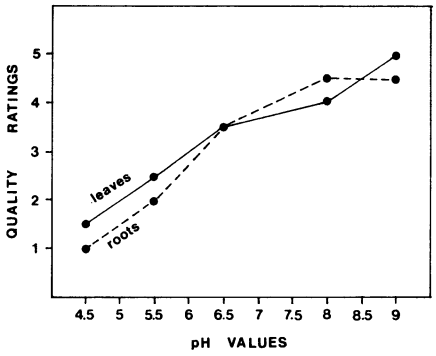

Fig. 1 Relation of root and leaf quality ratings to pH for hydroponically grown iris; 1 (poor) to 5 (excellent).

Root and leaf quality were judged on a scale of 0 (lowest) to 5 (highest). Overall quality for roots was based on root size (root length and total volume of roots) and presence of necrosis. Leaf quality was based on height and presence of chlorosis or necrosis.

Best foliar and root quality was attained at a pH 8.0 and 9.0 for hydroponically-grown plants (Fig. 1). Data from the tissue analysis suggested that higher Ca levels in root tissue tended to reduce necrosis in iris roots; and the subsequent decline in root tissue could directly lower foliage quality (tipburn). The poor plant performance at low pH was not readily explained by leaf or root tissue analyses since no nutrient level standards exist for this crop.

There were no differences between hydroponic treatments for plant height. Onset of foliar chlorosis was delayed significantly and root necrosis was minimized at pH 8.0 and 9.0.

A second greenhouse study was established to more closely duplicate field growing conditions. Iris plants were grown in clay pots containing a Pembroke silt loam (pH-5.1). This study was conducted at a mean temperature of 26°C under natural daylength. The pH levels were decreased by 1 unit using elemental sulfur at a rate of 681g/10 m^2 of soil surface area and raised with hydrated lime according to Woodruff (8); Treatment levels were 4.5, 5.5, 7.0, 8.5 and 9.5.

Daughter rhizomes of 'Captain Gallant' iris were obtained as in Experiment 1 and similarly surface sterilized. Rhizomes were planted (2/pot) in 15 cm clay containers in their preadjusted soil. Treatments were arranged in a randomized complete block design with 15 replications. All treatments received 14 N-6.OP-11.6K slow release fertilizer (Osmocote) at a rate of 5 g/pot applied to the media surface following planting.

Container studies using field soil also showed a relation between low pH and foliar tipburn. Although plants at lower pH initially grew more rapidly final plant height was the same. Leaves of most soil grown plants at pH 4.5 and 5.5 had leaf tipburn while those from alkaline soil were free of foliar damage. Leaf quality ratings are shown in Fig. 2.

Information derived from both hydroponic culture and soil studies indicates that the bearded iris grows better in alkaline soils (pH 8-9) than in acid soils. Plant quality and early foliage growth is enhanced by the higher pH.

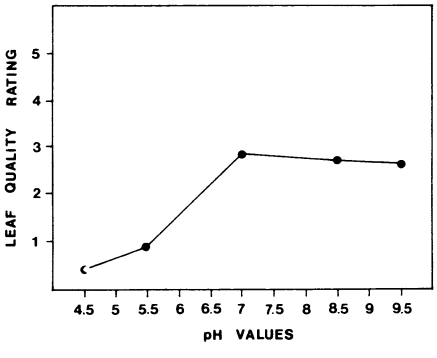

Fig. 2. Leaf rating by pH values for irises grown in soils; 1 (poor) to 5 (excellent).

