HortScience 11(6):585–586. 1976.

Nitrogen, Phosphorus, and Potassium Fertilization of the Bromeliad, *Aechmea fasciata* Baker[1]

Richard T. Poole and Charles A. Conover
Agricultural Research Center, University of Florida, Apopka, FL 32703

Additional index words. plant nutrition

Abstract. **Grade and color of the bromeliad, *Aechmea fasciata,* improved with increased N. Increased K fertilization increased grade but decreased color. Phosphorus had no effect. Placement of the fertilizer solution and water in the vase of the bromeliad was not essential for the production of quality bromeliads under greenhouse conditions.**

Aechmea fasciata has toothed 30-50 cm, green leaves with wide silver cross bands that are sometimes covered with a heavy powdery coating. Flowers are red-purple, subtended by pink bracts. This bromeliad has been popular for many years as an indoor plant and is currently one of the most frequently sold bromeliads.

Suggestions for fertilization of bromeliads include none, if potted in osmunda or leaf mold, or if growing in an inert medium, light fertilization may be applied during the warm months (10). Cathey and Taylor (1) fertilized bromeliads with 0.1 g of 20N-8.8P-16.6K/liter at bimonthly intervals. Sheehan and Conover (8) suggested application of liquid 10-4-8 at a rate equivalent to 350 kg/ha/year to bromeliads, while Weidner (9) used constant feed directly in *A. fasciata* vases of 120 mg/liter N, 100 mg/liter K and 53 mg/liter P. Weidner did not specify frequency, although he stated that vases were washed with clear water once a month to prevent salt accumulation. Poole and Conover (7) fertilized *A. fasciata* weekly with a solution containing 2.4 g/liter of 20N-8.8P-16.6K while Matthews (6) suggested fertilizing pineapple with 2N-0.5P-2K g/plant at 2 month intervals. Some "popular" articles emphasize the importance of maintaining water in the vase; however, Marlatt and Knauss (5) reported reduction of severity of *Helminthosporum rostratum,* which causes leaf spot of *A. fasciata,* by low humidity.

Two experiments were initiated to study fertilization requirements of *A. fasciata.* Expt. 1 evaluated factorial combinations of levels of N, P and K and Expt. 2 evaluated methods of application of water and factorial combinations of N and K levels.

Expt. 1. Nine month old seedling plants were potted Feb. 5, 1973 in 10 cm pots containing 2 Florida peat:1 pine bark:1 cypress shavings (v/v) containing 4.2 kg/m^3 dolomite and 0.9 kg/m^3 Perk[2] and placed in a glasshouse receiving 15-25 klx maximum. Plants were watered twice weekly in the vase with water running into soil mix and temp held between 32-35°C max and 20° min. Treatments consisted of a 3x3x3 factorial combination of N, P and K. N and K were added at 50, 100 and 150 mg/pot and P at 25, 50 and 75 mg/pot at 4 week intervals. Nitrogen was obtained from NH_4NO_3, P from H_3PO_4 and K from KCl. Fifty ml of fertilizer solution was poured into the vase of each plant 1 day after watering. Treatments were replicated 6 times with 1 plant/pot as an experimental unit.

Terminal data collected Nov. 16, 1973 included grade (1 = small, 5 = large) and color (1 = light green, 5 = dark green). The first mature leaves from the apex of the plant were collected and analyzed for N, P, K, Ca, Mg, Cu, Fe, Mn and Zn. Plants were not flowered.

Expt. 2. Nine month old seedling plants were potted Dec. 21, 1973 in 12.5 cm pots. Potting medium and environmental conditions were similar to Expt. 1. Treatments consisted of a 3x3x2 factorial combination of N, K and water-fertilizer application methods. N and K were added at rates of 60, 120 and 180 mg/pot every 4 weeks. Fertilizer and water, 160 ml, were applied either to the vase or to the soil only. When the solution was applied to the vase, a small amount overflowed to the soil. P (60 mg) was applied with each fertilizer application. Treatments were replicated 6 times with 1 plant/pot as an experimental unit. Data, similar to Expt. 1, were collected July 30, 1974 with the addition of length of the 5th leaf from the apex. Plants were not flowered.

N and K levels influenced grade and color in both experiments (Tables 1 and 2), but P levels had no influence. N at 100 to 150 mg/pot/4 weeks produced plants with a high grade and color; N at 120 mg/pot produced max leaf length. The effect of K was not as pronounced as N, but grade and color were affected. Increasing K increased grade, but slightly decreased color. K at 100 to 120 mg/pot appears to be most satisfactory. The exact quantity of fertilizer applied by previous researchers (1) is impossible to determine, but their rate of fertilizer application appears to be lower than rates which produced satisfactory plants in this experiment. Rates used in this experiment were probably much higher than suggested by Wilson and Wilson (10), although their rates and those applied by Cathey and Taylor (1) could be adequate for maintenance of bromeliads in the home. Conover and Poole (4) suggested fertilization of foliage plants in the home should be 1/10 or less the amount of fertilizer used for plant production. Fertilizer and water applied to the vase of bromeliads produced a slightly higher grade (Table 2), but did not improve color or length of the 5th leaf.

