RESEARCH RESULTS FOR FLOWER GROWERS

SNAPDRAGON STUDIES 1966-70

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Research Results for Flower Growers
Snapdragon Studies 1966-70

Kenneth C. Sanderson and Willis C. Martin, Jr.

Information on snapdragon culture in the deep South is limited. Most culture recommendations and cultivars have been developed for Northern latitudes. During 1966-70, Auburn University conducted studies on various aspects of snapdragon culture including cultivar adaptation, peat- and garbage-amended media and liquid and slow release fertilizer regimes and light changing plastic covers. The results of these studies are presented in this report.

Comparison of Japanese and American Group II Snapdragon Cultivars Grown Under Southern Conditions.

Procedure

Seed of ten cultivars of snapdragon were furnished by Herbst Brothers, New York, N. Y. The Herbst snapdragons were bred by Sakata, Tokoyo, Japan and were classified as Group II snapdragons with a recommended flowering period of December to April in the South. Very little was known about their performance in comparison to American-bred Group II snapdragons. Seeds of seven commercial, American-bred Group II cultivars were obtained for comparison with the Japanese cultivars. Seed were sown on December 12, 1968 and seedlings were benched directly into a greenhouse bench containing a 1:1:1 soil, peat and perlite mixture on January 12, 1968. A spacing of 4 x 4 in. was used to allow 16 sq. in. per plant. One plot of each cultivar, consisting of 144 plants was grown in each of two greenhouses. Commencing at benching, the plants were fertilized every two weeks with 25-10-10 at the rate of 1 oz. per 3 gal. A single application of borax, at the rate of 1/2 oz. per 100 sq. ft., was made on January 19. Prior to planting, dolomitic limestone was added according to test (3 lb. per 100 sq. ft.) and superphosphate was incorporated at the rate of 1.8 lb. per 100 sq. ft. Temperatures were maintained at 60° F. during the night and 70° F. during day when possible. Plants were grown in full sun. Comparisons of the plant height, plant weight, flowering date, flower spike length and stem strength in grams per centimeter (g/cm) were made at flowering. A sample of 20 plants from each plot (total 40) was used in all determinations except g/cm which considered the weight of five stripped stems, 50 cm long from each plot. The 50 cm section of stem came from directly behind the flower spike or head.

Results

An outstanding feature of the Japanese cultivars was the riot of flower color which was both pleasing and unusual in some cultivars. Pink 149 was slightly brighter than Rocky Mountain but not as deep a pink as Jackpot or Indiana. Both Yellow 150 and 117 were medium to deep yellow. Yellow 150 resembled Montezuma. The White 133 and White 102 were pure white and could not be compared with Twenty Grand, an ivory, and McKinley, an ivory-white. Bronze-Scarlet 147 was a most interesting blend of bright, intense colors. Lavender 54 was a pleasing lavender with a muted tone. Bronze-Yellow 163, like Bronze-Scarlet 147, was a blend of bronze and yellow. Spike shape in some of the Japanese cultivars was blunt and not tapered. Floret placement also was not as good as American cultivars.

The date of flowering for all the cultivars varied by 10 days. Flowering took place in approximately 14 to 15.4 weeks for both American and Japanese cultivars. The response was a Group II response with most cultivars. The Whites 133 and 102 might perform better as Group I cultivars.

Table 1 presents some of the growth comparisons of the cultivars. The mean height for the 10 Japanese cultivars (63.3 cm) was less than the mean for the 7 American cultivars (73.5 cm). The Japanese cultivar, Lavender 54, was the tallest cultivar grown whereas the two Japanese white cultivars, 117, and 102 were the shortest growing cultivars. The mean fresh weights of the plants were approximately the same for the Japanese (51.0 g) and American (51.8 g) cultivars. Crimson 101 produced the heaviest plants (66.0 g). The least fresh weight (41.1 g) was produced by White 102. The mean length of the flower spike of the American cultivars (18.5 cm) exceeded that of the Japanese cultivars (16.8 cm).