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Effects of Growth Regulators on Diseases of Begonia, Chrysanthemum, Poinsettia, and Rose[1]

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Abstract. **Seven growth regulators representing ethylene-generating materials, auxins, gibberellins, cytokinins and inhibitors were applied prior to inoculation with selected pathogens of chrysanthemum (*Chrysanthemum morifolium* Ramat.), begonia (*Begonia* X *hiemalis* Fotech.), rose (*Rosa hybrida* L.), and poinsettia (*Euphorbia pulcherrima* Willd.). (2-Chloroethyl)phosphonic acid (ethephon) and 6-benzylamino purine (BA) increased the incidence of Ascochyta ray blight (incited by *Ascochyta chrysanthemi* Stevens) on 'Ritz' chrysanthemum but the other materials had no effect. None of the growth regulators influenced powdery mildrew [*Sphaerotheca pannosa* (Wallr.) Lév.] of rose, powdery mildew (*Erysiphe cichoracearum* DC.) of begonia, or grey mold (*Botrytis cinerea* Pers. ex Fr.) of poinsettia.**

There are various examples of growth regulators increasing (1, 4, 8, 9) or decreasing (2, 4, 5) disease development. The objective of this work was to determine the effects of certain growth-regulators with potential use in greenhouse production on the incidence and severity of Ascochyta ray blight of chrysanthemum, grey mold of poinsettia, and powdery mildew of rose and begonia.

Plants of each species were grown in plastic pots in a root medium of 2 sphagnum peat moss: 1 perlite : 1 vermiculite : 1 sandy loam (by volume) amended with 2.6 g/m^3 fritted trace elements, and limed to pH 6.5. Experiments were conducted in the greenhouse at a night temperature of 17°C. Other cultural procedures of fertilization, watering, and insect control were consistent with those in use for the commercial production of the crop (6). The growth regulator treatments made 1 week before inoculation with pathogens were:

1. control — water with 1% polyoxyethylene sorbitan monolaurate (Tween 20) used as a wetting agent in all treatments,

2. 1:100 dilution of a seaweed extract having cytokinin activity (Cytex, Atlantic and Pacific Research, Inc., North Palm Beach, Florida),

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3. 50 and 150 ppm BA (Abbott Laboratories, North Chicago, Illinois),

4. 25 ppm BA + 25 ppm $GA_{4,7}$ (Promalin, Abbott Laboratories, North Chicago, Illinois),

5. 150 ppm 6-(benzylamino)-9-(2-tetrahydropyranyl-9H-purine) (PBA, Shell Development Co., Modesto, California),

6. 25, 50, and 100 ppm α-cyclopropyl-α-(p-methoxyphenyl)-5-pyrimidine methanol (ancymidol, Elanco Products Co., Indianapolis, Indiana),

7. 25 and 50 ppm GA_3 (Abbott Laboratories, North Chicago, Illinois),

8. 5 and 20 ppm naphthaleneacetic acid (NAA, Union Carbide Co., Ambler, Pennsylvania),

9. 500 and 1,000 ppm ethephon (Union Carbide Co., Ambler, Pennsylvania).

Solutions were applied to runoff with a Sure-Shot Sprayer (Milwaukee Sprayer, Milwaukee, Wisconsin).

The design was randomized block with 4 single-plant replicates of each cultivar in each treatment. Each test was repeated at least once.

Plants of 'Fiesta' and 'Ritz' chrysanthemum, propagated in the University of Maryland greenhouses and growing in 12.5 cm pots, were pinched to induce branching and exposed to 8 weeks of 14-hr dark periods to induce flowering. Growth regulators were applied as flowers were opening. Flowers were inoculated by spraying with a conidial suspension of *A. chrysanthemi* ($5.0–7.0 \times 10^5$ conidia/ml in 0.04% Tween 20) prepared from infected dried plant material. Plants were then placed under intermittent, low pressure mist at 21°C for 48 hr. Ray blight incidence was based upon the estimated percentage of flower area blighted: 1 = 0–5%, 2 = 6–10%, 3 = 11–25%, 4 = 26–50%, and 5 = 51–100% in 2 tests.

Plants of 'Annette Hegg Top Star' poinsettia in 12.5 cm pots were treated with growth regulators after 8 weeks of 14-hr nights. The leaves and developing bracts were inoculated by spraying with a conidial suspension of *B. cinerea* ($1.5–1.7 \times 10^6$ conidia/ml in 0.04% Tween 20) prepared from potato dextrose agar cultures. Plants were then covered with plastic bags for 48 hr. Grey mold incidence was determined as the percentage of leaves and bracts showing disease symptoms in 2 tests.

