QUALITY IN ANTHURIUM ANDREANUM AND AECHMEA FASCIATA GROWN IN PEAT SUBSTRATES AS AFFECTED BY NITROGEN AND POTASSIUM NUTRITION

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Abstract

A factorial trial including four N and three K rates with the cut flower crop Anthurium andreanum in coarse sphagnum peat showed that flower yield, flower fresh weight, stem length and spathe length and width favourably responded to K rates, but were adversely affected by N rates. It was concluded that in fertilizing Anthurium andreanum in sphagnum peat N and K_2O should be supplied in the ratio 1 : 2. 5. The corresponding optimum contents in recently matured leaves were 2. 03% N and 3% K.

A factorial trial including six N and three K rates with the pot plant Aechmea fasciata grown in straight Finnish sphagnum peat moss showed that K was highly beneficial to plant fresh weight, percentage of flowering plants, earliness of flowering and flower fresh weight. N at the lower rates was also advantageous. The ratio of N rate to K_2O rate, giving the best results, was 1 : 2.

Optimum N and K contents in all the leaves of the plant at the end of the trial were found to be 1. 29 and 2. 78%, respectively.

Introduction

In Dutch floriculture Anthurium andreanum has grown much in importance as a cut flower in recent years, while among pot plants bromeliads gained the leading position lately.

Since information on the nutritional requirements of both crops, in particular with respect to the quality characteristics, are scarce, the need for more data on this point was felt.

The present paper presents the results of factorial trials including various N and K rates, with Anthurium andreanum and the bromeliad species Aechmea fasciata.

4N × 3K factorial trial with Anthurium andreanum

Materials and methods

A trial of factorial design with Anthurium andreanum in pots was started on 2 April 1974. It includes:
N rates: 126, 216, 306 and 396 mg N/pot per week
K rates: 19, 225 and 431 mg K_2O/pot per week.

All treatments are replicated nine times (1 unit = 2 pots).

The replications were distributed among three greenhouse depart-

ments varying in climatic conditions.(Results, however, did not show a significant climate effect.)

Nutrients other than N and K and trace elements are amply supplied. In the first year treatments were also performed during winter. When it became apparent that this procedure resulted into a rapid build-up of salts in the soil, it was dropped. From then on treatments are restricted to the period Februari-October. Irrigation was with rain-water.

The pots contain 12. 5 litres of coarse fibrous sphagnum peat moss limed with 2 g of dolomitic limestone per litre up to an initial pH (water) of 5. 0. In order to maintain the pH at this level limestone is applied every three months. Observations included measurements of flower yield and the quality characteristics flower fresh weight, stem length, length and width of spathe, the former measured from the base of the spadix.

The trial is still in progress and will be terminated in August 1976.

The results below concern the period 19 October 1974 - 1 February 1976.

Results

The average response of flower yield (table 1) to N was adverse from the 1st rate upwards. So was the response of all four measured quality characteristics (tables 2, 3, 4 and 5). Hence the first N rate was optimum or beyond it in this trial.

Table 1 - Flower yield per plant as affected by nitrogen and potassium rate.

mg K_2O/pot per week	mg N/pot per week				
	126	216	306	396	Mean
19	7. 5	6. 1	6. 3	6. 4	6. 6
225	14. 5	12. 2	13. 5	12. 6	13. 2
431	14. 2	12. 9	12. 7	10. 0	12. 5
Mean	12. 2	10. 4	10. 8	9. 7	10. 7

Statistical evaluation†:
Nl(P=0. 05); Kl(P=0. 001); Kq(P=0. 001)

†Nl = linear N effect; Kl = linear K effect; Nq = quadratic N effect; Kq = quadratic K effect.

On the other hand average response of both flower yield and quality was markedly favourable. Flower yield distinctly rose with K from the first to the second rate as did flower fresh weight, stem length and length and width of spathe. Increasing K further up to the third rate produced a slight deterioration in these characteristics, except for the spathe width which remained constant. On account of the slight decrease in yield at the third K rate as compared to the far lower second K rate the optimum K rate might be estimated as lying approximately midway between both levels.