Table 1. Growth Comparison of Several Group II Snapdragon Cultivars Grown Under Southern Conditions

Cultivar	Height	Weight	Flower spike	Stem strength
	Cm.	G.	Cm.	G.
Pink 149	66.8	55.9	18.0	.18
Lavender 54	83.5	51.7	17.3	.20
Bronze-Scarlet 147	63.5	48.3	18.0	.18
Crimson 101	75.8	66.0	11.0	.20
Red 148	64.8	56.5	16.5	.17
Yellow 117	59.3	49.4	12.8	.20
Yellow 150	55.0	46.5	17.8	.18
Bronze-Yellow 163	60.0	51.6	19.5	.17
White 133	51.3	42.6	19.8	.15
White 102	51.5	41.1	15.8	.16
Jackpot	55.5	48.7	16.5	.21
Indiana	70.5	60.2	19.0	.17
Rocky Mountain	72.8	58.0	18.0	.19
Twenty Grand	59.3	44.8	19.5	.18
McKinley	67.0	48.4	18.5	.22
Swaps	66.0	58.3	17.5	.19
Montezuma	60.3	44.5	20.3	.18
Mean	63.8	51.3	17.8	.18

Montezuma produced the largest flower spike (60.3 cm) and Crimson 101 produced the shortest flower spike (11.0 cm). The index of stem strength (g/cm) for the two cultivar groups was approximately equal with the Japanese cultivars having .18g/cm and American cultivars having .19g/cm. McKinley had the largest g/cm reading (.22g/cm) and White 133 had the smallest (15g/cm).

Summary

Considering growth and quality factors, the Japanese cultivars Pink 149, Lavender 54, Bronze-Scarlet 147, Red 148, Yellow 150, Bronze 163 and White 133 compared favorably with some of the older American cultivars e.g., Jackpot but lacked the high quality of newer American cultivars e.g., McKinley. Some Japanese cultivars presented a pleasingly different color spectrum. Seed cost of Japanese cultivars are lower than American cultivar seed.

Comparison of Several New Group II Snapdragon Cultivars Grown Under Southern Conditions.

Procedure

Seed of eight cultivars of snapdragon were sown on November 26, 1968. The cultivars were hybrids belonging to Group II and included the commercial cultivars, Jackpot, Kodiak, McKinley, Montezuma, Phoenix and Rocky Mountain and two unreleased cultivars, Pink Butterfly and Round Pink Flower. The unrealeased cultivars were reported to have unusual flower forms and were furnished by Goldsmith Seeds, Gilroy, California. The seedlings were transplanted directly into a greenhouse bench containing a 1:1:1 soil, peat and perlite media on December 27, 1968. Commencing at benching, the plants were fertilized every two weeks with 25-10-10 at the rate of 1 oz. per 3 gal. A single application of Solubor, at the rate of 1/2 oz. per 100 sq. ft. was made on January 6, 1969. Temperatures were maintained at 60° F. during the night and 70° F. during the day when possible. Plants were grown in full sun.

Data consisted of plant height, plant weight, and flower spike length. A sample of 20 plants from each plot was used in all determinations. The cultivars were not replicated in the bench.

Results

Plants of Pink Butterfly exceeded the plants of the other seven cultivars in fresh weight, height and flower spike length, Table 2. Jackpot plants produced the least fresh weight and shortest plants. Kodiak flower spikes were the shortest in the experiment.

Table 2. Fresh Weight, Height and Flower Spike Length of Several Group II Snapdragons

Cultivars	Plant weight	Plant height	Flower spike length
	G.	Cm.	Cm.
Jackpot	48.3	82.3	15.5
Kodiak	65.8	92.3	13.5
McKinley	74.3	96.5	18.8
Montezuma	51.4	96.0	20.3
Pink Butterfly	103.9	119.0	24.5
Phoenix	54.2	106.5	22.3
Rocky Mountain	83.4	104.0	19.3
Round Pink Flower	93.1	115.3	18.8
Mean	71.8	101.5	19.0

Summary

Pink Butterfly, a Group II snapdragon with a new flower form, exceeded several Group II cultivars in plant height and weight and flower spike length. A Round Pink Flower cultivar also performed better than some standard flower form cultivars.