Young plants of 'Nixe', 'Improved Schwabenland Red', and 'Improved Schwabenland Pink' begonia were transplanted from 6 cm to 12.5 cm pots. Growth regulator treatments were applied 2 weeks later. Plants were inoculated by spraying with a conidial suspension of *E. cichoracearum* ($0.8–7.0 \times 10^5$ conidia/ml in 0.04% Tween 20) prepared from infected begonias and were then placed under low pressure, intermittent mist at 21°C for 24 hr. Mildew incidence was determined as the percentage of leaves showing symptoms in 2 tests. Severity was rated visually at the same time periods as the percentage of leaf area covered by conidia and conidiophores: 1 = 0–2%, 2 = 3–5%, 3 = 6–10%, 4 = 11–25%, 5 = 26–50%, and 6 = 51–100%.

Dormant, bare root, xx grade plants 'Forever Yours' rose were received from the nursery and grown in 30 cm pots for 4 weeks before growth regulator treatments were applied. Plants were inoculated by spraying with a conidial suspension of *S. pannosa* ($5.0–7.0 \times 10^4$ conidia/ml in Tween 20 at 0.04%) prepared from infected rose leaves and then subjected to low pressure, intermittent mist at 21°C for 24 hr. Mildew incidence and severity were estimated as for begonia in 2 tests.

Incidence of Ascochyta ray blight on 'Ritz' chrysanthemums was significantly different from the control with ethephon at 1000 ppm but not with 500 ppm 30 days after inoculation. At both rates, severity was significantly greater at 21 days after inoculation. Incidence was significantly greater at 30 days with BA at 150 ppm (Table 1). Except for ethephon and BA, the regulators did not significantly change the incidence or severity of the diseases studied. Ray blight was significantly influenced by ethephon and BA in both tests.

The results with ethephon are consistent with the concept that ethylene contributes to symptom development in many plant diseases (7). The lack of observable change in disease development in most of the plant-pathogen-chemical interactions could indicate the failure of the chemicals to affect the processes determining disease development or could be due to ineffectual concentrations of chemicals, inappropriate environmental conditions, or non-optimal host developmental stages.

Table 1. Effect of growth regulators on incidence and severity of Ascochyta ray blight on chrysanthemum 'Ritz' 21 and 30 days after inoculation.

	Incidence (%)[w]		Severity rating[x]	
	Days after inoculation		Days after inoculation	
Treatment & rate	21	30	21	30
Cytex (1:100)	82 ab[y]	78 a[y]	2.2 a[y]	4.3 a[y]
BA (50 ppm)	81 ab	91 abc	2.4 a	4.3 a
(150 ppm)	86 abc	99 b	2.6 a	4.5 a
BA (25 ppm) + $GA_{4,7}$ (25 ppm)[z]	83 ab	88 ab	2.1 a	4.4 a
PBA (150 ppm)	82 ab	88 ab	2.2 a	4.6 a
GA_3 (25 ppm)	85 abc	82 ab	2.6 a	4.6 a
(50 ppm)	84 abc	82 ab	2.8 a	4.2 a
Ancymidol (25 ppm)	85 abc	80 a	2.2 a	4.2 a
(50 ppm)	73 a	91 ab	2.1 a	4.1 a
(100 ppm)	73 a	93 ab	2.3 a	4.1 a
NAA (5 ppm)	76 a	83 ab	2.3 a	4.1 a
(20 ppm)	80 ab	90 ab	2.9 a	4.1 a
Ethephon (500 ppm)	99 c	94 ab	4.5 b	4.9 a
(1,000 ppm)	97 bc	98 b	4.8 b	5.0 a
Control H_2O + Tween 20	84 abc	80 a	2.7 a	4.3 a

[w]Incidence = percentage of flowers showing symptoms.
[x]Severity scale: 1 = 0–5%, 2 = 6–10%, 3 = 11–25%, 4 = 26–50%, 5 = 51–100% flower area blighted.
[y]Mean separation within columns by Student-Newman-Keuls test, 5% level. Each value is the mean of 4 replicates.
[z]Promalin.

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