl oz/gal)	Soak for 1 to 5 min. Conduct trials on a small number of bulbs, adjusting the rate and soaking period as needed for desired final plant height.
	To promote plant growth and overcome over-application of gibberellin inhibiting PGRs	Fascination	1 to 25 ppm spray (0.02 to 0.18 fl oz/gal)	Conduct trials on a small number of plants initially using 1 ppm unless previous experience warrants higher use rates. Following assessment of plant response, and if desired results were not evident, reapplication or an increase in rate may be warranted. The most common rates for use are 3 to 5 ppm. SEE LABEL FOR ADDITIONAL PRECAUTIONS BEFORE USE.
CALADIUM	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	See AGERATUM.
		Bonzi, Paczol, Piccolo	100 to 200 ppm spray (3.2 to 6.4 fl oz/gal)	Make first spray application when plants are 2 to 4 in. tall.
			0.24 to 1.77 mg a.i. (5 to 15 ppm) drench for a 6-in. pot (0.064 to 0.96 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Make first drench application when plants are 1 to 2 in. tall. Drench volumes and mg a.i. vary with pot size.
		Bonzi, Downsize, Paczol, Piccolo	60 ppm tuber soak (1.9 fl oz/gal)	Soak tubers for 30 minutes prior to planting.
Topflor	0.5 to 2 mg a.i (4.2 to 16.9 ppm) drench for a 6-in. pot	Based on NC State University trials. Adjust rates for other locations. Use lower rates for less vigorous cultivars.		
CALENDULA	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
CALIBRACHOA SP.	To control plant growth	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 fl oz/gal)	At planting, soft pinch to promote lateral shoot development. Multiple applications may be required.
		B-Nine or Dazide + Cycocel	2,500 ppm B-Nine (0.39 oz/gal) + 500 ppm Cycocel (0.56 fl oz/gal) applied as a tank mix spray	
		Bonzi, Paczol, Piccolo	20 to 50 ppm spray (0.64 to 1.6 fl oz/gal)	
		Florel	500 ppm spray (1.62 fl oz/gal)	
		Sumagic	10 to 25 ppm spray (2.56 to 6.4 fl oz/gal)	Try lower rate initially. Apply 2 weeks after transplanting.
CALLA LILY	To control plant height	Bonzi, Downsize, Paczol, Piccolo	0.59 to 1.77 mg a.i. (5 to 15 ppm) drench for a 6-in. pot (0.32 to 0.96 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	See CALADIUM.
		Bonzi, Paczol, Piccolo	20 ppm rhizome/tuber soak (0.64 fl oz/gal)	Soak the rhizomes/tubers for 15 min prior to planting.
		Topflor	1 to 2.25 mg a.i (8.45 to 21.1 ppm) drench for a 6-in. pot	Based on NC State University trials. Adjust rates for other locations.
	To promote flowering	ProGibb, T&O	500 ppm rhizome/tuber soak (1.9 fl oz/gal)	Soak the rhizomes or tubers for 10 minutes prior to planting. See label for details.
CAMPANULA	To control plant height	Topflor	10 to 30 ppm spray (0.34 to 1.01 fl oz/gal)	
CANNA LILY	To control plant height	Topflor	50 to 80 ppm spray (1.68 to 2.69 fl oz/gal)	
CELOSIA	To control plant height	A-Rest	7 to 26 ppm spray (3.4 to 12.6 fl oz/gal)	See AGERATUM.
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
		Bonzi, Paczol, Piccolo	15 to 45 ppm spray (0.48 to 1.44 fl oz/gal)	
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	
		Sumagic	10 to 20 ppm spray (2.56 to 5.12 fl oz/gal)	Based on NC State University trials. Adjust rates for other locations.
Topflor	10 to 40 ppm spray (0.34 to 1.35 fl oz/gal)			
CELOSIA, PLUGS	To control plant height	Bonzi, Paczol, Piccolo	5 to 10 ppm spray (0.16 to 0.32 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage.
CENTAUREA	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.70 oz/gal)	
CHINA ASTER	To control plant height	A-Rest	7 to 26 ppm spray (3.4 to 12.6 fl oz/gal)	
CHRYSANTHEMUMS, CUT	To reduce "neck" stretching	B-Nine, Dazide	2,500 ppm spray (0.39 oz/gal)	Spray upper foliage 5 weeks after start of short-day treatment.
	To elongate peduncles of pompom-type mums	ProGibb, T&O	25 to 60 ppm spray (0.09 to 0.23 fl oz/gal)	Use a single application 4 to 5 weeks after initiation of short days. Direct spray solution towards the flower buds. See label for precautions.

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
CHRYSANTHEMUMS, PERENNIAL	To control plant height	Bonzi, Piccolo, Paczol	50 to 200 ppm spray (1.6 to 6.4 fl oz/gal)	
		Bonzi, Downside, Paczol, Piccolo	0.12 to 0.48 mg a.i. (1 to 4 ppm) drench for a 6 in. pot; apply 4 fl oz/6-in. pot	
CHRYSANTHEMUMS, POTTED	To control plant height	A-Rest	25 to 50 ppm spray (12.1 to 24.2 fl oz/gal)	
			0.25 to 0.5 mg a.i. drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Apply when plants are 2 to 6 inches in height (about 2 weeks after pinch). Drench rates and application volumes vary with pot size.
		B-Nine, Dazide	1,000 ppm preplant foliar dip (0.16 oz/gal)	Rooted cuttings can be dipped in solution just to thoroughly wet leaves and stems and then potted. Allow foliage to dry before watering in. For unrooted cuttings, dip stems in solution, remove to flat, cover to prevent dehydration, and hold overnight under cool conditions. Stick the next day.
			2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	Spray when new growth from pinch is 1 to 2 in. long. Some varieties may require another application 3 weeks later.
		Bonzi, Paczol, Piccolo	50 to 200 ppm spray (1.6 to 6.4 fl oz/gal)	Begin applications when axillary shoots are 2- to 3-in. long. Sprays can be applied earlier to vigorous cultivars if additional control is desired. Sequential applications of lower rates generally provide more uniformly shaped plants than single spray applications.
		Bonzi, Downsize, Paczol, Piccolo	0.118 to 0.473 mg a.i. (1 to 4 ppm) drench for a 6-in. pot (0.032 to 0.128 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size. Begin when the axillary shoots are 2 to 3 in. long. Uniform application is required.
		Sumagic	2.5 to 10 ppm spray (0.64 to 2.56 fl oz/gal)	
CHRYSANTHEMUMS, GARDEN	To control plant height	Sumagic	2.5 to 10 ppm spray (0.64 to 2.56 fl oz/gal)	
	To increase lateral branching	Florel	500 ppm spray (1.619 fl oz/gal)	Florel applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.
CLEMATIS	To control plant height	A-Rest	25 to 132 ppm spray (12.1 to 64 fl oz/gal)	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
CLEOME	To control plant height	A-Rest	7 to 26 ppm spray (3.4 to 12.6 fl oz/gal)	See AGERATUM.
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	
CLERODENDRUM	To increase lateral branching	Atrimmec	1,042 to 2,083 ppm spray (0.67 to 1.33 fl oz/gal)	
COLEUS, VEGETATIVE	To control plant growth	B-Nine or Dazide + Cycocel	2,500 to 4,000 ppm B-Nine (0.39 to 0.63 oz/gal) + 1,000 to 1,500 ppm Cycocel (1.08 to 1.63 fl oz/gal) applied as a tank mix spray	See General Recommendations. Scheduling the crop to avoid excessive stretch is the most effective means of controlling growth.
		Bonzi, Paczol, Piccolo	5 to 30 ppm spray (0.16 to 0.96 fl oz/gal)	
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	
		Sumagic	10 to 20 ppm spray (2.56 to 5.12 fl oz/gal)	
COLEUS, SEED	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	See AGERATUM.
		Bonzi, Paczol, Piccolo	15 to 30 ppm spray (0.48 to 0.96 fl oz/gal)	
		Cycocel	400 to 3,000 ppm spray (0.43 to 3.25 fl oz/gal)	
		Sumagic	10 to 20 ppm spray (2.56 to 5.12 fl oz/gal)	
		Topflor	20 to 40 ppm spray (0.67 to 1.35 fl oz/gal)	Based on NC State University trials. Adjust rates for other locations.
COLEUS, PLUGS	To control plant height	Bonzi, Paczol, Piccolo	5 to 10 ppm spray (0.16 to 0.32 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage.
COLUMBINE	To control plant height	A-Rest	65 to 132 ppm spray (31.5 to 64 fl oz/gal)	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
CONEFLOWER	To control plant height	Sumagic	30 to 40 ppm spray (7.7 to 10.2 fl oz/gal)	
COREOPSIS	To control plant height	Bonzi, Piccolo, Paczol	80 to 100 ppm spray (2.56 to 3.2 fl oz/gal)	
		Bonzi, Downsize, Paczol, Piccolo	0.59 to 1.18 mg a.i. (5 to 10 ppm) drench for a 6-in. pot; apply 4 fl oz/6-in. pot	

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
CORNFLOWER, (Centaurea)	To control plant height	A-Rest	7 to 26 ppm spray (3.4 to 12.6 fl oz/gal)	See AGERATUM.
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
COSMOS	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	See AGERATUM.
CROSSANDRA	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	See AGERATUM.
CUPHEA	To control plant growth	B-Nine, Dazide	1,500 to 2,500 ppm spray (0.23 to 0.39 oz/gal)	PGRs not required on compact cultivars.
		Bonzi, Paczol, Piccolo	1 to 5 ppm spray (0.03 to 0.16 fl oz/gal)	Initially, test on a few plants to determine rate for optimum control. Cuphea is sensitive to excessive rates.
DAFFODIL	To control plant height	Bonzi, Downsize, Paczol, Piccolo	2.37 to 4.73 mg a.i. (20 to 40 ppm) drench for a 6-in. pot; (0.64 to 1.28 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	See CALADIUM.
		Bonzi, Paczol, Piccolo	80 ppm bulb soak (2.56 fl oz/gal)	Soak bulbs for 1 hour prior to planting.
		Florel	2,000 ppm spray (6.47 fl oz/gal)	Controls plant height and stem topple. Apply when shoots are 3 to 4 inches tall. See label for cultivar differences in rates.
DAHLIA, BEDDING PLANT	To control plant height	A-Rest	7 to 26 ppm spray (3.4 to 12.6 fl oz/gal)	See AGERATUM.
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
		B-Nine or Dazide + Cycocel	2,500 to 4,000 ppm B-Nine (0.49 to 0.78 oz/gal) + 1,000 to 1,500 ppm Cycocel (1.08 to 1.63 fl oz/gal) applied as a tank mix spray	
		Bonzi, Paczol, Piccolo	15 to 45 ppm spray (0.48 to 1.44 fl oz/gal)	
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	
		Sumagic	10 to 20 ppm spray (2.56 to 5.12 fl oz/gal)	
DALIA, PLUGS, BEDDING PLANT	To control plant height	Bonzi, Paczol, Piccolo	5 to 10 ppm spray (0.16 to 0.32 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage.
DAHLIA, TUBEROUS	To control plant height	A-Rest	0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		Bonzi, Downsize, Paczol, Piccolo	1.18 to 4.73 mg a.i. (10 to 40 ppm) drench for a 6-in. pot (0.32 to 1.28 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	
		Bonzi, Paczol, Piccolo	Greater than 40 ppm tuber soak (1.28 fl oz/gal)	Soak tubers for 20 minutes prior to planting.
		Topflor	0.5 to 2 mg a.i. (4.2 to 16.9 ppm) drench for a 6-in. pot	Based on NC State University trials. Adjust rates for other locations. Use lower rates for less vigorous cultivars.
DELPHINIUM	To control plant height	A-Rest	35 to 132 ppm spray (17 to 64 fl oz/gal)	See AGERATUM.
			0.25 to 0.5 mg a.i. drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	See AGERATUM.
		Bonzi, Paczol, Piccolo	30 to 60 ppm spray (0.96 to 1.92 fl oz/gal)	
DELPHINIUM, CUT	To promote plant growth and stem elongation	ProGibb, T&O	50 to 100 ppm spray (0.19 to 0.4 fl oz/gal)	Apply when plants are 4 to 8 in. tall. More than one application possible at 2- to 3-week intervals. See label for precautions.
DIANTHUS, BEDDING PLANT	To control plant height	A-Rest	7 to 26 ppm spray (3.4 to 12.6 fl oz/gal)	See AGERATUM.
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
		Bonzi, Paczol, Piccolo	10 to 20 ppm spray (0.32 to 0.64 fl oz/gal)	
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	
DIANTHUS, BEDDING PLANT, PLUGS	To control plant height	Bonzi, Paczol, Piccolo	10 to 20 ppm spray (0.32 to 0.64 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage.
DIANTHUS, CUT	To promote plant growth and stem elongation	ProGibb, T&O	50 to 100 ppm spray (0.19 to 0.4 fl oz/gal)	Apply when plants are 4 to 8 in. tall. More than one application possible at 2- to 3-week intervals. See label for precautions.
DIASCIA HYBRID	To control plant growth	B-Nine, Dazide	1,250 to 5,000 ppm (0.19 to 0.79 oz/gal)	At planting, soft pinch to promote lateral shoot development. Use higher rates on vigorous cultivars.
		Florel	200 to 500 ppm spray (0.67 to 1.62 fl oz/gal)	Use 2 weeks after pinch.
DIGITALIS	To control plant height	Bonzi, Paczol, Piccolo	80 to 160 ppm spray (2.56 to 5.12 fl oz/gal)	
		Bonzi, Downsize, Paczol, Piccolo	0.24 to 0.48 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl oz/6 in. pot	