Comparison of Several Summer Flowering Cultivars Grown Under Southern Conditions.

Procedure

Seed of eight summer flowering cultivars were sown on June 25, 1968. The eight cultivars were Summer, Jewel, Potomac Rose, Georgia, Potomac Pink, Vera Cruz, Potomac Yellow, White Skies and Potomac White. The recommended flowering period for these cultivars in the South is mid-June to October. Seedlings were benched on July 19, 1968 using a 4 x 4 in. spacing to allow 16 sq. in. per plant. The plants were planted in a soil mixture consisting of equal portions of soil, peat and perlite. Fertilization consisted of 25-10-10 at the rate of 1 oz. per 3 gal. every two weeks. A single application of Solubor was applied on July 29 at the rate of 1/2 oz. per 100 sq. ft.

Two greenhouses were used to grow the plants. One bench in each house was planted with the eight cultivars. At flowering the plant height, fresh weight and flowering spike length were recorded for 40 plants (20 from each house) and means computed. The date of flowering was also observed.

Results

Potomac Yellow and Potomac White flowered in 48 days following benching. Vera Cruz flowered in 53 days after benching. Georgia and Potomac Rose averaged 58 days until flowering. Potomac Pink and Summer Jewel flowered in 62 days. White Skies requires 70 days to flower after benching.

The results on plant height, fresh weight and flower spike length are presented in Table 3. The mean plant height for all cultivars was 92.5 cm. Potomac Pink had the tallest plants (109.0 cm.). Plants of Potomac White produced the shortest mean height (79.8 cm.). The mean plant fresh weight for the experiment was 35.2 g. Summer Jewel, Georgia, Potomac Pink and White Skies produced the heaviest plants (in excess of 39.0 g.). The fresh weight of Potomac White (27.9 g.) was the poorest of the eight cultivars. The mean flower spike length for all cultivars was 18.8 cm. Summer Jewel had the longest flower spikes (21.8 cm.). White Skies (16.3 cm.) and Potomac White (16.5 cm) produced the shortest flower spikes.

Table 3. Comparison of the Plant Height, Weight and Flower Spike Length of Several Summer Flowering Cultivars

Cultivar	Height	Weight	Flower Spike
	Cm.	G.	Cm.
Summer Jewel	89.3	39.3	21.8
Potomac Rose	73.5	38.4	18.8
Georgia	93.5	39.2	20.8
Potomac Pink	109.0	39.2	19.0
Vera Crus	82.5	29.4	19.3
Potomac Yellow	88.0	28.0	17.8
White Skies	104.8	39.8	16.3
Potomac White	79.8	27.8	16.5
Mean	92.5	35.2	18.8

Summary

Plant height for summer flowering cultivars was greater with Potomac Pink and White Skies. Summer Jewel, Potomac Rose, Georgia Potomac Pink, and White Skies produced heavier plants than Vera Cruz, Potomac Yellow and Potomac White. Flower Spike length was greatest in summer Jewel, followed by Georgia, Vera Cruz, Potomac Pink, Potomac Rose, Potomac Yellow, Potomac White and White Skies.

Comparison of Several New Group I Snapdragon Cultivars Grown Under Southern Conditions.