Table 2 - Flower fresh weight in g per flower as affected by nitrogen and potassium rate.

mg K_2O/pot	mg N/pot per week				
per week	126	216	306	396	Mean
19	25.8	24.1	24.3	21.6	24.0
225	38.6	37.8	32.7	28.0	34.3
431	37.2	33.0	26.8	31.1	32.0
Mean	33.9	31.6	27.9	26.9	30.1

Statistical evaluation:
N1 (P=0.001); K1 (P=0.001); Kq(P=0.001)

Table 3 - Flower stem length in cm as affected by nitrogen and potassium rate.

mg K_2O/pot	mg N/pot per week				
per week	126	216	306	396	Mean
19	50.2	46.9	45.9	43.6	46.7
225	62.8	58.7	56.3	53.5	57.8
431	63.9	56.8	51.3	54.4	56.6
Mean	59.0	54.1	51.2	50.5	53.7

Statistical evaluation:
N1(P=0.001); K1(P=0.05); Kq(P=0.01)

Table 4 - Spathe width in cm as affected by nitrogen and potassium rate.

mg K_2O/pot	mg N/pot per week				
per week	126	216	306	396	Mean
19	11.1	10.7	10.1	10.6	10.6
225	11.6	12.3	12.0	10.8	11.7*
431	12.4	11.3	11.3	11.7	11.7
Mean	11.7	11.4	11.1	11.0	11.3

Statistical evaluation:
N1(P=0.05); K1(P=0.01); Kq(P=0.05); Nq × Kq(P=0.01)

In terms of both flower yield and fresh weight treatment N1K2 was the best in the trial.

In May, 1975 samples of recently matured leaves were collected for foliar analysis.

Table 5 - Spathe length in mm measured from base of spadix as affected by nitrogen and potassium rate.

mg K_2O/pot	mg M/pot per week				
per week	126	216	306	396	Mean
19	83.5	81.7	76.1	77.1	79.6
225	84.1	90.8	88.1	81.4	86.1
431	92.1	82.0	83.1	85.5	85.7
Mean	86.6	84.8	82.4	81.3	83.8

Statistical evaluation:
N1(P=0.01); K1(P=0.05); $N_q \times K_q$(P=0.05)

Table 6 - Percentage of nitrogen in leaves as affected by nitrogen and potassium rate.

mg K_2O/pot	mg N/pot per week				
per week	126	216	306	396	Mean
19	2.18	2.30	2.69	2.82	2.50
225	2.03	2.06	2.08	2.22	2.10
431	1.90	2.01	2.42	2.45	2.20
Mean	2.04	2.12	2.40	2.50	2.27

Total N in leaves (table 6) rose slowly but steadily with increasing N rate. At the first and second N level it decreased with higher K rate; at the higher N levels it showed first a decline and then a rise with increasing K.

K content in leaves sharply increased with larger K rates, so it did with rising N rate but far more slowly.

The N content in leaves for the best treatment N1K2 was 2.03% which practically equals the optimum value suggested by Poole et al. (1968) for Anthurium andreanum. From this it can be inferred that the first N level in this trial was in the optimum range.

Table 7 - Percentage of potassium in leaves as affected by nitrogen and potassium rate.

mg K_2O/pot	mg N/pot per week				
per week	126	216	306	396	Mean
19	1.64	1.76	1.54	1.62	1.64
225	2.84	2.87	2.93	3.09	2.93
431	3.30	3.39	3.53	3.68	3.48
Mean	2.59	2.67	2.67	2.80	2.68

As explained earlier, the optimum K rate might be assumed to be midway between the second and third K level, which corresponds with a K content in leaves of about 3%. This is substantially higher than the value of K content in leaves considered sufficient by the above authors, which is 2%.

From the above estimations of the N and K rate it may be concluded that in fertilizing Anthurium andreanum in sphagnum peat N and K_2O should be supplied in the ratio 1 : 2.5. This ratio reflects the high requirement of this species for K relative to that for N, as compared to other flower crops.

6N × 3K factorial trial with Aechmea fasciata

Material and methods

Three months old plants of Aechmea fasciata were potted in 0.5-litre plastic pots on 13 February 1973 and transplanted into 1-litre plastic pots on 30 August 1973.

The trial included six N rates factorially combined with three K rates to give a total of eighteen treatments which were replicated twelve times (1 unit = 1 pot). For the 1-litre pots the rates were as follows:
N: 7.2, 25.2, 43.2, 61.2, 79.2 and 97.2 mg N/pot per week
K: 3.8, 45.4 and 86.2 mg K_2O/pot per week.
For the 0.5-litre pots N and K were supplied at half these rates.

The potting compost was straight Finnish sphagnum peat moss (commercial ST-400 type AO) limed with 2 g of dolomitic limestone up to an initial pH (water) of 5.0.