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
DRACAENA	To control plant height	A-Rest	25 to 132 ppm spray (12.1 to 64 fl oz/gal)	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
DUSTY MILLER	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	See AGERATUM.
		Sumagic	30 ppm spray (7.7 fl oz/gal)	
EASTER LILY (See Lily, Easter)				
EUPATORIUM	To control plant height	Bonzi, Paczol, Piccolo	>240 ppm spray (10.24 fl oz/gal)	
		Bonzi, Downsize, Paczol, Piccolo	0.96 to 1.18 mg a.i. (8 to 10 ppm) drench for a 6-in. pot; apply 4 fl oz/6-in. pot	
EXACUM	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
		Topflor	25 to 50 ppm spray (0.84 to 1.68 fl oz/gal)	Based on NC State University trials. Adjust rates for other locations.
			0.01 to 0.03 mg a.i. (0.08 to 0.25 ppm) drench for a 6-in. pot	Based on NC State University trials. Adjust rates for other locations. Exacum is very responsive to Topflor drenches, so start trials with lower rates.
FATSHEDERA	To control plant height	A-Rest	65 to 132 ppm spray (31.5 to 64 fl oz/gal)	
			0.25 to 0.5 mg a.i. drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
FLOWERING/ FOLIAGE PLANTS, HERBACEOUS SPECIES (Not specifically listed in this table)	To control plant height	A-Rest	20 to 50 ppm spray (9.7 to 24.2 fl oz/gal)	Recommended starting rate for an A-Rest spray on a new herbaceous flowering or foliage species is 33 ppm (16 fl oz/gal).
			0.125 to 0.25 mg a.i. (1 to 2 ppm) drench for a 6-in. pot (0.5 to 1 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		Bonzi, Paczol, Piccolo	30 ppm spray (0.96 fl oz/gal)	Users should conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and length of height control.
		Bonzi, Downsize, Paczol, Piccolo	0.118 mg a.i. (1 ppm) drench for a 6-in. pot (0.032 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Users should conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and length of height control. Drench volumes and mg a.i. vary with pot size.
		Cycocel	800 to 3,000 ppm spray (0.87 to 3.25 fl oz/gal)	Optimum rate depends on species, desired amount of height control, and environmental conditions. The suggested initial rate for small-scale trials is 1,250 ppm. Example herbaceous species known to respond to Cycocel are Achimenes, Aster, Astilbe, Begonia, (hiemalis), Begonia (tuberous), Calceolaria, Carnation, Chrysanthemum, Columbine, Easter lily, <i>Gynura aurantiaca</i> , Ivy, Kalanchoe, <i>Lilium</i> spp., Morningglory, Pachystachys, <i>Pilea</i> spp., Pentas, <i>Salvia</i> spp., Schefflera, <i>Sedum</i> spp., and Sunflower.
			2,000 to 4,000 ppm drench (2.17 to 4.34 fl oz/gal)	Drench volumes vary with pot size. See label for recommended volumes. Herbaceous species known to respond to Cycocel are listed above.
		Sumagic	5 to 40 ppm spray (1.3 to 10.2 fl oz/gal)	Users should conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and length of height control.
			0.1 to 1 ppm drench (0.026 to 0.26 fl oz/gal)	Drench volumes and mg a.i. vary with pot size.
	To promote plant growth and overcome over-applications of gibberellin-inhibiting PGRs	ProGibb, T&O	1 to 25 ppm spray (0.003 to 0.09 fl oz/gal)	Conduct trials on a small number of plants initially using 1 ppm unless previous experience warrants higher use rates. Following assessment of plant response, and if desired results are not evident, reapplication or an increase in rates may be warranted. Consult the label for additional precautions.

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
FLOWERING/ FOLIAGE PLANTS, WOODY SPECIES (continued)	To control plant height	A-Rest	50 ppm spray (24.2 fl oz/gal)	Drench volumes and mg a.i. vary with pot size.
			0.25 mg a.i. (2 ppm) drench for a 6-in. pot (1 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	
		B-Nine, Dazide	2,500 to 7,500 ppm spray (0.39 to 1.18 oz/gal)	Two or more applications may be necessary if new growth begins to stretch or for enhanced coloration.
		Bonzi, Paczol, Piccolo	50 ppm spray (1.6 fl oz/gal)	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and length of height control.
		Bonzi, Downsize, Paczol, Piccolo	0.237 mg a.i. drench for a 6-in. pot (0.064 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and length of height control. Drench volumes and mg a.i. vary with pot size.
			Cycocel	800 to 3,000 ppm spray (0.87 to 3.25 fl oz/gal)
	Sumagic	2,000 to 4,000 ppm drench (2.17 to 4.34 fl oz/gal)	Drench volumes vary with pot size. See label for recommended volumes. Woody species known to respond to Cycocel are listed above.	
		20 to 50 ppm spray (5.1 to 12.7 fl oz/gal)	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and length of height control.	
To promote plant growth and overcome over-application of gibberellin-inhibiting PGRs	Fascination	0.5 to 2 ppm drench (0.13 to 0.52 fl oz/gal)	Drench volumes and mg a.i. vary with pot size.	
		1 to 25 ppm spray (0.02 to 0.18 fl oz/gal)	Conduct trials on a small number of plants initially using 1 ppm unless previous experience warrants higher use rates. Following assessment of plant response, and if desired results were not evident, reapplication or an increase in rate may be warranted. The most common rates for use are 3 to 5 ppm. SEE LABEL FOR ADDITIONAL PRECAUTIONS BEFORE USE.	
FREESIA	To control plant height	Bonzi, Downsize, Paczol, Piccolo	0.22 to 0.48 mg a.i. (2 to 4 ppm) drench for a 6 inch pot (0.06 to 0.13 fl oz/gal of drench solution, apply 4 fl oz/6 inch pot)	To increase lateral branching.
		Bonzi, Paczol, Piccolo	100 to 300 ppm corm soak (3.2 to 9.6 fl oz/gal)	Soak corms in the solution for 1 hr before planting.
FUCHSIA	To control plant growth	B-Nine, Dazide	1,250 to 2,500 ppm spray (0.19 to 0.39 oz/gal)	
	To increase lateral branching	Atrimmec	781 to 2,343 ppm spray (0.5 to 1.5 fl oz/gal)	
		Florel	500 ppm spray (1.619 fl oz/gal)	Florel applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.
GARDENIA	To control plant height	A-Rest	50 ppm spray (24.2 fl oz/gal)	Drench volumes and mg a.i. vary with pot size.
			0.25 mg a.i. (2 ppm) drench for a 6-in. pot (1 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	
	B-Nine, Dazide	5,000 ppm spray (0.79 oz/gal)	Spray when plants are at two-thirds final market size.	
To increase lateral branching	Atrimmec	2,343 to 4,687 ppm spray (1.5 to 3 fl oz/gal)	Labeled for ivy geraniums only. Avoid treating plants under stress.	
GAURA	To control plant growth	B-Nine, Dazide	3,000 to 4,000 ppm spray (0.47 to 0.63 fl oz/gal)	
		Bonzi, Downsize, Paczol, Piccolo	3.54 mg a.i. (30 ppm) drench for a 6-in. pot; apply 4 fl oz/6-in. pot	Controls plant height.
		Bonzi, Paczol, Piccolo	30 to 50 ppm spray (0.96 to 1.6 fl oz/gal)	
		Sumagic	10 to 30 ppm spray (3.84 to 7.68 fl oz/gal)	

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
GERANIUM	To control plant height	A-Rest	26 to 66 ppm spray (12.6 to 32 fl oz/gal)	See AGERATUM.
		Bonzi, Paczol, Piccolo	5 to 30 ppm spray (0.16 to 0.96 fl oz/gal)	Apply to zonal geraniums when new growth is 1.5 to 2 in. long. Apply to seed geraniums approximately 2 to 4 weeks after transplanting.
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	Make first application 2 to 4 weeks after planting plugs or rooted cuttings (after stems have started elongating). Multiple applications may be needed.
		Sumagic	3 to 6 ppm spray (0.77 to 1.54 fl oz/gal) for cutting geraniums and 2 to 4 ppm spray (0.51 to 1.02 fl oz/gal) for seed geraniums	See AGERATUM.
		Topflor	15 to 25 ppm spray (0.5 to 0.83 fl oz/gal)	Apply to zonal geraniums when new growth is 1.5 to 2 inches long.
	To promote earlier flowering in seed geraniums	Cycocel	1,500 ppm spray (1.63 fl oz/gal)	Make two applications at 35 and 42 days after seeding. Treated plants should flower earlier, be more compact, and more well-branched than untreated plants.
		ProGibb T&O	5 to 15 ppm spray (0.02 to 0.06 fl oz/gal)	Make a single foliar application when first flower bud set is noted. Spray the entire plant until runoff. See label for precautions.
	To increase flower number and size in cutting geranium	ProGibb, T&O	1 to 5 ppm spray (0.003 to 0.02 fl oz/gal)	Make a single foliar application when first flower bud set is noted. Spray the entire plant until runoff. See label for precautions.
	To increase lateral branching	Atrimmec	1,562 ppm spray (1 fl oz/gal)	Labeled for ivy geraniums only.
		Florel	300 to 500 ppm spray (1.0 to 1.62 fl oz/gal)	Labeled for zonal and ivy geraniums. Use the lower concentration for ivy geraniums. Florel will also provide some growth retardant effect and delay flowering. Read the label for restrictions on timing of applications.
GERBERA DAISY	To control plant height	A-Rest	25 to 132 ppm spray (12.1 to 64 fl oz/gal)	
			0.25 to 0.5 mg a.i. drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		B-Nine, Dazide	1,200 to 5,000 ppm spray (0.18 to 0.79 oz/gal)	
GLOXINIA	To control peduncle length	B-Nine, Dazide	1,250 ppm spray (0.19 oz/gal)	Phytotoxicity may occur at rate >1,250 ppm.
GOMPHRENA	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	See AGERATUM.
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	
GRAPE IVY	To increase lateral branching	Atrimmec	781 to 1,562 ppm spray (0.5 to 1 fl oz/gal)	
GYPSOPHILIA	To accelerate plant growth, increase stem and flower number, and increase flower uniformity	ProGibb, T&O	150 to 500 ppm spray (0.6 to 1.9 fl oz/gal)	Make 3 to 4 foliar applications after 4 weeks of new growth has occurred after pinching. Use 2-week intervals between sprays. See label for precautions.
<i>HELICHRYSUM PETIOLARE</i> (Licorice Plant)	To increase lateral branching	Florel	300 to 500 ppm spray (1.0 to 1.62 fl oz/gal)	
HIBISCUS	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
		Bonzi, Paczol, Piccolo	30 to 150 ppm spray (0.96 to 4.8 fl oz/gal)	Application should be made when laterals are 1 to 4 in. long. Single applications control lateral growth for 3 to 6 weeks.
		Cycocel	200 to 600 ppm spray (0.22 to 0.65 fl oz/gal)	Multiple applications starting prior to first pinch are recommended.
		Sumagic	10 ppm spray (2.6 fl oz/gal)	Treat with 7 days of pruning. Multiple applications may be required.
HOLLY	To control plant height	A-Rest	50 ppm spray (24.2 fl oz/gal)	
			0.25 mg a.i. (2 ppm) drench for a 6-in. pot (1 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
HOLLYHOCK	To control plant height	Bonzi, Paczol, Piccolo	30 to 50 ppm spray (0.96 to 1.6 fl oz/gal)	
		Sumagic	5 to 40 ppm spray (1.3 to 10.2 fl oz/gal)	
HYACINTH	To reduce stem topple	Florel	1,000 ppm spray (3.24 fl oz/gal)	To reduce stem topple at time of full flower, apply foliar spray before florets have opened.
	To control plant height	Topflor	0.5 to 1 mg a.i. (4.2 to 8.45 ppm) drench for a 6-in. pot	Based on NC State University trials. Adjust rates for other locations.
HYBRID LILY (See Lily, Hybrid)				