Sheehan and Conover (8) suggest light levels of 1500 ft-c (15 klx), lower than levels of this experiment. Results from these experiments indicate *A. fasciata* could be grown at levels of 15-25 klx. Conover and Poole reported fertilizer-light interactions with several foliage plants (2, 3) indicating higher

Table 1. Influence of N, P and K on grade (1 = small, 5 = large) and color (1 = light green, 5 = dark green) of *Aechmea fasciata.* Expt. 1.

Element	mg/10 cm pot/4 wk	Grade	Color
N	50	2.8a[z]	2.1a
	100	3.2b	3.7b
	150	3.3b	4.0c
P	25	3.2a	3.4a
	50	3.2a	3.2a
	75	3.1a	3.2a
K	50	3.0a	3.5a
	100	3.1a	3.2b
	150	3.3a	3.1b

[z]Mean separation, within an element, in a column, by Duncan's multiple range test, 5% level. Numbers are average of 54 units.

Table 2. Influence of N, K and method of water-fertilizer application on grade (1 = small, 5 = large), color (1 = light green, 5 = dark green) and length (cm) of 5th leaf from apex of *Aechmea fasciata.* Expt. 2.

Element	mg/12.5 cm pot/4 wk	Grade	Color	Length
N	60	1.6a[z]	1.2a	32a
	120	3.4c	4.2b	47b
	180	3.0b	4.4b	46b
K	60	2.2a	3.4b	40a
	120	2.8b	3.4b	42a
	180	3.0b	3.0a	43a
Water-fertilizer placement				
Medium		2.4a	3.2a	41a
Plant vase		3.0b	3.4a	42a

[z]Mean separation, within a series in a column, by Duncan's multiple range test, 5% level. Numbers are averages of 36 units (N & K) and 54 units (water-fertilizer).

[1]Received for publication July 1, 1976. Florida Agricultural Experiment Stations Journal Series No. 6182.

[2]A micronutrient blend manufactured by Kerr-MaGee, Inc., Jacksonville, Florida.

fertilizer is required at higher light levels.

Nitrogen increased tissue levels of N, slightly decreased K and had no effect on Ca and Mg in both experiments (Tables 3 and 4). In Expt. 1, increasing N slightly decreased P, but N had no effect on P in Expt. 2. Levels of N, K and Mg were similar in both experiments but tissue Ca was higher in Expt. 1 than Expt. 2. An increase in P levels increased tissue P and decreased tissue Ca (Table 3). Increasing levels of K did not influence tissue N or P, decreased Ca and Mg and increased tissue K. Tissue P was the only element affected by placement of water and fertilizer. More P was absorbed when the water-fertilizer solution was applied to the vase of the plant than to the medium. Treatments had no effect on Cu, Fe, Mn or Zn in *A. fasciata* tissue which averaged 20, 160, 140 and 170 ppm, respectively.

Table 3. Influence of N, P, K on foliar content of *Aechmea fasciata,* Expt. 1.

Element	mg/10 cm pot/4 wk	% dry wt N	P	K	Ca	Mg
N	50	1.3a[z]	0.33b	3.2b	.79a	.51a
	100	1.5b	0.27a	2.8a	.79a	.53a
	150	1.8c	0.26a	2.9a	.81a	.54a
P	25	1.5a	0.20a	3.0a	.97b	.53a
	50	1.6a	0.29b	3.0a	.73a	.53a
	75	1.4a	0.36c	2.9a	.68a	.51a
K	50	1.5a	0.30a	2.2a	.92c	.61c
	100	1.5a	0.27a	3.2b	.82b	.51b
	150	1.4a	0.28a	3.4b	.65a	.45a

[z]Mean separation, within elements in a column, by Duncan's multiple range test, 5% level. Numbers are average of 54 units.

Table 4. Influence of N, K and method of water-fertilizer application on foliar content of *Aechmea fasciata.* Expt. 2.

Element	mg/12.5 cm pot/4 wk	% dry wt N	P	K	Ca	Mg
N	60	1.2a[z]	.29a	3.4c	.32a	.39a
	120	2.0b	.31a	2.4a	.37a	.37a
	180	2.4c	.30a	2.7b	.34a	.35a
K	60	2.1a	.31a	1.7a	.39b	.45c
	120	1.8a	.31a	3.1b	.34ab	.36b
	180	1.9a	.28a	3.8c	.30a	.30a
Water-fertilizer placement						
Medium		1.8a	.26a	2.8a	.34a	.36a
Plant vase		2.0a	.34b	2.9a	.35a	.37a

[z]Mean separation, within a series in a column, by Duncan's multiple range test, 5% level. Numbers are averages of 36 units (N & K) and 54 units (water-fertilizer).