Nutrients other than N and K, and trace elements were added in ample amounts. The plants were watered with rainwater.

Fertilizers were added in liquid form through the soil.

Neither growth substances nor artificial lighting were applied to induce or accelerate flowering. The first trial plant flowered on 26 June 1974; the previous day was taken as the reference point on the time scale (in days) by which the response of earliness of flowering to treatments could be evaluated.

On 1 August 1974 the aerial parts of the plants were harvested and measured for plant fresh weight and flower fresh weight including the stem.

Results

Table 8 shows that the plant fresh weight and hence plant size remarkably benefitted by K application, which agrees with the findings of Penningsfeld (1960). Increase in average fresh weight was strong from the first to the second K rate and less but still distinct from the second to the third K rate. From the course of the average fresh weight relative to K rate it might be estimated that the optimum rate for K was close, if not equal, to the third rate.

It can be noted that all plants at the first K level showed tip die-back (K deficiency) in the older leaves; so the first K level should be considered deficient.

There was also a favourable influence of N on fresh weight with a

Table 8 - Fresh weight yield in g per plant of Aechmea fasciata as affected by nitrogen and potassium rate.

mg K_2O/pot per week	mg N/pot per week						
	7.2	25.2	43.2	61.2	79.2	97.2	Mean
3.8	357.4	411.5	368.0	334.9	295.7	303.3	345.0
45.0	487.5	548.5	555.0	645.6	597.6	537.2	561.9
86.2	592.1	634.9	657.0	603.8	639.2	622.8	625.0
Mean	479.0	531.6	526.7	528.1	510.5	487.8	510.6

Statistical evaluation:
Nq(P=0.01); Kl(P=0.001); Kq(P=0.001); N × K(P=0.001)

tendency for the optimum N rate to shift towards higher levels with increasing K. At the third K level the third N level was optimum. The treatment with the largest fresh weight was N3K3; with this treatment the ratio of N to K_2O supplied was 1 : 2, showing that Aechmea has a higher demand for K than for N.

Flowering expressed as the percentage of plants that came into bloom (table 9) was highly responsive to K application. Average flowering markedly rose with K rate from the first to the second level

Table 9 - Percentage of flowering plants in Aechmea fasciata as affected by nitrogen and potassium rate.

mg K_2O/pot per week	mg N/pot per week						
	7.2	25.2	43.2	61.2	79.2	97.2	Mean
3.8	45.5	51.7	36.4	9.1	0	0	22.1
45.0	75.0	91.7	100.0	100.0	100.0	91.7	93.1
86.2	66.7	100.0	100.0	91.7	91.7	58.3	84.7
Mean	62.4	77.8	78.8	66.9	63.9	50.0	66.6

but declined somewhat from the second to the third level.

At too low a K rate such as the first K level, N deteriorated flowering whereas at adequate K rates N enhanced it, at least if applied at the proper rate. It may be mentioned that the aforementioned best treatment, i.e. N3K3 showed 100% flowering.

A close relationship appeared to exist between flowering and plant fresh weight (figure 1). Sytsema (1969) found for an other bromeliad viz. Vriesea splendens that ripeness to flower is determined by plant size. This principle seems to hold also good for Aechmea . Apparently, the favourable effect of K on flowering acts through its effect on plant size.

Table 10 shows an advantageous K effect on flowering time: the higher the K rate the earlier the flowers opened. In contrast, N generally tended to delay opening of flowers from the second level

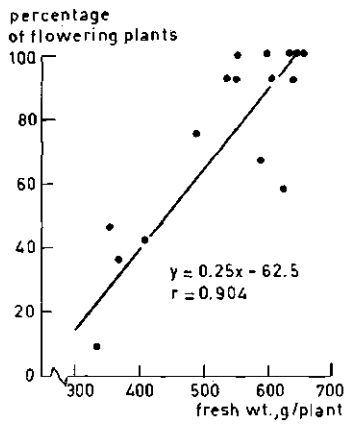

Figure 1 - Relationship between percentage of flowering plants and plant fresh weight for Aechmea fasciata

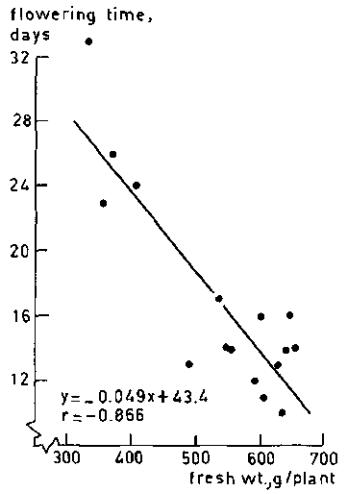

Figure 2 - Relationship between time of flowering (with 25 June 1974 as point of reference on time scale) and plant fresh weight for Aechmea fasciata.