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
HYDRANGEA	To control plant height	A-Rest	50 ppm spray (24.2 fl oz/gal) 0.25 mg a.i. (2 ppm) drench for a 6-in. pot (1 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		B-Nine, Dazide	2,500 to 7,500 ppm spray (0.39 to 1.18 oz/gal)	Use lower rate in spring when four to five pairs of leaves are visible and new growth is starting to unfold, but not later than 4 weeks after initiation of forcing. Use higher rate for summer when regrowth after pinching is 1 to 2 inches long.
HYPOESTES	To control plant height	Cycocel	400 to 1,500 ppm spray (0.43 to 1.63 fl oz/gal)	See AGERATUM.
IMPATIENS, SEASHELL-TYPE	To control plant growth	Bonzi, Paczol, Piccolo	5 to 8 ppm spray (0.16 to 0.25 fl oz/gal)	Apply when plants have reached 75 percent of finished height. Do not apply to plants under stress. Recommendations based on Michigan trials.
IMPATIENS, SEED	To control plant height	A-Rest	10 to 44 ppm spray (4.8 to 21.3 fl oz/gal)	See AGERATUM.
		Bonzi, Paczol, Piccolo	10 to 45 ppm spray (0.32 to 2.02 fl oz/gal)	
		Sumagic	5 to 10 ppm spray (1.28 to 2.56 fl oz/gal)	
		Topflor	20 to 60 ppm spray (0.67 to 2.02 fl oz/gal)	Based on NC State University trials. Adjust rates for other locations.
IMPATIENS PLUGS, SEED	To control plant height	Bonzi, Paczol, Piccolo	0.5 to 10 ppm spray (0.015 to 0.32 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage.
IMPATIENS, VEGETATIVE	To control plant growth	Bonzi, Piccolo	2 to 15 ppm spray (0.06 to 0.48 fl oz/gal)	Cultivars' response to PRGs varies, so test a few plants to determine rate for optimum control.
			0.5 to 1 ppm drench (0.06 to 0.118 mg ai)	Drench volumes vary with pot size. See label for recommended volumes.
		Florel	100 to 300 ppm spray (0.33 to 1 fl oz/gal)	Will improve branching.
IMPOMEA	To control plant growth	Sumagic	10 to 25 ppm spray (2.56 to 6.4 fl oz/gal)	Not needed if optimal scheduling is used. If needed, apply when plants have reached 75% of finished growth. Recommendations based on NC State University trials.
JACOBINIA, PINK	To control plant height	Bonzi, Paczol, Piccolo	5 to 10 ppm spray (0.16 to 0.32 fl oz/gal)	
		Bonzi, Downsize, Paczol, Piccolo	0.06 to 0.12 mg a.i. (0.5 to 1 ppm) drench for a 6-in. pot; apply 4 fl oz/6-in. pot	
JERUSALEM CHERRY	To control plant height	Cycocel	400 to 1,500 ppm spray (0.43 to 1.63 fl oz/gal)	See AGERATUM.
KALANCHOE	To increase lateral branching	Atrimmec	1,042 to 2,343 ppm spray (0.67 to 1.5 fl oz/gal)	
	To control peduncle length	B-Nine, Dazide	1,200 to 5,000 ppm spray (0.18 to 0.79 oz/gal)	Phytotoxicity possible if B-Nine accumulates in cupped areas of certain cupped-leaved varieties.
LANTANA	To control plant growth	B-Nine or Dazide + Cycocel	2,500 to 5,000 ppm B-Nine (0.39 to 0.79 oz/gal) + 1,000 to 1,500 ppm Cycocel (1.08 to 1.63 fl oz/gal) applied as a tank mix spray	Cultivar response varies.
		Bonzi, Paczol, Piccolo	20 to 40 ppm spray (0.64 to 1.28 fl oz/gal)	
		Sumagic	10 to 20 ppm spray (2.56 to 5.12 fl oz/gal)	
	To increase lateral branching	Atrimmec	781 to 1,562 ppm spray (0.5 to 1 fl oz/gal)	
		Florel	500 ppm spray (1.619 fl oz/gal)	Florel applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.
LARKSPUR, CUT	To promote growth and stem elongation	ProGibb T&O	50 to 100 ppm spray (0.19 to 0.4 fl oz/gal)	Apply when plants are 4 to 8 in. tall. Apply at 2- to 3-week intervals. See label for precautions.
LIATRIS	To control plant height	A-Rest	25 to 132 ppm spray (12.1 to 64 fl oz/gal) 0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
LILY, EASTER	To control plant height	A-Rest	30 to 132 ppm spray (14.5 to 64 fl oz/gal). Use 50 ppm spray (24.2 fl oz/gal) as a base rate and adjust as needed. 0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Apply when newly developing shoots are 2 to 3 inches in length; a second application when shoots average 6 inches in length may be needed Single drench should be applied when shoots average 3 to 5 inches in length. Drench volumes and mg a.i. vary with pot size.

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks	
LILY, EASTER (continued)	To control plant height (continued)	Sumagic	3 to 15 ppm spray (0.8 to 3.8 fl oz/gal)	Apply when shoots average 3 inches tall.	
			0.03 to 0.06 mg a.i. (0.25 to 0.5 ppm) drench for a 6-in. pot (0.065 to 0.13 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.	
	To prevent leaf yellowing	Fascination, Fresco	5 to 10 ppm spray (0.04 to 0.07 fl oz/gal)	Apply early season (7 to 10 days PRIOR to visible bud stage) and mid-season (7 to 10 days AFTER visible bud stage). Apply spray only to lower leaves to minimize stem elongation. See label.	
To prevent leaf yellowing and prolong flowering	100 ppm spray (0.71 fl oz/gal)		Apply late season (when first bud reaches at least 8 cm in length) and no more than 14 days prior to placement in a cooler or shipping. Apply to foliar and flower buds. See label.		
LILY, HYBRID	To control plant height	Bonzi, Paczol, Piccolo	200 to 500 ppm spray (6.4 to 16.0 fl oz/gal)	See CALADIUM.	
			5 to 30 ppm bulb soak (0.16 to 0.96 fl oz/gal)	Soak bulbs in the solution for 15 min. prior to planting.	
		Sumagic	0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; (0.14 to 0.96 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Single drench should be applied when shoots average 3 to 5 inches in length. Drench volumes and mg a.i. vary with pot size and cultivar.	
			3 to 15 ppm spray (0.8 to 3.8 fl oz/gal)	Apply when shoots average 3 inches tall.	
	To prevent leaf yellowing	Fascination, Fresco	0.03 to 0.06 mg a.i. (0.25 to 0.5 ppm) drench for a 6-in. pot; (0.065 to 0.13 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.	
			0.25 to 0.5 mg a.i. (2.1 to 4.2 ppm) drench for a 6-in. pot	Based on NC State University trials. Adjust rates for other locations.	
To prevent leaf yellowing and prolong flowering	5 to 10 ppm spray (0.04 to 0.07 fl oz/gal)	Apply early season (7 to 10 days PRIOR to visible bud stage) and mid-season (7 to 10 days AFTER visible bud stage). Apply spray only to lower leaves to minimize stem elongation. See label.			
To prevent leaf yellowing and prolong flowering	100 ppm spray (0.71 fl oz/gal)	Apply late season (when first bud reaches at least 8 cm in length) and no more than 14 days prior to placement in a cooler or shipping. Apply to foliar and flower buds. See label.			
LILY, ORIENTAL	To prevent leaf yellowing	Fascination, Fresco	100 ppm spray (0.71 fl oz/gal)	Apply early season (7 to 10 days PRIOR to or AFTER visible bud stage). Apply spray only to lower leaves to minimize stem elongation. See label.	
	To prevent leaf yellowing and prolong flowering		100 ppm spray (0.71 fl oz/gal)	Apply late season (no more than 14 days prior to placement in a cooler or shipping). Apply to foliar and flower buds. See label.	
LIPSTICK VINE	To increase lateral branching	Atrimmec	521 to 1,042 ppm spray (0.33 to 0.67 fl oz/gal)		
LISIANTHUS	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)		
MARIGOLD	To control plant height	A-Rest	13 to 33 ppm spray (6.3 to 16 fl oz/gal)	See AGERATUM.	
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)		
		Bonzi, Paczol, Piccolo	15 to 60 ppm spray (0.48 to 1.92 fl oz/gal)	Apply 15 to 30 ppm to French-type and 30 to 60 ppm to African-type marigolds.	
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)		
		Sumagic	10 to 20 ppm spray (2.56 to 5.12 fl oz/gal)		
MARIGOLD, PLUGS, SEEDS	To control plant height	Topflor	20 to 60 ppm spray (0.67 to 2.02 fl oz/gal)	Based on NC State University trials. Adjust rates for other locations.	
			Bonzi, Paczol, Piccolo	5 to 20 ppm spray (0.16 to 0.64 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage. Use 5 to 10 ppm for French-type and 10 to 20 ppm for African-type marigolds.
MATTHIOLA, CUT (STOCK)	To promote growth and stem elongation	ProGibb T&O	50 to 100 ppm spray (0.19 to 0.4 fl oz/gal)	Apply when plants are 4 to 8 in. tall. Apply at 2- to 3-week intervals. See label for precautions.	
MONARDA	To control plant height	Bonzi, Downsize, Paczol, Piccolo	>0.48 mg a.i. (>4 ppm) drench for a 6 in. pot; apply 4 fl oz/6-in. pot		
			Bonzi, Paczol, Piccolo	60 to 160 ppm spray (1.92 to 5.12 fl oz/gal)	
			Sumagic	15 to 30 ppm spray (3.8 to 7.7 fl oz/gal)	
MONSTERA	To control plant height	A-Rest	25 to 132 ppm spray (12.1 to 64 fl oz/gal)		
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.	

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
MONTBRETIA	To control plant height	Bonzi, Paczol, Piccolo	20 to 30 ppm corm soak (0.64 to 0.96 fl oz/gal)	Soak corms in the solution for 15 min prior to planting.
NASTURTIUM	To control plant height	Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	See AGERATUM.
NEMESIA FRUTICANS	To control plant growth	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.38 to 0.79 oz/gal)	Use on compact varieties to tone and hold crop.
		Bonzi, Paczol, Piccolo	10 to 20 ppm spray (0.32 to 0.64 fl oz/gal)	
		Florel	500 ppm spray (1.619 fl oz/gal)	
		Sumagic	5 to 30 ppm spray (1.3 to 7.8 fl oz/gal)	In NC State University trials, 5 ppm worked well on Vanilla Sachet' nemesia.
		Topflor	2.5 to 5 ppm spray (0.084 to 0.167 fl oz/gal)	Recommendation based on NC State University trials with 'Vanilla Sachet' nemesia.
NEPHTHYTIS, GREEN & GREEN GOLD	To control plant height	A-Rest	25 to 132 ppm spray (12.1 to 64 fl oz/gal)	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
NEW GUINEA IMPATIENS	To control plant growth	Bonzi, Paczol, Piccolo	0.25 to 15 ppm spray (0.01 to 0.48 fl oz/gal)	Apply 2 to 4 weeks after transplanting. Cultivars' response to PGRs varies greatly. Test a few plants to determine rate for optimal control.
			0.25 to 2 ppm drench (0.03 to 0.236 mg ai)	Drench volumes vary with pot size. See label for recommended volumes. Cultivars' response to PGRs varies greatly. Test a few plants to determine rate for optimal control.
		Florel	100 to 300 ppm spray (0.33 to 1 fl oz/gal)	To increase lateral branching and reduce premature flowering. Do not apply within 8 weeks of desired flower date.
		Topflor	5 to 15 ppm spray (0.167 to 0.5 fl oz/gal)	Apply 2 to 4 weeks after transplanting. Cultivars' response to PGRs varies greatly. Test a few plants to determine rate for optimal control.
ORNAMENTAL CABBAGE and KALE	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	Use the higher rates for more aggressive types/cultivars. Multiple applications may be needed. Based on North Carolina conditions.
		Sumagic	2.5 to 8 ppm spray (0.6 to 2.1 fl oz/gal)	Use higher rates for more aggressive cultivars. Based on North Carolina conditions.
ORNAMENTAL PEPPERS	To control plant height	Bonzi, Paczol, Piccolo	20 ppm foliar spray (0.64 fl oz/gal)	Based on North Carolina conditions for a moderately vigorous cultivar..
		Sumagic	5 to 15 ppm spray (1.3 to 3.8 fl oz/gal)	
ORNAMENTAL VEGETABLES	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	Use the higher rates for more aggressive types/cultivars like 'Red Bor' Kale. Multiple applications may be needed. Based on North Carolina conditions.
		Sumagic	10 to 25 ppm spray (2.6 to 6.4 fl oz/gal)	Use higher rates for more aggressive cultivars. Based on North Carolina conditions.
OSTEOSPERMUM SP.	To control plant growth	B-Nine or Dazide + Cycocel	1,500 to 3,000 ppm B-Nine (0.24 to 0.47 oz/gal) + 1,000 to 1,500 ppm Cycocel (1.08 to 1.63 fl oz/gal) applied as a tank mix spray	Multiple sprays required. Stop applications after visible bud to avoid flower delay and smaller flowers. Not effective in NC State University trials.
		Bonzi, Paczol, Piccolo	27 to 54 ppm drench (8 to 16 mg ai) during production (based on NC State trials)	Drench volumes vary with pot size. See label for recommended volumes. 1,500 ppm worked well in NC State University trials.
			2 to 3 ppm drench (0.236 to 0.35 mg ai) for holding plants	
		Cycocel	750 ppm spray (0.82 fl oz/gal)	Two applications may be required.
			1,500 to 3,000 ppm drench (1.63 to 3.26 fl oz/gal)	Drench volumes vary with pot size. See label for recommended volumes. 1,500 ppm worked well in NC State University trials.
		Sumagic	8 ppm spray (2.08 fl oz/gal)	Recommendations based on European trials on a cultivar with prostrate growth. Rates less than 24 ppm were not effective in NC State University trials.
			0.25 to 0.5 ppm drench (0.85 to 1.7 mg ai)	Recommendations based on NC State University trials.
Topflor	20 to 60 ppm spray (0.67 to 2.02 fl oz/gal)			
OTACANTHUS	To control plant growth	B-Nine, Dazide	2,500 ppm spray (0.39 oz/gal)	Make first application when new growth appears after pinching. A second application may be used if a second pinch is planned.
PANSY	To control plant height	A-Rest	3 to 15 ppm spray (1.5 to 7.3 fl oz/gal)	See AGERATUM.
		Bonzi, Paczol, Piccolo	5 to 15 ppm spray (0.16 to 0.48 fl oz/gal)	Apply when plants are 2 inches in diameter. Use higher rates for higher temperatures and more aggressive cultivars. Late applications may delay flowering.
		Sumagic	1 to 6 ppm spray (0.26 to 1.54 fl oz/gal)	Apply when plants are 3 to 4 inches tall. Use higher rates for higher temperatures and more aggressive cultivars. Late applications may delay flowering.