Procedure

Group I (winter flowering in the North) snapdragons are not recommended for Southern culture because they usually produces short, poor, quality flowers. Some growers grow them because they offer a large selection of cultivars and a wide range of colors. Most successful southern growers have used flexible plastic greenhouses for their culture. Such greenhouses provide low temperatures, especially soil temperatures since the plants are often grown on the ground. A flexible plastic greenhouse equipped with ground benches was used in this experiment. The benches were constructed so that a 1:1:1 media of soil, perlite, and peat was approximately 6 in. above, but in contact with the ground. Vapam was applied to the media and benches at the rate of 1 qt. per 100 sq. ft. on November 18, 1969. The house was not covered with plastic at the time of Vapam application. Seedlings of the cultivars Rio Grande, Vulcan. Yosmite, and Zion were benched (4 x 4 in.) on Decemner 18, 1969. Cultivars were grown in separate benches approximately 18 ft. long. Fertilization consisted of 2 lb. of Osmocote 14-14-14 fertilizer per 100 sq. ft. preplant. The winter was unusually cold. Night temperatures inside ranged from 35° to 50° with the thermostat set at 52° F. Records were taken at flowering on plant height and weight, and length and g/cm of stem. Plants were cut at the soil line for height and weight determinations. The index of stem strength, g/cm of stem, was obtained from 50 cm of stem cut from directly behind the flower spike.

Results

Flowering occurred in 103 (Zion) to 110 (Rid Grande, Yosemite and Vulcan) days. Table 4 shows that Vulcan produced plants with the greatest fresh weight, height, spike length, and strongest stem (g/cm of stem). Rio Grande plants weighed less than other cultivars tested. Mean height and flower spike length of Zion plants were the shortest in the experiment Rio Gtande and Yosemite plants had the lowest g/cm of stem determinations in the experiment.

Table 4. Plant Weight, Height, Flower Spike Lenth and g/cm of Stem of Four Group II Snapdragon Cultivar

Cultivar	Plant weight	Plant height	Spike Length	Stem Strength
	G.	In.	In.	G/Cm.
Rio Grande	88.7	122.3	26.0	.30
Vulcan	119.7	134.3	26.1	.41
Yosemite	107.8	122.3	26.0	.30
Zion	104.0	119.4	23.9	.33

Group I cultivars can probably be grown in Central Alabama for a brief period during the winter, especially a cold winter like 1970. Osmocote 14-14-14 at the rate of 2 lb. per 100 sq. ft. gave satisfactory results, however, Spurway soil tests one month after planting revealed the following averages: NO_3 = 12 p.p.m., P = 5 p.p.m., K - 8 p.p.m. and Ca = 57 p.p.m. Also, initially the soil contained nutrients since it was used to grow other crops. Salable flowers were produced but foliage was light green in color. The plants probably would have benefitted from additional from additional fertilization.

Influence of Peat and Sewage Treated Garbage Compost-Amended Media on the Growth of Two Flowering Groups of Snapdragons

Procedure

The influence of peat and sewage treated garbage compost on the growth of two crops of snapdragons was studied. Sewage treated garbage compost consisted of ground municipal refuse sprayed with raw sewage prior to composting. Crop 1 consisted of snapdragons belonging to the flowering response Group II which is recommended for winter flowering in the South. Seedlings of the cultivars Jackpot, Twenty Grand and Sakata No. 148 were benched on January 18, 1968. Crop 2 consisted of snapdragons belonging to the flowering response Group IV which is recommended for summer flowering in the South. Seedlings of the cultivars Potomac White and Potomac Pink were benched on March 7, 1968. A spacing of 4 x 4 inches was used on both crops. All plants were grown single stem. Dexon-Terrachlor, at the rate of 8 oz. per 100 gal. of water, was applied after benching to control damping off diseases. The seedlings were transplanted into six media: (1) soil and peat; (2) soil and garbage; (3) soil, peat, and garbage; (4) soil, perlite, and peat; (5) soil, perlite, and garbage; (6) soil, perlite, peat, and garbage. Equal portions of the materials were used in each media. The pH of the media was adjusted to 6.0. Gypsum was added to all media at the rate of 4 lb. per 100 sq. ft. Fertilization consisted of bimonthly applications of 25-10-10 at the rate of $2\frac{1}{2}$ lb. per 100 gal. of water.