Table 10 - Time of flowering in days in Aechmea fasciata with 25 June 1974 as point of reference as affected by nitrogen and potassium rate.

mg K_2O/pot	mg N/pot per week						
per week	7.2	25.2	43.2	61.2	79.2	97.2	Mean†
3.8	22.8	24.0	26.0	33.0	n.f.‡	n.f.‡	26.5
45.0	12.7	13.5	13.5	16.4	15.9	17.4	14.0
86.2	11.7	9.6	13.5	11.0	14.0	13.2	11.5
Mean†	15.7	15.7	17.7	20.1	-	-	17.3

†Treatments N5K1, N5K2, N5K3, N6K1, N6K2 and N6K3 were not included in calculating the mean.
‡n.f. = no flowering.

upwards.

The close relationship between flowering time and plant fresh weight (figure 2) may be looked upon as another expression of the dependency of flowering on plant size in Aechmea as was earlier shown in figure 1.

The response of flower fresh weight to treatments followed the same pattern as that of plant fresh weight (table 11) except that the beneficial effect of K was even more pronounced. This similarity in

Table 11 - Flower fresh weight in g per flower of Aechmea fasciata as affected by nitrogen and potassium rate.

mg K_2O/pot	mg N/pot per week						
per week	7.2	25.2	43.2	61.2	79.2	97.2	Mean†
3.8	56.9	60.8	66.1	64.2	n.f.‡	n.f.‡	62.0
45.0	76.5	95.3	109.9	119.1	114.9	106.5	100.2
86.2	84.3	112.8	130.7	112.2	125.2	121.4	110.0
Mean†	72.6	89.6	102.2	98.5	-	-	90.7

†Treatments N5K1, N5K2, N5K3, N6K1, N6K2 and N6K3 were not included in calculating the mean.
‡n.f. = no flowering.

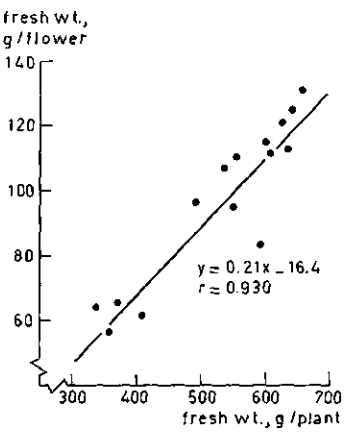

Figure 3 - Relationship between flower fresh weight and plant fresh weight for Aechmea fasciata.

response may also be inferred from figure 3 which shows a close relationship between both plant characteristics.

The average N content in all the leaves of the plant at the end of the trial increased with increasing N up to the fifth N rate and

Table 12 - Percentage of nitrogen in leaves of Aechmea fasciata at end of trial as affected by nitrogen and potassium rate.

mg K_2O/pot	mg N/pot per week						
per week	7.2	25.2	43.2	61.2	79.2	97.2	Mean
3.8	0.89	1.29	2.17	3.12	3.26	2.88	2.27
45.0	0.77	1.19	1.60	1.93	1.93	2.13	1.59
86.2	0.67	1.12	1.29	1.67	1.72	1.72	1.35
Mean	0.78	1.20	1.67	2.24	2.30	2.22	1.74

Table 13 - Percentage of potassium in leaves of Aechmea fasciata at end of trial as affected by nitrogen and potassium rate.

mg K_2O/pot	mg N/pot per week						
per week	7.2	25.2	43.2	61.2	79.2	97.2	Mean
3.8	0.59	0.45	0.45	0.51	0.55	0.61	0.53
45.0	2.40	2.07	1.76	1.82	1.76	1.76	1.91
86.2	3.13	2.97	2.78	2.78	2.78	2.62	2.84
Mean	2.04	1.83	1.66	1.70	1.70	1.66	1.76

decreased slightly with further N rise; it decreased rather sharply with increasing K rate possibly because of a "dilution effect".

The average K content markedly rose with K rate whereas it tended to decrease with increasing N rate in the lower range.

The N and K content in leaves for the best treatment were 1.29 and 2.78%, respectively.

The average K content in leaves at the deficient first K level was 0.53%.

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