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
PANSY (continued)	To control plant height (continued)	Topflor	2.5 to 7.5 ppm spray (0.08 to 0.25 fl oz/gal)	Based on NC State University trials. Adjust rates for other locations.
PANSY, PLUGS	To control plant height	Bonzi, Paczol, Piccolo	1 to 5 ppm spray (0.007 to 0.16 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage. Pansies are sensitive as plugs so the user should determine optimal rates.
PERILLA	To control plant growth	B-Nine or Dazide + Cycocel	2,500 to 4,000 ppm B-Nine (0.39 to 0.63 oz/gal) + 1,000 to 1,500 ppm Cycocel (1.08 to 1.63 fl oz/gal) applied as a tank mix spray	
		Bonzi, Paczol, Piccolo	10 to 20 ppm spray (0.32 to 0.64 fl oz/gal)	
PETUNIA, SEED	To control plant height	A-Rest	10 to 26 ppm spray (4.8 to 12.6 fl oz/gal)	See AGERATUM.
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
		Bonzi, Paczol, Piccolo	15 to 45 ppm spray (0.48 to 1.44 fl oz/gal)	
		Sumagic	25 to 50 ppm spray (6.4 to 12.79 fl oz/gal)	
		Topflor	20 to 60 ppm spray (0.67 to 2.02 fl oz/gal)	Based on NC State University trials. Adjust rates for other locations.
PETUNIA, SEED, PLUGS	To control plant height	Bonzi, Paczol, Piccolo	5 to 10 ppm spray (0.16 to 0.32 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage.
PETUNIA, VEGETATIVE	To control plant growth	A-Rest	10 to 26 ppm spray (4.8 to 12.6 fl oz/gal)	Multiple applications may be required.
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
		B-Nine or Dazide + Bonzi or Piccolo	2,500 ppm spray (0.39 oz/gal) + 40 ppm Bonzi or Piccolo (1.28 fl oz/gal) applied as a tank mix spray	Recommendations based on NC State University trials.
		B-Nine or Dazide + Topflor	2,500 ppm spray (0.39 oz/gal) + 15 to 30 ppm Topflor (0.5 to 1.0 fl oz/gal) applied as a tank mix spray	
		Bonzi, Paczol, Piccolo	5 to 45 ppm spray (0.16 to 1.44 fl oz/gal)	An application at 2 to 4 ppm can be made 1 to 2 weeks after transplanting, followed by a 20 to 30 ppm spray 2 to 3 weeks later. Cultivars' response to PGRs varies. Test a few plants to determine rate for optimal control. Finished plants can be maintained and have prolonged shelf life when 5 to 10 ppm sprays are applied on full-grown, mature plants. Recommendations based on Michigan conditions.
		Sumagic	20 to 50 ppm spray (5.12 to 12.79 fl oz/gal)	20 ppm worked well in NC State University trials.
	Topflor	15 to 60 ppm spray (0.5 to 2.0 fl oz/gal)	Recommendations based on NC State University trials.	
	To increase lateral branching	Florel	300 to 500 ppm spray (1.0 to 1.62 fl oz/gal)	
PHILODENDRON	To control plant height	A-Rest	25 to 132 ppm spray (12.1 to 64 fl oz/gal)	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		B-Nine, Dazide	2,500 to 7,500 ppm spray (0.39 to 1.18 oz/gal)	
PHLOX	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	See AGERATUM.
PILEA	To control plant height	A-Rest	25 to 132 ppm spray (12.1 to 64 fl oz/gal)	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
PLECTRANTHUS	To control plant growth	B-Nine or Dazide + Cycocel	1,500 to 2,500 ppm B-Nine (0.24 to 0.39 oz/gal) + 750 to 1,000 ppm Cycocel (0.81 to 1.08 fl oz/gal) applied as a tank mix spray	Cultivars' response to PGRs varies. Test a few plants to determine rate for optimal control.
		Bonzi, Paczol, Piccolo	5 to 20 ppm spray (0.16 to 0.64 fl oz/gal)	
POINSETTIA	To control plant height	A-Rest	0.06 to 0.25 mg a.i. (2 to 4 ppm) drench for a 6-in. pot (0.25 to 1 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volume and mg a.i. vary with pot size. Start with lower rates
		B-Nine, Dazide	2,000 to 3,000 ppm spray (0.31 to 0.47 oz/gal)	Not effective in N.C. State University studies.
		B-Nine or Dazide + Cycocel	800 to 2,500 ppm (0.13 to 0.39 oz/gal) + 1,000 to 1,500 ppm (1.08 to 1.63 fl oz/gal) applied as a tank mix spray	Use the higher rates of this tank mix spray on stock plants and for finishing crops in very warm regions. Outside of very warm areas, use the lower rates. Late applications can delay flowering and reduce bract size.

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
POINSETTIA (continued)	To control plant height (continued)	Bonzi, Paczol, Piccolo	10 to 30 ppm spray (0.32 to 0.96 fl oz/gal)	Higher rates of 15 to 45 ppm are for southern Florida. Begin applications to slower growing cultivars in cooler sections of North Carolina?? when axillary shoots are 2- to 3-in. long. Begin applications for vigorous growing cultivars in warmer sections of North Carolina when axillary shoots are 1.5- to 3-in. long. See label for other precautions.
		Bonzi, Downsize, Paczol, Piccolo	0.237 to 0.473 mg a.i. (0.25 to 3 ppm) drench for a 6-in. pot; (0.064 to 0.128 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drenches generally have less of an effect on bract size than sprays. Drench volume and mg a.i. vary with pot size. Start with lower rates.
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	For natural season crops in N.C., do not apply Cycocel after mid-October to Nov. 1. Late applications can reduce bract size and delay flowering.
			3,000 to 4,000 ppm drench (3.25 to 4.34 fl oz/gal of drench solution)	Drench volume varies with pot size. Consult the label for recommended volumes.
		Sumagic	2.5 to 10 ppm spray (0.64 to 2.56 fl oz/gal)	
		Topflor	2.5 to 80 ppm spray (0.08 to 2.69 fl oz/gal)	Use lower rates for less vigorous cultivars. SEE LABEL FOR ADDITIONAL RATE RECOMMENDATIONS.
	To promote plant growth	Fascination	0.03 to 0.5 mg a.i. (0.25 to 4.2 ppm) drench for a 6-in. pot	Use lower rates for less vigorous cultivars. SEE LABEL FOR ADDITIONAL RATE RECOMMENDATIONS.
			3 ppm spray (0.02 fl oz/gal)	Use an early season application during vegetative growth prior to the start of short days and flower initiation if promote vegetative growth. SEE LABEL FOR ADDITIONAL PRECAUTIONS BEFORE USE.
PORTULACA	To control plant height	A-Rest	7 to 26 ppm spray (3.4 to 12.6 fl oz/gal)	See AGERATUM.
		Sumagic	15 to 30 ppm spray (3.8 to 7.7 fl oz/gal)	
	To increase lateral branching	Florel	300 to 500 ppm spray (1.0 to 1.62 fl oz/gal)	Recommendations based on Michigan conditions.
POTHOS	To control plant height	A-Rest	25 to 132 ppm spray (12.1 to 64 fl oz)	Drench volumes and mg a.i. vary with pot size.
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in pot)	
		B-Nine, Dazide	2,500 to 7,500 ppm spray (0.39 to 1.18 oz/gal)	
PURPLE CONEFLOWER	To control plant height	Sumagic	30 to 40 ppm spray (7.7 to 10.2 fl oz/gal)	
PURPLE PASSION (<i>Gynura aurantiaca</i>)	To control plant height	A-Rest	26 to 132 ppm spray (12.6 to 64 fl oz/gal)	Drench volumes and mg a.i. vary with pot size.
	0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)			
SALVIA, ANNUAL	To control plant height	A-Rest	10 to 26 ppm spray (4.8 to 12.6 fl oz/gal)	See AGERATUM.
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
		Bonzi, Paczol, Piccolo	20 to 60 ppm spray (0.64 to 1.92 fl oz/gal)	
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	
		Sumagic	5 to 10 ppm spray (1.28 to 2.56 fl oz/gal)	
		Topflor	20 to 80 ppm spray (0.67 to 2.69 fl oz/gal)	
SALVIA, ANNUAL, PLUGS	To control plant height	Bonzi, Paczol, Piccolo	5 to 10 ppm spray (0.16 to 0.32 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage.
SALVIA, PERENNIAL	To control plant height	Bonzi, Paczol, Piccolo	40 to 60 ppm spray (1.28 to 1.92 fl oz/gal)	
SALVIA, VEGETATIVE	To control plant growth	B-Nine, Dazide	1,000 to 2,000 ppm spray (0.16 to 0.32 fl oz/gal)	Multiple applications may be needed to tone crop.
		B-Nine or Dazide + Cycocel	2,000 to 3,500 ppm B-Nine (0.32 to 0.55 oz/gal) + 1,000 to 1,500 ppm Cycocel (1.08 to 1.63 fl oz/gal) applied as a tank mix spray	
SANVITALIA	To control plant growth	B-Nine, Dazide	1,200 to 5,000 ppm spray (0.18 to 0.79 oz/gal)	Use to tone plants. Cultivars' response to PGRs varies. Test a few plants to determine rate for optimal control.

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
SCAEVOLA AEMULA	To control plant growth	Bonzi, Paczol, Piccolo	20 to 40 ppm spray (0.64 to 1.28 fl oz/gal)	Drench volumes vary with pot size. See label for recommended volumes. Cultivars' response to PGRs varies.
			1 to 3 ppm drench (0.12 to 0.35 mg ai)	
		Sumagic	30 ppm spray (7.8 fl oz/gal)	Based on NC State University trials, 300 ppm worked well. Adjust rates to other locations; test on a few plants to determine rate for optimal control.
			0.125 ppm drench (0.011 mg ai)	Drench volumes vary with pot size. See label for recommended volumes. Scaevola is very responsive to Sumagic drenches. Test on a few plants to determine rate for optimal control. Recommendations based on NC State University trials.
		Topflor	45 to 60 ppm spray (1.5 to 2.0 fl oz/gal)	Recommendations based on NC State University trials.
			0.79 to 2.25 ppm drench (0.075 to 0.2 mg ai)	Drench volumes vary with pot size. See label for recommended volumes. Scaevola is very responsive to Topflor. Test the lower rates on a few plants. Recommendations based on NC State University trials.
2 to 4 ppm linear dip (0.067 to 0.133 fl oz/gal)	Scaevola is very responsive to Topflor. Test the lower rates on a few plants. Recommendations based on NC State University trials.			
To increase lateral branching	Florel	300 to 500 ppm spray (1.0 to 1.62 fl oz/gal)		
SCHEFFLERA	To control plant height	A-Rest	25 to 132 ppm spray (12.1 to 64 fl oz/gal)	Drench volumes and mg a.i. vary with pot size.
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot (1 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	
	B-Nine, Dazide	2,500 to 7,500 ppm spray (0.39 to 1.18 oz/gal)		
To increase lateral branching	Atrimmec	3,125 ppm spray (2 fl oz/gal)	Labeled for <i>Schefflera arboricola</i> only.	
SHASTA DAISY	To control plant height	Sumagic	15 to 30 ppm spray (3.8 to 7.7 fl oz/gal)	
SHRIMP PLANT	To increase lateral branching	Atrimmec	781 to 1,562 ppm spray (0.5 to 1 fl oz/gal)	
SNAPDRAGON, SEED	To control plant height	A-Rest	10 to 26 ppm spray (4.8 to 12.6 fl oz/gal)	See AGERATUM.
		Bonzi, Paczol, Piccolo	30 to 90 ppm spray (0.96 to 2.88 fl oz/gal)	
		Sumagic	25 to 50 ppm spray (6.4 to 12.79 fl oz/gal)	
SNAPDRAGON, ANNUAL, PLUGS	To control plant height	Bonzi, Paczol, Piccolo	10 to 20 ppm spray (0.32 to 0.64 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage.
SNAPDRAGON, VEGETATIVE	To control plant growth	Bonzi, Paczol, Piccolo	30 to 60 ppm spray (0.96 to 1.92 fl oz/gal)	
		Sumagic	20 to 45 ppm spray (5.2 to 11.5 fl oz/gal)	
	To control plant growth and peduncle stretch	B-Nine, Dazide	1,500 ppm spray (0.23 oz/gal)	Use during periods of high temperatures.
SPATHIPHYLLUM	To induce flowering	GibGro	265 ppm spray (1.06 fl oz/gal)	Apply one full coverage spray during non-seasonal bloom period (June through January). Some cultivars exhibit distorted blooms, increased petiole length, and narrow leaves.
	To accelerate bloom and increase flower number	ProGibb, T&O	150 to 250 ppm spray (0.6 to 0.95 fl oz/gal)	Use a single application approximately 9 to 12 weeks prior to expected sale date. Spray to the point of runoff and thoroughly wet all growing points.
STATICE CUT (<i>Limonium</i>)	To promote plant growth and stem elongation	ProGibb, T&O	50 to 100 ppm spray (0.19 to 0.4 fl oz/gal)	Apply when plants are 4 to 8 in. tall. Other applications can be made at 2- to 3-week intervals. See label.
	For earlier flowering and increased flowering	ProGibb, T&O	400 to 500 ppm spray (1.5 to 1.9 fl oz/gal)	Give each plant 10 ml (0.33 fl oz) of solution. Use when plants are 10 in. or more in diameter (approximately 90 to 100 days after sowing). See label.
STOKESIA	To control plant height	Bonzi, Paczol, Piccolo	40 to 80 ppm spray (1.28 to 2.56 fl oz/gal)	
STREPTOCARPUS	To control plant height	Topflor	5 to 20 ppm spray (0.17 to 0.67 fl oz/gal)	
STROBILANTHES DYERIANUS (Persian Shield)	To control plant growth	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
SUNFLOWER	To control plant height	Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	See AGERATUM.
		Topflor	30 to 50 ppm spray (1.01 to 1.68 fl oz/gal)	
			1 to 2 mg a.i. (8.45 to 16.9 ppm) drench for a 6-in. pot	
TORENIA SP.	To control plant growth	Florel	Avoid Use	Florel significantly delays flowering.