At flowering, 20 plants from each media were cut at the soil line and the plant height, plant weight and flower head or spike length determined. Five plants from each media were stripped of all foliage, cut to 50 cm in length and weighed. A grams per centimeter (g/cm) reading was thus obtained as an index of stem strength.

Results

The mean height of snapdragons grown in peat and soil (94.3 cm) was greater than the height of plants grown in the other media (Table 5). Plants grown in soil, perlite and peat (89.4 cm) averaged the shortest plants. Soil, perlite, and garbage (86.8 cm) produced the tallest and soil, peat, and garbage (73.3 cm) and soil, peat, and garbage (73.3 cm) and soil and garbage (73.5 cm) averaged the shortest plants for the Group II snapdragons. Soil, peat, and garbage (111.5 cm) and soil, perlite, and garbage (98.3 cm) yielded the tallest and shortest plants respectively for the Group IV snapdragons. The mean height of the Group IV snapdragons (107.3 cm) exceeded the mean height of the Group II snapdragons (74.8 cm). Potomac White (65.2 cm) produced shorter plants than Potomac Pink (88.2 cm). Sakata Red No. 148 (79.8 cm) and Twenty Grand (78.0 cm) averaged taller plants than Jackpot (66.5 cm).

The mean plant fresh weight ranged from 78.3 g (soil, peat, and garbage) to 48.3 g (soil and garbage). The results are presented in Table 6. Group II snapdragons produced the most fresh weight in soil, peat, and garbage (46.9 g) and the least fresh weight in soil and peat (42.8 g). Considering Group IV snapdragons, soil, peat, and garbage (112.3 g) yielded plants more than twice as heavy as plants grown in soil and garbage (52.2 g). The fresh weight of Group IV snapdragons averaged 76.8 g whereas Group II plants averaged 44.6 g. The plant fresh

weights of the Group II cultivars were 46.4 g for Sakata Red No. 148, 44.1 g for Jackpot and 43.3 g for Twenty Grand. Potomac Pink (88.2 g) exceeded Potomac White (65.2 g) in fresh weight of the Group IV snapdragons.

Table 7 shows that the greatest difference in the mean length of flower head or spike occurred between soil and garbage (22.9 cm), soil, perlite, and garbage (22.9 cm) and soil, perlite, and peat (22.8 cm) and soil and peat (19.8 cm). Group II snapdragons produced the longest spikes in soil, perlite, and garbage (24.5 cm) and the shortest spikes in soil and peat (17.0 cm). In the Group IV snapdragons, spike length was greatest in soil and garbage (27.3 cm) and least in soil, perlite, and garbage, (21.3 cm). Group IV snapdragons produced longer spikes than Group II snapdragons. Twenty Grand (21.0 cm) averaged longer spikes than the other Group II snapdragons, Sakata ed No. 148 (20.5 cm) and Jackpot (17.3 cm). Potomac White (26.3 cm) had a greater spike length than Potomac Pink (21.3 cm).

The mean g/cm of stem for the two flowering groups is presented in Table 8. Soil, perlite, peat, and garbage (.028 g/cm) yielded plants with the strongest stems as measured by g/cm readings. Plants grown in soil, perlite, and garbage (.019) had the smallest g/cm reading. The g/cm readings for the Group II cultivars ranged from .014 g/cm to .016 g/cm. Group IV cultivars produced the largest and smallest g/cm readings when grown in soil, perlite, peat, and garbage (.041 g/cm) and soil, perlite, and garbage (.021 g/cm) respectively. The stem strength of the Group IV cultivars (.030 g/cm) exceeded the stem strength of the Group II cultivars (.015 g/cm). The mean g/cm for Sakata Red No. 148, Twenty Grand and Jackpot were .016, .015 and .016 respectively. Potomac White (.032 g/cm) had higher g/cm readings than Potomac Pink (.028 g/cm).

Summary

Group II and IV snapdragons produced satisfactory growth in media amended with sewage treated garbage compost. Plants grown in garbage amended media often exceeded in peat amended media in growth and quality measurements.