Literature Cited

1. Cathey, H. M. and R. C. Taylor. 1970. Flowering of bromeliads with spray applications of 2-chloro-ethane phosphonic acid (Ethrel). *Flor. Rev.* 146(3790):38, 39, 82-86.
2. Conover, C. A. and R. T. Poole. 1974. Influence of shade and fertilizer source and level on growth, quality and foliar content of *Philodendron oxycardium* Schott. *J. Amer. Soc. Hort. Sci.* 99:150-152.
3. ________ and ________. 1974. Influence of shade, nutrition and season on growth of *Aglaonema, Maranta* and *Peperomia* stock plants. *Proc. Trop. Reg., Amer. Soc. Hort. Sci.* 18:(In press).
4. ________ and ________. 1975. Acclimatization of tropical foliage plants. *Agricultural Research Center – Apopka Research Rpt.* RH-75-3.
5. Marlatt, R. B. and J. F. Knauss. 1974. A new leaf disease of *Aechmea fasciata* caused by *Helminthosporium rostratum. Plant Dis. Rptr.* 58:445-448.
6. Matthews, W. H. 1962. Pineapples in Florida. *Agr. Ext. Serv., Univ. of Florida, Gainesville, Cir. 195A.*
7. Poole, R. T. and C. A. Conover. 1974. Media and watering effects on *Aechmea fasciata. Florida Foliage Grower* 11(12): 1-2.
8. Sheehan, T. J. and C. A. Conover. 1966. Bromeliads. *Agr. Ext. Serv., Univ. of Florida. Cir.* 300.
9. Weidner, Robert. 1965. Pointers on the culture of *Aechmea fasciata. Ohio Flor. Assoc. Bul.* 423:9.
10. Wilson, R. G. and Catherine Wilson. 1963. Bromeliads in Cultivation. Hurrican House Publishers, Inc., Coconut Grove, FL.

HortScience 11(6):586–588. 1976.

Postharvest Control of Endogenous Brown Spot in Fresh Australian Pineapples with Heat[1]

Ernest K. Akamine[2]

Department of Botany, University of Hawaii, Honolulu, HI 96822

Additional index words. Ananas comosus, black heart

Abstract. **Heating fruits at 37.2°C for 24 hours controlled endogenous brown spot (EBS) in refrigerated fresh pineapples [*Ananas comosus* (L.) Merr. cv. Smooth Cayenne]. Heat treatment after refrigeration was more effective than before refrigeration and reduced molding of the fruit butt. Heat treatments did not affect surface coloring, fruit weight loss, crown browning, senescence, decay incidence, translucence, flavor, or pulp aroma, but did improve pulp appearance by making it more golden yellow than of untreated fruits.**

Endogenous brown spot (EBS) or black heart as it is called when the spots are coalesced is an important physiological disease of pineapples, and its formation (1, 2, 4), symptoms (1, 4), and incidence (1, 5, 9) have been described. In Queensland, Australia, up to 50% of the winter fruits may be discarded after slicing at the cannery because they are afflicted with this disease. Summer fruits, on the other hand, do not seem to be afflicted with the malady when immediately processed. In Hawaii, this disease is rarely seen in fruit being processed in the cannery in any season, but it is the most important problem in fresh fruit shipped overseas under refrigeration. Development of this malady during and after refrigeration causes fruit losses that range from little to total loss. Heat treatment to control this disease proved effective for Hawaiian pineapples (1). The present paper reports the results of experiments conducted to determine the effect of heat on the incidence of EBS in refrigerated summer Queensland pineapples.

Fresh pineapples for this investigation were obtained from Queensland in the summer months of Jan. and Feb., 1975. They were harvested in the morning at commercial harvest stages (2–30% yellowed fruit surface) and shipped via railway in the afternoon of the same day to Division of Food Re-

[1]Received for publication July 23, 1976. Journal Series No. 1919 of the Hawaii Agricultural Experiment Station.

[2]This work was carried out in the laboratories of the Division of Food Research, Commonwealth Scientific and Industrial Research Organization, North Ryde, New South Wales, Australia, while the author, on leave from the University of Hawaii, was a visiting scientist. The technical assistance of W. M. Bailey is acknowledged with appreciation. R. Wassman of Golden Circle Cannery, Queensland, supplied the fruits for this investigation and information on the status of endogenous brown spot in Australia.