TABLE 9-5. GROWTH REGULATORS FOR FLORICULTURAL CROPS IN GREENHOUSES

Crop	Purpose	Chemical	Rate	Precautions and Remarks
TULIP	To control plant height	A-Rest	0.125 to 0.5 mg a.i. (1 to 4 ppm) drench for a 6-in. pot (0.5 to 2 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		Bonzi, Downsize, Paczol, Piccolo	0.591 to 4.732 mg a.i. (5 to 40 ppm) drench for a 6-in. pot (0.16 to 1.28 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		Bonzi, Paczol, Piccolo	2 to 5 ppm bulb soak (0.064 to 0.16 fl oz/gal)	Soak bulbs for 1 hr prior to planting.
		Topflor	0.5 to 1 mg a.i. (4.2 to 8.45 ppm) drench for a 6-in. pot	Based on NC State University trials. Adjust rates for other locations.
			80 to 100 ppm spray (2.69 to 3.36 fl oz/gal)	Based on NC State University trials. Adjust rates for other locations.
VERBENA, ANNUAL	To control plant height	B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	See AGERATUM.
		Bonzi, Paczol, Piccolo	15 to 30 ppm spray (0.48 to 0.96 fl oz/gal)	
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	
		Sumagic	15 to 30 ppm spray (3.84 to 7.68 fl oz/gal)	
	To increase lateral branching	Atrimmec	521 to 1,042 ppm spray (0.33 to 0.67 fl oz/gal)	Florel applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.
Florel	500 ppm spray (1.619 fl oz/gal)			
VERBENA, ANNUAL, PLUGS	To control plant height	Bonzi, Paczol, Piccolo	5 to 10 ppm spray (0.16 to 0.32 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage.
VERBENA, PERENNIAL	To control plant height	Bonzi, Paczol, Piccolo	120 to 160 ppm spray (3.84 to 5.12 fl oz/gal)	
		Bonzi, Downsize, Paczol, Piccolo	>0.36 mg a.i. (>3 ppm) drench for a 6 in. pot; apply 4 fl oz/6-in. pot	
VERBENA, VEGETATIVE	To control plant growth	B-Nine or Dazide + Cycocel	2,000 to 3,500 ppm B-Nine (0.32 to 0.55 oz/gal) + 750 to 1,000 ppm Cycocel (0.82 to 1.08 fl oz/gal) applied as a tank mix spray	See General Recommendations.
VERONICA	To control plant height	Bonzi, Paczol, Piccolo	20 to 40 ppm spray (0.64 to 1.28 fl oz/gal)	
		Sumagic	20 to 40 ppm spray (5.1 to 10.2 fl oz/gal)	
VINCA (Catharanthus)	To control plant height	A-Rest	5 to 18 ppm spray (2.4 to 8.7 fl oz/gal)	See AGERATUM.
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	See AGERATUM.
		Sumagic	1 to 3 ppm spray (0.26 to 0.77 fl oz/gal)	
		Topflor	2.5 to 7.5 ppm spray (0.08 to 0.25 fl oz/gal)	
VINCA VINE (Vinca spp.)	To increase lateral branching	Florel	500 ppm spray (1.619 fl oz/gal)	Florel applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.
VIOLA	To control plant height	Sumagic	1 to 5 ppm spray (0.26 to 1.28 fl oz/gal)	See AGERATUM.
WANDERING JEW	To control plant height	A-Rest	26 to 132 ppm spray (12.6 to 64 fl oz/gal)	
WOODY LANDSCAPE PLANTS (Not specifically listed in this table)	To control plant height	A-Rest	50 ppm spray (24.2 fl oz/gal)	Drench volumes and mg a.i. vary with pot size.
			0.25 mg a.i. (2 ppm) drench for a 6-in. pot (1 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	
		Bonzi, Paczol, Piccolo	100 ppm spray (3.2 fl oz/gal)	See BEDDING PLANTS.
		Bonzi, Downsize, Paczol, Piccolo	0.47 mg a.i. (4 ppm) drench for a 6-in. pot; (0.128 fl oz/gal of drench solution; apply 4 fl oz/6-in. pot)	See BEDDING PLANTS.
		Sumagic	10 to 50 ppm spray (2.56 to 12.8 fl oz/gal) 1 to 2 ppm drench (0.26 to 0.52 fl oz/gal)	
ZINNIA	To control plant height	A-Rest	7 to 26 ppm spray (3.4 to 12.6 fl oz/gal)	See AGERATUM.
		B-Nine, Dazide	2,500 to 5,000 ppm spray (0.39 to 0.79 oz/gal)	
		Bonzi, Paczol, Piccolo	15 to 45 ppm spray (0.48 to 1.45 fl oz/gal)	
		Cycocel	800 to 1,500 ppm spray (0.87 to 1.63 fl oz/gal)	
ZINNIA, PLUGS	To control plant height	Bonzi, Paczol, Piccolo	5 to 10 ppm spray (0.16 to 0.32 fl oz/gal)	Timing of application should normally begin at the 1 to 2 true leaf stage.

GROWTH REGULATORS FOR WOODY ORNAMENTAL CROPS

F. A. BLAZICH, Horticultural Science Department

TABLE 9-6. GROWTH REGULATORS FOR WOODY ORNAMENTAL CROPS

Crop	Purpose	Chemical	Rate	Precautions and Remarks
AZALEA	To produce compact plants.	succinic acid (daminozide) (B-Nine) 85% WSP	9 oz/gal water	Spray foliage to runoff. Apply during early part of July. Follow label instructions.
WOODY ORNAMENTALS	To stimulate rooting of cuttings.	K-IAA (Rhizopon A Water Soluble Tablet) 0.0018 oz (50 mg) K-IAA	Variable	Concentration will depend on species and also on time of year rooting is to take place. Follow label instructions.
		IBA (C-mone) 1% to 2%	1% to 2%	
		K-IBA (Rhizopon AA Water Soluble Tablet) 0.0018 oz (50 mg) K-IBA	Variable	
		K-IBA (C-mone K) 1%	1%	
		K-IBA + K-NAA (C-mone K+) 1.5% L	1.5%	
		IBA + NAA (Dip 'N Grow) 1.5% L	1.5%	
		IBA (Hormex) 0.1% to 4.5% D	0.1% to 4.5%	
		IBA (Hormodin) 0.1% to 0.8% D	0.1% to 0.8%	
		IBA + thiram (Hormo-Root) 0.1% to 2% IBA + 15% thiram D	0.1% to 2% + thiram 15%	
		IBA (Rhizopon AA) 0.1% to 0.8% D	0.1 to 0.8%	
		K-NAA (Rhizopon B Water Soluble Tablet) 0.0009 oz (25 mg) K-NAA	Variable	
		NAM + thiram (Rootone) 4.24% D	4.24%	
		IBA + NAA (Wood's Rooting Compound) 1.54% L	1.54%	
	To promote lateral branching and produce compact plants in various species and suppress flowering and fruit formation in various species.	dikegulac sodium (Atrimmec) 20% L	Depending on species, size, vigor of plants, and specific use	Amount used and concentration will vary depending on a number of factors. Follow label directions.
	To control height on a wide variety of woody landscape plants (container grown in greenhouses or shadehouses) using both spray or drench applications.	paclobutrazol (Bonzi) 0.4% L	variable	Amount used and concentration will vary depending on a number of factors. Follow label directions.
	To reduce or eliminate undesirable fruit development on many ornamental trees and shrubs such as apples, cottonwood, crabapples, elm, flowering pear, horse chestnut, maples, oaks, pines, sour orange, sweetgum, and sycamore.	ethephon (Florel) 3.9% L	1 qt/10 gal water (3 oz/gal)	Timing is extremely critical. Application must be made prior to fruit set; so apply at the full bloom stage in sufficient water to wet (do not spray to run off). Follow label directions.
	To retard regrowth of most trees (hickory, red oak, silver maple), shrubs (viburnum, glossy albelia), and vines (ajuga, periwinkle, English ivy).	chlorflurenol (Maintain CF 125) 12.5% EC, A	0.33 pt to 8 pt/100 gal water	Concentration will depend on particular species. Apply after new flush of growth or after pruning and new leaves have fully expanded. Take care to confine the use of this material to the particular area treated.
	To promote lateral shoot growth on vegetative plants of azalea, cotoneaster, juniper, taxus.	methyl decanoate/octanoate (Off-Shoot-O) 45% EC	2 to 5 oz/qt water	Amount will vary with genera. Follow label for specific conditions.
	To retard regrowth of most trees, (sycamore, sweetgum, willow), shrubs (pyracantha, privet), and ivy.	maleic hydrazide (Royal Slo-Gro) 21.7% SOL	1.33 gal/100 gal water	Prune plant to desired height. After regrowth occurs (as new leaves expand), apply to drip point. Uniform coverage is important for desired results.

SUCKER CONTROL FOR FLUE-CURED TOBACCO
L. R. FISHER, J. A. PRIEST, and D. S. WHITLEY, Crop Science Department