Table 5. Influence of Peat and Sewage Treated Garbage Compost-Amended Media on the Mean Height (cm) of Two Flowering Groups of Snapdragons

Media	Group II	Group IV	Media mean
	Cm.	Cm.	Cm.
Soil and peat 1:1	78.3	110.3	94.3
Soil and garbage 1:1	73.5	109.3	91.4
Soil, peat, and garbage 2:1:1	73.3	111.5	92.4
Soil, perlite, and peat 1:1:1	76.8	102.0	89.4
Soil, perlite, and garbage 1:1:1	86.8	98.3	92.6
Soil, perlite, peat, and garbage 2:2:1:1.	82.0	113.0	97.5
Group mean	74.8	107.3	91.1

Table 6. Influence of Peat and Sewage Treated Garbage Compost Amended Media on the Mean Fresh Weight (g) of Two Flowering Groups of Snapdragons

Media	Group II	Group IV	Media mean
	G.	G.	G.
Soil and peat 1:1	42.8	81.5	62.2
Soil and garbage 1:1	44.4	52.2	48.3
Soil, peat, and garbage 2:1:1	45.3	112.3	78.8
Soil, perlite, and peat 1:1:1	44.3	69.4	56.9
Soil, perlite, and garbage 1:1:1	46.9	73.3	60.1
Soil, perlite, peat, and garbage 2:2:1:1.	43.8	71.8	57.8
Group Mean	44.6	76.8	60.7

Table 7. Influence of Peat and Sewage Treated Garbage Compost-Amended Media on the Mean Flower Head Length (cm) of Two Flowering Groups of Snapdragons

Media	Group II	Group IV	Media mean
	Cm.	Cm.	Cm.
Soil and peat 1:1	17.0	22.5	19.8
Soil and garbage 1:1.	18.5	27.3	22.9
Soil, peat, and garbage 2:1:1	18.0	22.8	20.4
Soil, perlite, and peat 1:1:1	19.0	26.5	22.8
Soil, perlite, and garbage 1:1:1.	24.5	21.3	22.9
Soil, perlite, peat, and garbage 2:2:1:1.	22.0	22.0	22.0
Group mean.	19.8	23.8	21.8

Table 8. Influence of Peat and Sewage Treated Garbage Compost-Amended Media on the Mean Grams per (cm) of Stem of Two Flowering Groups of Snapdragons.

Media	Group II	Group IV	Media mean
	Gm.	Gm.	Gm.
Soil and peat 1:1	.014	.030	.022
Soil and garbage 1:1	.016	.029	.023
Soil, peat, and garbage 2:1:1	.016	.035	.026
Soil, perlite, and peat 1:1:1	.016	.023	.020
Soil, perlite, and garbage 1:1:1	.016	.021	.019
Soil, perlite, peat, and garbage 2:2:1:1	.015	.041	.028
Group mean	.016	.030	.023

Growth of Group III and IV Snapdragons in Sewage-Garbage, Garbage- and Peat-Amended Media

Procedure

Two experiments were conducted to determine the influence of garbage amended soil on the growth of two successive crops of snapdragons. Group IV cultivars were grown during July and September 1969 in Experiment 1 and Group III cultivars were grown during December 1969 and March 1970 in Experiment 2. Media treatments consisted of media originally formulated in 1967 and 1968. These media were brought up to volume using organic material. The 1967 garbage compost was a sewage treated compost. The 1968 garbage compost did not contain sewage. Imported German peat moss was used in the peat media. The media were (1) 1:1 soil and peat 1967, (2) 1:1 soil and peat 1968, (3) 1:1 soil, and sewage-garbage 1967, (4) 1:1 soil and garbage 1968, (5) 1:1:1 soil, peat, and sewage-garbage 1967, (6) 1:1:1 soil, peat, and garbage 1968, (7) soil, perlite, and peat 1967, (8) 1:1:1 soil, perlite, and peat 1968, (9) 1:1:1 soil, perlite, and sewage-garbage 1967, (10) 1:1:1 soil, perlite, and garbage 1968, (11) 2:2:1:1 soil, perlite, peat, and sewage-garbage 1967 and 2:2:1:1 soil, perlite, peat, and garbage 1968. Fertilization consisted of 150 p.p.m. N, 30 p.p.m. P and 120 p.p.m. K. The cultivars Potomac Pink and Veracruz were grown in Experiment 1 and the cultivars Kansas and Pan-American Pink were grown in Experiment 2. Growth data included plant height and weight, flower spike length and g/cm of stem (an index of stem strength).