TABLE 9-7. SUCKER CONTROL FOR FLUE-CURED TOBACCO

Chemical and Formulation	Purpose	Amount of Formulation Per Acre	Precautions and Remarks
CONTACT TYPE C8–C10 fatty alcohol (various brands) 6.01 lb/gal	Normal sucker control	2 or 2.5 gal (4% or 5%)	Apply in 48 gal of water per acre (4% solution) to plants in button stage with second application 3 to 5 days later at any time of the day, except when plants are wet or temperature exceeds 90°F or plants are wilted. Use two TG-3 nozzle tips plus a TG-5 in the center or equivalents per row with approximately 20 psi operated from 12 to 16 in. above the top of the button or stalk at 2.5 to 3 mph. Rate of second application may be increased to 2.5 gal in 47.5 gal of water (5% solution) unless crop is tender. Will not control suckers more than 1 in. long. Excess nitrogen increases the chance of leaf drop.
C10 fatty alcohol 5.72 lb/gal		1.5 gal (3%)	Apply in 48.5 gal water per acre (3% solution) for both applications. Follow application instructions above for C8–C10 alcohol.
CONTACT TYPE C8–C10 fatty alcohol 6.01 lb/gal	Control of late-season sucker regrowth	2.5 gal (5%)	Apply 3 to 4 weeks after MH application if suckers begin to grow. Apply in 47.5 gal of water per acre. Follow same directions as above. Will not control suckers more than 1 in. long. Do not make more than three applications of a contact per crop per season.
SYSTEMIC TYPE (Maleic hydrazide [MH]) Liquids, various brands 1.5 lb/gal	Normal sucker control	1.5 gal (1 qt/1,000 plants)	Rate varies with plant population. 1.5 gal of the 1.5 lb per gal material assumes 6,000 plants per acre. For plant populations other than 6,000, adjust rate accordingly. Apply to plants 5 to 7 days after the last contact application. Apply in the morning, using 30 to 50 gal of water per acre, two to three cone nozzle tips per row, and 40 to 60 psi. Effectiveness will be reduced if applied to wet plants or those that are drought stressed or wilted from too much rainfall or high temperatures. Do not make more than one application per season. Should wash-off occur within 6 hr, a single repeat application may be made. DO NOT APPLY AT HIGHER THAN SUGGESTED RATES OR WITHIN 7 DAYS BEFORE HARVEST IN ORDER TO MINIMIZE MH RESIDUES.
2.25 lb/gal		1 gal (1 qt/1,500 plants)	
60% Water-Soluble Products Fair 80 SP or Sucker Stuff 60 WS		3.75 lb	
Royal MH-30 SG		4 to 5 lb	
CONTACT, LOCAL-SYSTEMIC TYPE flumetralin (Prime +, Flupro or Drexalin Plus) 1.2 lb/gal	Normal sucker control, power sprayer	2 qt	Mix in 49 gal of water per acre and apply like a contact at elongated button to early flower stage with three nozzles per row (TG-3, TG-5, TG-3) at 20 psi. Remove suckers longer than 1 in. within 24 hr before application and remove missed suckers as observed later. Excess spray to the point of runoff on the soil increases the risk of carryover residues, which may stunt early growth of next crop, including tobacco if a dinitroaniline herbicide is also used. Do not apply these products through any type of irrigation system, and apply only once per season. Rainfall within 2 hr after application may reduce effectiveness. Follow WSP requirements and other precautions and restrictions listed on product labels.
flumetralin (Prime +, Flupro or Drexalin Plus) 1.2 lb/gal	Hand application	1.2 to 2.4 qt (2.5 oz/gal water)	Mix in desired amount of water at rates shown in parenthesis and apply mixture as a coarse spray or drench to top of stalk. Apply about 0.5 oz of mixture per plant after topping and removing suckers longer than 1 in., but do not exceed 25 to 30 gal per acre. See remarks above for power sprayer application and follow precautions, restrictions, and WPS requirements shown on product labels.
flumetralin (Prime +, Flupro or Drexalin Plus) 1.2 lb/gal	Control of late season sucker regrowth	2 qt	Apply only if control with MH is beginning to break down. Mix in 49 gal water per acre and apply like a contact at 20 to 25 psi 3 to 4 weeks after MH application; will not control suckers longer than 1 in. TO REDUCE THE RISK OF SOIL RESIDUE CARRYOVER, DO NOT USE FOR LATE-SEASON CONTROL IF USED EARLIER IN THE SEASON.
SYSTEMIC TYPE maleic hydrazide (MH) + CONTACT, LOCAL-SYSTEMIC TYPE flumetralin (Prime +, Flupro or Drexalin Plus)	Normal sucker control	Full rate MH +	See precautions and remarks for MH to determine “full rate” of MH. Mix in sufficient water to total 50 gal per acre, and apply 5 to 7 days after the last contact or when MH alone is normally applied. Apply like a contact, using three nozzles (TG-3, TG-5, TG-3) per row at approximately 20 psi. Follow precautions and restrictions on labels. DO NOT APPLY AT HIGHER THAN LABELED RATES OR WITHIN 7 DAYS BEFORE HARVEST IN ORDER TO REDUCE MH RESIDUES.
		2 qt	
CONTACT-SYSTEMIC TYPE C10 fatty alcohol + MH (FST-7 or Leven-38) 4 lb/gal	Normal sucker control	3 gal	Apply in 47 gal water to plants in early flower stage (1 week after button) any time during the day except when plants are wet or temperatures exceed 90°F or plants are wilted. Use three nozzles per row with tips that deliver a coarse spray and desired rate when operated at 20 psi. Operate sprayer at a speed of 2 1/2 to 3 miles per hour and spray 50 gal of diluted emulsion per acre. Use a semi-coarse spray covering the top 1/3 to 1/2 of the plant and allowing the liquid to run down the stalk to the bottom of each plant. DO NOT APPLY AT HIGHER THAN SUGGESTED RATES OR WITHIN 7 DAYS BEFORE HARVEST IN ORDER TO MINIMIZE MH RESIDUES. Effectiveness will be reduced if applied to plants that are drought-stressed or wilted from too much rainfall or high temperatures.

YELLOWING AGENTS FOR FLUE-CURED TOBACCO
L. R. FISHER and W. D. SMITH, Crop Science Department

TABLE 9-8. YELLOWING AGENTS FOR FLUE-CURED TOBACCO

Purpose	Chemical	Amount of Formulation Per Acre	Pounds Active Ingredient Per Acre	Precautions and Remarks
To increase the rate of yellowing	ethephon (Prep), (Super Boll), or (Mature XL)	1.33 to 2.67 pt	1 to 2 lb	Use after second or third priming when remaining leaves are physiologically mature. Determine if tobacco is ready to spray by treating several representative plants at several locations with test kit (or prepare test spray by mixing 1 tsp of product in 1 qt of water). If test leaves begin to yellow in 24 to 72 hr, apply product to tobacco in 40 to 60 gal water per acre as a fine spray mist (40 to 60 psi). Effectiveness may be reduced by application on cool, cloudy days, poor spray coverage, or rain within 4 hr after application. Harvest leaves within 24 to 48 hr or when they reach the desired degree of yellowness; prolonged delay in harvest may result in yield and quality loss or leaf drop. Therefore, do not spray more acreage than can be harvested before major rain is anticipated. DO NOT USE SURFACTANTS!

SUCKER CONTROL FOR BURLEY TOBACCO
L. R. FISHER, J. A. PRIEST, and D. S. WHITLEY, Crop Science Department

TABLE 9-9. SUCKER CONTROL FOR BURLEY TOBACCO

Chemicals and Formulations	Amount of Formulation Per Acre	Precautions and Remarks
CONTACT TYPE C8–C10 fatty alcohol (various brands) 6.01 lb/gal	1.5 to 2 gal* (3% to 4%)	Apply in button to early flower stage as coarse, low pressure (approximately 20 psi) spray directed downward on plant tops. Leaf burn may occur with high application rates and pressure, especially on tender or wilted plants when temperature exceeds 90°F. High rates or reapplication may contribute to leaf drop. Application before dew dries will reduce effectiveness.
SYSTEMIC TYPE (maleic hydrazide [MH]) Liquids, various brands 1.5 lb/gal 2.25 lb/gal 60% Water-Soluble Products Fair 80 SP or Sucker Stuff 60 WS Royal MH-30 SG	1.5 to 2 gal 1 to 1.33 gal 3.75 lb 4 to 5 lb	For all systemic products, apply to upper 1/3 to 1/4 of plant in 20 to 50 gal water per acre at approximately 20 psi after topping to 8-in. leaf. Effectiveness reduced when applied to drought-stressed or wilted plants, or before dew has dried. Apply a single repeat application ONLY if wash-off occurs within 6 hr. For water-soluble products, see rate information below and read labels carefully for mixing instructions. Rate for 6,000 plants per acre. Adjust rate accordingly for other plant populations.
CONTACT + SYSTEMIC MIXTURE (FST-7 or Leven-38) C10 fatty alcohol + maleic hydrazide (MH)	9 qt*	Apply downward on plant tops as coarse, low-pressure (approximately 20 psi) spray after topping down to 8-in. leaf. Follow precautions given above and label restrictions for both contact- and systemic-type chemicals. High rates or reapplication after wash-off may contribute to leaf drop and increase MH residues on cured tobacco.
CONTACT, LOCAL-SYSTEMIC TYPE flumetralin (Prime +, Flupro or Drexalin Plus) butralin (Butralin)	1 gal* 3 to 4 qt*	Apply downward on plant tops as coarse, low-pressure (approximately 20 psi) spray after topping down to 8-in. leaf. Suckers longer than 1 in. should be removed at application time and missed suckers removed when seen. Apply only once per plant per season. Excessive spray volume that causes downstalk runoff on soil increases the chance of soil residue carryover, which may stunt the growth of small grains and corn or cause early season stunting of the next tobacco crop when a dinitroaniline herbicide is also used. Rainfall within 2 hr may reduce effectiveness.
SYSTEMIC + CONTACT, LOCAL- SYSTEMIC maleic hydrazide (MH) + flumetralin (Prime +, Flupro or Drexalin Plus) maleic hydrazide (MH) + butralin (Butralin)	1/2 to full rate MH + 2 qt flumetralin * Full rate MH + 2 qt Butralin*	Apply as tank mix downward on topped plants as coarse, low pressure (approximately 20 psi) spray at time recommended for MH application. Follow precautions given above and label restrictions for both systemic and contact, local-systemic-type chemicals. The 3/4 rate of MH (1.5 gal for most products) tank mixed with Prime+ has given satisfactory sucker control on vigorous crops and/or those harvested more than 3 weeks after application.

* Mix in sufficient water to total 50 gal spray per acre.

GROWTH REGULATORS FOR PROCESSING TOMATOES

C. C. GUNTER, Horticultural Science Department

TABLE 9-10. GROWTH REGULATORS FOR PROCESSING TOMATOES

Crop	Purpose	Chemical	Pounds Active Ingredient Per Acre	Amount of Formulation Per Acre	Precautions and Remarks
PROCESSING TOMATOES Early and midseason crops or warm conditions	Stimulate uniform ripening for one harvest.	ethephon (Ethrel)	0.3 to 1.6 lb	2.25 to 3.25 pt	Apply to cover foliage and fruit uniformly when 5% to 15% of the fruit is pink and red. Apply in a minimum of 20 gallons per acre for ground application (10 gallons for aerial). Under warm temperatures (above 85F) rates as low as 1.25 pts/acre can be effective. Thorough coverage is essential. Observe treated fields closely and harvest fruit at proper maturity.
PROCESSING TOMATOES Late season or coastal crops or cool conditions	Stimulate uniform ripening for one harvest.	ethephon (Ethrel)	0.8 to 1.6 lb	3.25 to 6.5 pt	Apply to cover foliage and fruit uniformly when 5% to 15% of the fruit is pink and red. Apply in a minimum of 20 gallons per acre for ground application (10 gallons for aerial). Use the higher rate when nighttime temperatures are cool (below 65F) or vegetative growth is dense. Thorough coverage is essential. Observe treated fields closely and harvest fruit at proper maturity.

GROWTH REGULATORS FOR PEANUT

D. L. JORDAN, Crop Science Department

TABLE 9-11. GROWTH REGULATORS FOR PEANUT

Purpose	Chemical and Formulation	Amount of Formulation Per Acre	Remarks
To suppress excessive vegetative growth and reduce pod shed	prohexadione calcium (Apogee) 27.5% WDG	7.25 + 7.25 oz	Apply Apogee when 50% of vines from adjacent rows are touching. Follow with a repeat application 2 to 3 weeks later. Two applications are needed in most circumstances. In some instances a third application may be needed to provide optimum row visibility. Apply with crop oil concentrate and nitrogen solution. Do not exceed 21.75 oz per acre per year. The preharvest interval for Apogee is 25 days.

For further information, see Extension publication *Peanut Information*, AG-331, and *Tank Mixing Chemicals Applied to Peanut Crops: Are the Chemicals Compatible*, AGW-653, which is on the Web at <http://www.peanut.ncsu.edu/ag653.pdf>. Copies are available from your county Cooperative Extension center.

GROWTH REGULATORS FOR TURFGRASSES

F. H. YELVERTON, R. COOPER, L. S. WARREN JR., and T. W. GANNON, Crop Science Department

TABLE 9-12. GROWTH REGULATORS FOR TURFGRASSES

Purpose	Brand	Amount of Formulation Per Acre	Pounds Active Ingredient Per Acre	Precautions and Remarks
COOL SEASON GRASSES				
WELL-MAINTAINED TURF Seedhead and foliar suppression	mefluidide (Embank) 0.2	5 pt/15 to 150 gal water	0.125	See Embark 2-S for low-maintenance cool-season turf. Follow label directions and precautions.
	trinexapac-ethyl (Governor) 0.17 G	30 to 258 lb	0.05 to 0.44	Apply 30 to 41 lb per acre to greens, 53 to 152 lb per acre to fairways less than 0.5 in. cut, and 152 to 258 lb per acre to residential and commercial turf. Do not exceed 2.5 lb active ingredient per acre per year. These rates should provide 50% turf growth suppression for 4 weeks with minimal yellowing.
	(Primo Maxx) 1 MEC or (T-Nex) 1AQ (Primo WSB) 25 WP	6 to 44 fl oz 2.75 to 21.8 oz	0.085 to 0.34 0.085 to 0.34	Application rate varies with turfgrass species and height of cut. Apply to actively growing, nonstressed turf. More growth suppression occurs at lower mowing heights. See label for specific rate and other directions and precautions. Repeat applications can be made, but do not exceed a total of 21.4 pt per acre per year of Primo Maxx or a total of 174 oz per acre per year of Primo WSB. Do not exceed a total of 19 pt per acre per year of T-Nex. Refer to the respective Primo label for guidelines regarding mowing prior to and following application. Mix with 0.5 to 4 gal of water per 1,000 sq ft (20 to 174 gal per acre). Primo can be applied to putting greens. See label for instructions.
Foliar suppression	ethephon (Ethephon or Proxy) 2 SL	1.7 gal	3.4	May be applied to Kentucky bluegrass, perennial ryegrass, bentgrass, and tall and fine fescues. Apply in 22 to 174 gal of water per acre. Do not use a surfactant. Plant growth regulator effect will not be seen until 7 to 10 days after application. May be reapplied to Kentucky bluegrass and perennial ryegrass at 7-week intervals. Repeat applications to bentgrass and tall and fine fescue may be made at 4-week intervals.
	flurprimidol (Cutless 50 W) 50 WP	0.75 to 3 lb/50 to 200 gal water	0.37 to 1.5	Rates depend upon grass species and cultivar. Apply to bentgrass, Kentucky bluegrass, and perennial ryegrass in late spring-early summer and/or late summer-early fall. Time the second application to occur at least 3 months before expected winter dormancy. Do not apply to putting greens. Do not exceed 1.5 lb per acre per application on coarse-textured soils. Treated areas should receive 0.5 in. of irrigation within 24 hr after application. Resume mowing 3 to 5 days after application.
	flurprimidol + trinexapac-ethyl (Legacy) 1.51 SL	5 to 22 fl oz	0.059 to 0.26	Tolerant species include bentgrass greens and fairways, Kentucky bluegrass, and perennial ryegrass. Do not use on turf grown for sale or other commercial use as sod or seed production. Do not seed 3 weeks before or 3 weeks after application. Wait 6 to 8 weeks after sprigging or laying sod before applying. Use only 5 to 8 fl oz per acre on bentgrass greens. Repeat applications at 2- to 6-week intervals until 4 weeks before the onset of inactive growth.
	paclobutrazol (TGR Turf Enhancer 2 SC or Trimmit 2 SC) 2 SC	1 to 2 pt /43 to 200 gal water	0.25 to 0.5	Apply in spring after greenup and after turf has been mowed once or twice. Apply at least 1 month before onset of high temperatures. In late summer-early fall, apply at least 1 month before anticipated first killing frost. Apply with 0.5 to 0.9 lb nitrogen per 1000 sq ft of a nonburning fertilizer. Apply 0.25 in. of water within 24 hr after application to remove product from foliage and onto soil surface. See label for special rates and directions for applications to bentgrass, putting greens, and overseeded bermudagrass. Repeat applications within the same growing season may be made but refer to label for instructions. Do not apply more than three times annually. Do not use on areas containing greater than 70% <i>Poa annua</i> . Do not seed within 6 weeks prior to or 2 weeks after applications.
	trinexapac-ethyl (Primo Maxx) 1 MEC or (T-Nex) 1 AQ (Primo WSB) 25 WP	6 to 22 fl oz 2.75 to 10.9 oz	0.085 to 0.17 0.085 to 0.17	Application rates are for mowing heights of less than or equal to 0.5 in. Apply to actively growing, non-stressed turf. Rate varies with turfgrass species. See label for specific rate and other directions and precautions. Repeat applications can be made but do not exceed a total of 21.4 pt per acre per year of Primo Maxx or a total of 174 oz per acre per year of Primo WSB. Do not exceed a total of 19 pt per acre per year of T-Nex. Refer to the respective Primo label for guidelines regarding mowing prior to and following applications. Mix with 0.5 to 4 gal of water per 1,000 sq ft (20 to 174 gal per acre). Primo can be applied to putting greens. See label for instructions.
LOW-MAINTENANCE TURF Seedhead and foliar suppression	chlorsulfuron (Telar DF) 75 DF + mefluidide (Embank 2-S) 2 S	0.25 oz + 0.5 pt	0.012 + 0.125	For growth and seedhead suppression in fescue/bluegrass stands. Apply up until seedhead emergence. Do not apply Telar DF to turf less than 1 year old. Grass seed may be planted in treated areas 6 months after treatment but cultivation is recommended. For broadcast applications, do not exceed 0.5 oz Telar DF per acre within a 12-month period. Telar DF alone can also be used for weed control in bahiagrass, bermudagrass, fescue, and bluegrass.
	glyphosate (Touchdown Pro) 3 LC	4 to 8 fl oz/10 to 40 gal water	0.09375 to 0.1875	Touchdown Pro may be used on turf described in "GENERAL USE AREAS" section of the label. 4 to 5 oz will suppress annual grasses, such as ryegrass, wild barley, and wild oats, growing in turf areas. 6 oz will suppress Kentucky bluegrass and serve as a mowing substitute. 8 oz will suppress fine fescue and tall fescue and serve as a mowing substitute. A nonionic surfactant containing at least 75% active ingredient at 0.25% v/v (1 qt per 100 gal) or ammonium sulfate at 0.5% by weight (4.25 to 17 lb per 100 gal) may be added.

TABLE 9-12. GROWTH REGULATORS FOR TURFGRASSES

Purpose	Brand	Amount of Formulation Per Acre	Pounds Active Ingredient Per Acre	Precautions and Remarks
COOL SEASON GRASSES (continued)				
LOW-MAINTENANCE TURF Seedhead and foliar suppression (continued)	imazethapyr + imazapyr (Event) 1.46 lb/gal	8 to 10 fl oz	0.09 to 0.11	Apply to tall fescue, perennial ryegrass, and bluegrass only. Apply after the turf is at 100% greenup and has at least 2 in. of vertical growth. The addition of a nonionic surfactant containing at least 80% active ingredient at 0.25% v/v of the spray (2 pt per 100 gal of spray mixture) is required. Do not use on newly established stands less than 1 year old or on highly managed turf. Do not reseed before 3 months after application. See label for herbicide tank mix options. Follow label directions and precautions.
	maleic hydrazide (Retard) 2.25 lb/gal (Royal Slo-Gro) 1.5 lb/gal (Liquid Growth Retardant) 0.6 lb/gal	1.3 gal/50 gal water 2 gal/30 to 50 gal water 5 gal/45 gal water	3	Treat in the spring when the grass is actively growing but before seedhead appears. Applications made after seedhead appears will suppress subsequent seedheads. Do not apply to turf less than 3 years old, and do not reseed within 3 days after application. Treated turf may appear less dense and temporarily discolored. Optimum results may not be obtained if rainfall or overhead irrigation occurs within 12 hr following application. Remove excess grass clippings and fallen leaves before application. Do not add a surfactant. Follow label directions and precautions.
	mefluidide (Embark 2-S) 2 S	1.5 to 2 pt/15 to 150 gal water	0.38 to 0.5	Apply after uniform spring greenup until approximately 2 weeks before seedheads appear. Do not apply to turf within four growing months after seeding, and do not reseed within 3 days after application. Treated turf may appear less dense and temporarily discolored. Optimum results may not be obtained if rainfall or overhead irrigation occurs within 8 hr following application. Remove excess clippings and fallen leaves before application. Adding 1 to 2 qt of nonionic surfactant per 100 gal of spray solution may enhance suppression; however, discoloration may also be increased. Follow label directions and precautions.
	metsulfuron methyl (Escort XP) 60 DF	0.25 to 0.5 oz	0.009 to 0.018	Apply to well-established tall fescue and perennial bluegrass turf. Can tank mix with 0.125 to 0.25 pt per acre of Embark to improve pgr performance. Treat after 2 to 3 inches of new growth but before seed stalk formation. Temporary discoloration may occur. Do not use on stressed turf.
WARM SEASON GRASSES				
WELL-MAINTAINED TURF Seedhead and foliar suppression	trinexapac-ethyl (Governor) 0.17 G	12 to 258 lb	0.02 to 0.44	Apply 12 to 41 lb per acre to greens, 30 to 77 lb per acre to fairways less than 0.5 in. cut, and 41 to 258 lb per acre to residential and commercial turf. Do not exceed 2.5 lb active ingredient per acre per year. These rates should provide 50% turf growth suppression for 4 weeks with minimal yellowing.
	(Primo Maxx) 1 MEC or (T-Nex) 1 AQ (Primo WSB) 25 WP	2.7 to 88 fl oz 1.35 to 43.6 oz	0.085 to 0.68 0.085 to 0.68	Application rate varies with turfgrass species and height of cut. Apply to actively growing, nonstressed turf. More growth suppression occurs at lower mowing heights. See label for specific rate and other directions and precautions. Repeat applications can be made but do not exceed a total of 21.4 pt per acre per year of Primo Maxx or 174 oz per acre per year of Primo WSB. Do not exceed a total of 19 pt per acre per year of T-Nex. Refer to the respective Primo label for guidelines regarding mowing prior to and following application. Mix with 0.5 to 4 gal of water per 1,000 sq ft (20 to 174 gal per acre). Primo can be applied to putting greens. See label for directions.
	mefluidide (Embark) 0.2	10 pt/15 to 150 gal water	0.25	For St. Augustinegrass. See Embark 2-S for low-maintenance warm season turf. Follow label directions and precautions.
WELL-MAINTAINED TURF Foliar suppression	flurprimidol (Cutless 50 W) 50 WP	0.75 to 3 lb/50 to 200 gal water	0.37 to 1.5	Rates depend upon grass species and cultivar. Apply to Tifway, Tifgreen, common bermudagrass, or zoysiagrass. Treated areas should receive 0.5 in. of irrigation within 24 hr of application. Resume mowing. Overseed 2 to 3 weeks after fall application with a desired perennial ryegrass.
	flurprimidol + trinexapac-ethyl (Legacy) 1.51 SL	8 to 15 fl oz	0.094 to 0.177	Tolerant species include Tifway and Tifsport bermudagrass, zoysiagrass, and seashore paspalum. Do not use on turf grown for sale or other commercial use as sod or seed production. Do not seed 3 weeks before or 3 weeks after application. Wait 6 to 8 weeks after sprigging or laying sod before applying. Repeat applications at 2- to 6-week intervals until 4 weeks before winter dormancy.
	paclobutrazol (TGR Turf Enhancer 2 SC or Trimit 2 SC) 2 SC	2 to 3 pt/43 to 200 gal water	0.5 to 0.75	Use any time when established hybrid bermudagrass and St. Augustinegrass are green, are actively growing, and have recovered from dormancy (filled in fully following winter). Apply with 0.5 to 0.9 lb nitrogen per 1,000 sq ft of a nonburning fertilizer. Apply 0.25 in. of water within 24 hr after application to remove product from foliage and onto soil surface. A repeat application within the same growing season may be made, but not sooner than 8 weeks following initial application. Do not apply more than 3 times annually. Do not use on areas containing greater than 70% <i>Poa annua</i> . Refer to label to determine bermudagrass and St. Augustine cultivar response relating to sensitivity, growth, and color response. Do not seed within 6 weeks prior to or 2 weeks after application.
	trinexapac-ethyl (Primo Maxx) 1 MEC or (T-Nex) 1 AQ (Primo WSB) 25 WP	2.7 to 13 fl oz 1.35 to 6.5 oz	0.042 to 0.085 0.042 to 0.085	Application rates are for mowing heights of less than or equal to 0.5 in. Apply to actively growing, non-stressed turf. Rate varies with turfgrass species. See label for specific rate and other directions and precautions. Repeat applications can be made but do not exceed a total of 21.4 pt per acre per year of Primo Maxx or a total of 174 oz per acre per year of Primo WSB. Do not exceed a total of 19 pt per acre per year of T-Nex. Refer to the respective Primo label for guidelines regarding mowing prior to and following applications. Mix with 0.5 to 4 gal of water per 1000 sq ft (20 to 174 gal per acre). Primo can be applied to putting greens. See label for directions.

TABLE 9-12. GROWTH REGULATORS FOR TURFGRASSES

Purpose	Brand	Amount of Formulation Per Acre	Pounds Active Ingredient Per Acre	Precautions and Remarks
WARM SEASON GRASSES (continued)				
LOW-MAINTENANCE TURF Seedhead and foliar suppression	glyphosate (Roundup Pro) 4 lb/gal	6 fl oz/10 to 25 gal water	0.2	Apply to bahiagrass only. Apply after full greenup of the bahiagrass (about late May) and make only one application per year. Do not apply to turf less than 3 years old. Treated turf may appear less dense and temporarily discolored. Optimum results may not be obtained if rainfall or overhead irrigation occurs within 6 hr following application. This is a nonselective herbicide. If application exceeds the above recommended rates, it can result in permanent loss of turf.
	(Touchdown Pro) 3 LC	0.375 to 4 pt/10 to 40 gal water	0.14 to 1.5	Touchdown Pro may be used on dormant or actively growing bermudagrass and bahiagrass turf described in "GENERAL USE AREAS" section of label. May be tank mixed with 0.25 to 2 oz of Oust for residual weed control. Check label for correct rates. Touchdown Pro will control winter annual weeds less than 6 in. tall and also 4-to 6-leaf tall fescue in dormant turf. Use only on well-established bermudagrass. Injury may occur, but regrowth will occur under moist conditions. Bahiagrass vegetative growth and seedheads may be suppressed approximately 45 days when applied 1 to 2 wk after spring greenup and before seedhead emergence. A second application at 45 days will extend suppression to approximately 120 days.
	imazapic (Plateau) 2 ASU	2 fl oz	0.031	Only government entities may buy Plateau. Used for bahiagrass seedhead suppression. Apply to bahiagrass in spring after full greenup but approximately 3 to 4 weeks prior to expected seedhead emergence or 7 to 10 days after mowing. Do not apply to wetlands. Add a surfactant according to label directions. Bahiagrass may appear less dense and discolored following application.
	imazapic (Panoramic) 2 SL	2-3 fl oz	0.031	May be used for seedhead suppression of bahiagrass or tall fescue turf areas including industrial turf, golf courses, and non-residential areas. Apply 2-3 oz/A for tall fescue seedhead suppression prior to seedhead emergence. Apply 2 oz/A after bahiagrass greenup but prior to seedhead emergence. Temporary turf discoloration may occur.
	imazapic + glyphosate (Journey) 2.25 AS	11 to 32 fl oz	0.19 to 0.56	Use in noncrop areas. Temporary turf discoloration may occur. Apply 4 to 8 fl oz per acre on a small area first to determine rate needed for desired results. Do not use with methylated seed oil. Do not apply to drought-stressed turf. Apply after full turf greenup.
	imazethapyr + imazapyr (Event) 1.46 lb/gal	8 to 10 fl oz	0.09 to 0.11	Apply to bahiagrass only. Apply after the turf is at 100% greenup and has at least 2 in. of vertical growth. The addition of a nonionic surfactant containing at least 80% active ingredient at 0.25% v/v of the spray (2 pt per 100 gal of spray mixture) is required. Do not use on newly established stands less than 1 year old or on highly managed turf. Do not reseed before 3 months after application. See label for herbicide tank mix options. Follow label directions and precautions.
	maleic hydrazide (Retard) 2.5 lb/gal (Royal Slo-Gro) 1.5 lb/gal (Liquid Growth Retardant) 0.6 lb/gal	1.3 gal/50 gal water 2 gal/30 to 50 gal water 5 gal/45 gal water	3 3 3	Apply to bahiagrass only. Apply in late spring but before seedheads appear. Applications made after seedhead appearance will suppress subsequent seedheads. Do not apply to turf less than 3 years old and do not reseed within 3 days after application. Treated turf may appear less dense and temporarily discolored. Optimum results may not be obtained if rainfall or overhead irrigation occurs within 12 hr following application. Remove excess grass clippings and leaves before application. Do not add a surfactant. Follow label directions and precautions. A repeat application may be needed 6 weeks after initial application.
	mefluidide (Embark 2-S) 2 S	2 qt/15 to 150 gal water	1	Apply to bermudagrass only. Apply in late spring until about 2 weeks before seedhead appearance. Do not apply to turf within 4 growing months after seeding, and do not reseed within 3 days after application. Treated turf may appear less dense and temporarily discolored. Optimum results may not be obtained if rainfall or overhead irrigation occurs within 8 hr following application. Remove excess grass clippings and leaves before application. Adding 1 to 2 qt of a nonionic surfactant per 100 gal of spray solution may enhance suppression; however, discoloration may also be increased. Follow label directions and precautions.
	sulfometuron methyl (Oust) 75 DG	0.5 oz/30 to 50 gal water	0.02 lb	Apply to bahiagrass in late spring or early summer before seedheads appear. Do not apply to wetlands or where runoff water may flow onto agricultural lands or forests. Injury of desirable trees may result if applications are made near plants or where their roots extend or may be subjected to runoff from treated areas. Do not apply to turf less than 3 years old. Treated turf may appear less dense and temporarily discolored. Do not add a surfactant. Follow label directions and precautions.
	sulfometuron methyl + chlorsulfuron (Landmark MP) 50 + 25 DG (Landmark II MP) 56.25 + 18.75 DG	0.9 oz 1.0 oz	0.042 0.047	For established bermudagrass and centipede-improved turf. Temporarily suppresses foliar and seedhead growth while controlling many grass and broadleaf weeds. Apply 30 days after breaking dormancy or either late fall or early winter. Landmark MP may discolor or cause top kill of desired turf species. Do not apply to turf less than 1 year old. Annual retreatments may reduce turf vigor.
sulfometuron methyl + metsulfuron methyl (Oust Extra) 56.25 + 15 DG	0.5 to 2 oz	0.022 to 0.088	For use on well-established, unimproved bermudagrass and centipede-grass. Apply 30 days after breaking dormancy. Can also be applied in late fall or early winter depending on weed presence. Oust Extra can be tank mixed with 3 to 4 lb active ingredient per acre MSMA on bermudagrass during the summer. Do not add a surfactant.	

TABLE 9-12. GROWTH REGULATORS FOR TURFGRASSES

Purpose	Brand	Amount of Formulation Per Acre	Pounds Active Ingredient Per Acre	Precautions and Remarks
ANNUAL BLUEGRASS				
Suppression	flurprimidol (Cutless 50 W) 50 WP	0.25 to 0.5 lb/50 to 100 gal water	0.12 to 0.25	Apply to actively growing bentgrass putting greens in spring after third or fourth mowing or in the fall. Repeat, if necessary, at 3- to 6-week intervals, not to exceed 2 lb per acre per growing season. Delay overseeding 2 weeks after application. Make final fall application 8 weeks before onset of winter dormancy.
		1 to 1.5 lb/50 to 200 gal water	0.5 to 0.75	Apply to bentgrass, Kentucky bluegrass, and perennial ryegrass in late spring-early summer and/or late summer-early fall. Time the second application to occur at least 3 months before expected winter dormancy. Management practices that encourage vigorous growth of perennial turfgrass following application will enhance conversion. <i>Poa annua</i> discoloration will be visible 7 to 10 days after treatment and last for 3 to 6 weeks. Do not apply to putting greens. Treated areas should receive 0.5 in. of irrigation within 24 hr after application. Resume mowing 3 to 5 days after application.
	flurprimidol + trinexapac-ethyl (Legacy) 1.51 SL	5 to 30 fl oz	0.059 to 0.354	Use in cool season turfgrasses, such as bentgrass greens and fairways, Kentucky bluegrass, and perennial ryegrass. Repeat applications at 2- to 6-week intervals. Annual bluegrass suppression is gradual and could take several growing seasons. Start treatments in early spring and continue through early fall.
	maleic hydrazide (Retard) 2.25 lb/gal (Royal Slo-Glo) 1.5 lb/gal (Liquid Growth Retardant) 0.6 lb/gal	1 qt/30 to 40 gal water 2 qt/30 to 40 gal water 1.25 gal/30 to 40 gal water	0.56 0.75 0.75	Treat after two normal mowings but before seedhead appears. Applications made after seedhead appears will suppress subsequent seedheads. Do not apply to golf greens. Do not apply to turf less than 3 years old, and do not reseed within 3 days after application. Treated turf may appear less dense and temporarily discolored. Optimum results may not be obtained if rainfall or overhead irrigation occurs within 12 hr following application. Remove excess grass clippings and fallen leaves before application. Do not add a surfactant. Follow label directions and precautions for use on fairways.
	mefluidide (Embark 2-S) 2 S (Embark) 0.2	0.5 pt/15 to 150 gal water 2 to 5 pt/15 to 150 gal water	0.125 0.05 to 0.125	Apply after uniform greenup but before first appearance of seedheads. Do not apply to turf within 4 growing months after seeding, and do not reseed within 3 days after application. Treated turf may appear less dense and temporarily discolored. Optimum results may not be obtained if rainfall or overhead irrigation occurs within 8 hr following application. Remove excess grass clippings and leaves before application. Adding 1 to 2 qt of a nonionic surfactant per 100 gal of spray solution enhances suppression; however, discoloration may also be increased. Follow label directions and precautions for use of fairways and tees.
	paclobutrazol (31-3-9 Fertilizer with TGR <i>Poa annua</i> Control 0.42%)	128 lb	0.5	Apply only to bentgrass, Kentucky bluegrass, perennial ryegrass fairways, or bentgrass greens with less than a 70% <i>Poa annua</i> infestation. Follow label directions and precautions. Note: This product supplies 0.9 lb N per 1,000 sq ft.
	(15-0-29 High K Fertilizer with TGR <i>Poa annua</i> Control 0.34%)	98 lb to 146 lb	0.33 to 0.5	Apply only to bentgrass, zoysiagrass, Kentucky bluegrass, and Kentucky bluegrass/perennial ryegrass fairways, tees, and roughs, as well as bentgrass greens with less than 70% <i>Poa annua</i> infestation. Note: This product supplies 0.5 lb N per 1,000 sq ft.
	(TGR Turf Enhancer 2 SC or Trimmit 2 SC) 2 SC	6.4 to 48 fl oz/43 to 200 gal water	0.1 to 0.75	Apply on hybrid bermudagrass, bentgrass, perennial ryegrass, and Kentucky bluegrass/perennial ryegrass fairways, tees, and roughs. Can also be applied to bentgrass putting greens. Apply in spring after greenup or regrowth has begun and after mowing once or twice. Apply with a nonburning fertilizer. Apply 0.25 in. of water within 24 hr after application to remove product from foliage and onto soil surface. See label for rates and other directions for applications to bentgrass putting greens and overseeded bermudagrass. Do not apply more than 3 times annually. Do not use on areas containing more than 70% <i>Poa annua</i> . For bentgrass putting greens, do not apply more than 0.25 lb active ingredient per acre per application.
ethephon (Proxy) 2 SL	1.7 gal	3.4	May be used to suppress annual bluegrass seedheads and growth of other cool season turfgrasses including golf course greens, fairways, tees, and roughs. Do not use an adjuvant. Do not apply to stressed turfgrass or where excessive thatch is present. Scalping may occur on bentgrass surfaces after application. Consult label for repeat application intervals.	
OVERSEEDED BERMUDAGRASS TURF				
Foliar suppression	flurprimidol (Cutless 50 W) 50 WP	0.75 to 3 lb/50 to 200 gal water	0.37 to 1.5	Rates depend upon grass species and cultivar. Apply to zoysiagrass, Tifway, Tifgreen, and common bermudagrass in late spring-early summer and/or late summer-early fall. Time the second application to occur 8 to 10 weeks before expected winter dormancy. Do not apply to putting greens. Do not exceed 1.5 lb per acre per application on coarse-textured soils. Treated areas should receive 0.5 in. of irrigation within 24 hr after application. Resume mowing 3 to 5 days after application.
	flurprimidol + trinexapac-ethyl (Legacy) 1.51 SL	5 to 30 fl oz	0.059 to 0.354	Use in cool season turfgrasses, such as bentgrass greens and fairways, Kentucky bluegrass, and perennial ryegrass. Repeat applications at 2- to 6-week intervals. Annual bluegrass suppression is gradual and could take several growing seasons. Start treatments in early spring and continue through early fall.

TABLE 9-12. GROWTH REGULATORS FOR TURFGRASSES

Purpose	Brand	Amount of Formulation Per Acre	Pounds Active Ingredient Per Acre	Precautions and Remarks
OVERSEEDED BERMUDAGRASS TURF (continued)				
Foliar suppression (continued)	maleic hydrazide (Royal Slo-Gro) 1.5 lb/gal (Liquid Growth Retardant) 0.6 lb/gal	1.5 gal/50 gal water 3.3 gal/50 gal water	2.25	Apply in late September or early October to inhibit bermudagrass growth and allow winter overseeding to establish. Overseed no sooner than 48 hr after application. Follow label directions and precautions for use on greens and fairways.
	paclobutrazol (TGR Turf Enhancer 2 SC or Trimit 2 SC) 2 SC	6.4 to 16 fl oz/43 to 200 gal water	0.1 to 0.25	Apply any time after overseeded turf has successfully established itself. Do not apply after March 15 to avoid delay in bermudagrass green-up. Apply with 0.25 to 0.5 lb N per 1,000 sq ft of a nonburning fertilizer. Apply 0.25 in. of water within 24 hr after application to remove product from foliage and onto soil surface. Repeat applications can be made but do <i>not</i> apply more than 3 times annually. Do not use on areas containing more than 70% <i>Poa annua</i> . Do not seed within 6 weeks prior to or 2 weeks after application. Do not apply to 'Tifdwarf' putting greens.
	trinexapac-ethyl (Governor) 0.17G	129 to 165 lb	0.22 to 0.28	Apply before verticutting, scalping, or spiking the bermudagrass. Apply 1 to 5 days before overseeding. To minimize yellowing, use iron at recommended rates or available nitrogen at 0.2 to 0.5 lb per 1,000 square feet.
	(Primo Maxx) 1 MEC or (T-Nex) 1 AQ (Primo WSB) 25 WP	6 to 44 fl oz 2.75 to 21.8 oz	0.08 to 0.34 0.08 to 0.34	Application rate varies with turfgrass species and height of cut. Apply to actively growing, nonstressed turf. More growth suppression occurs at lower mowing heights. See label for specific rate and other directions and precautions. Repeat applications can be made but do not exceed a total of 21.4 pt per acre per year of Primo Maxx or a total of 174 oz per acre per year of Primo WSB. Do not exceed 19 pt per acre per year of T-Nex. Refer to the respective Primo label for guidelines regarding mowing prior to and following application. Mix with 0.5 to 4 gal of water per 1,000 sq ft (20 to 174 gal per acre). Primo can be applied to putting greens. See label for directions.
LAWN EDGING	maleic hydrazide (Retard) 2.25 lb/gal (Royal Slo-Gro) 1.5 lb/gal (Liquid Growth Retardant) 0.6 lb/gal	1.33 gal/100 gal water 2 gal/100 gal water 6.67 gal/100 gal water	3 3 4	Apply in spring to a 6-in. band along sidewalks. Consult instructions on applicator for delivery dosage.
	mefluidide (Embark) 0.2	1.36 gal/174 gal water	0.27	For Kentucky bluegrass, tall fescue, chewings fescue, red fescue, perennial ryegrass, and St. Augustinegrass. For bermudagrass, use 5.45 gal in 174 gal water. Apply in 6- to 12-in. bands. Avoid overlapping.
	trinexapac-ethyl (Governor) 0.17G	100 to 259 lb	0.17 to 0.44	Do not exceed 2.5 lb active ingredient per acre per year. These rates should provide 50% turf growth suppression for 4 weeks with minimal yellowing.
	(Primo Maxx) 1 MEC (T-Nex) 1 AQ (Primo WSB) 25 WP			Apply 0.75 to 2 oz per 1,000 linear feet of Primo Maxx or T-Nex, or 0.4 to 2 oz per 1,000 linear ft of Primo WSB. Apply to actively growing, nonstressed turf. Apply along perimeter of lawns, sidewalks, curbs, parking lots, driveways, flower beds, or fences. Apply in an 8- to 12-in. band along the perimeter of the lawn to reduce growth of turf into adjacent areas. Application rate varies with turf species. Follow label directions for repeat applications and other precautions.