Results

In Experiment 1, Potomac Pink and Veracruz plants had greater plant heights and weights when grown in soil, perlite, peat and sewage-garbage media. Soil and sewage-garbage media and soil, peat and sewage-garbage media produced the shortest plants for Potomac Pink and Veracruz respectively, Table 9. Soil and peat media plants and soil, perlite and garbage plants weighed the least for Potomac Pink and Veracruz cultivars respectively, Table 10. Table 11 shows that Potomac Pink and Veracruz had the largest flowering spikes when grown in soil, perlite, and peat media and soil, perlite, and sewage-garbage media respectively. Both cultivars had the greatest g/cm of stem reading when grown in soil, perlite, peat, and sewage-garbage, Table 12.

In Experiment 2, Kansas produced the tallest plants in several garbage-amended media whereas Pan-American Pink had the tallest plants when grown in soil and peat media and soil, perlite, and peat media, Table 13. Plant fresh weight was greatest in garbage-amended media for both cultivars. Kansas plants weighed the most when grown in soil and garbage; soil, perlite, and peat; and soil, perlite, and garbage. Pan-American Pink plants weighed the most when grown in soil, peat, and garbage; soil, perlite, and garbage; and soil, perlite, peat, and garbage, Table 14. Table 15 shows that both cultivars had the longest flower spikes when grown in soil and sewage-garbage. Stem strength (g/cm) of Kansas was greatest in soil, perlite and peat and soil, perlite and sewage-garbage grown plants, Table 16. Pan-American Pink had the greatest g/cm of stem reading with plants grown in soil and sewage-garbage and soil, perlite, peat, and sewage-garbage.

Table 9. Plant Height (cm) of Potomac Pink and Veracruz Snapdragon Cultivars Grown in Various Media

Media	Potomac Pink	Veracruz	Mean
	Cm.	Cm.	Cm.
Soil and peat 67	115.3	90.3	102.8
Soil and peat 68	112.0	95.8	103.9
Soil and sewage-garbage 67	112.8	94.8	103.8
Soil and garbage 68	113.0	94.0	103.5
Soil, peat, and sewage-garbage 67	116.8	86.5	101.7
Soil, peat and garbage 68	117.5	90.5	104.0
Soil, perlite, and peat 67	116.8	98.3	107.6
Soil, perlite, and peat 68	116.5	97.5	107.0
Soil, perlite, and sewage-garbage 67	117.3	96.5	106.9
Soil, perlite, and garbage 68	116.8	90.3	103.6
Soil, perlite, peat, and sewage-garbage 67	120.3	96.3	108.3
Soil, perlite, peat, and garbage 68	119.8	92.3	106.2
Mean	116.3	93.6	105.0

Table 10. Fresh Plant Weight (g) of Potomac Pink and Veracruz Snapdragon Cultivars Grown in Various Media

Media	Potomac Pink	Veracruz	Mean
	G.	G.	G.
Soil and peat 67	78.9	53.2	61.1
Soil and peat 68	56.0	63.0	59.5
Soil and sewage-garbage 67	70.0	54.6	62.3
Soil and garbage 68	64.4	57.4	60.9
Soil, peat, and sewage-garbage 67	70.0	53.2	61.6
Soil, peat, and garbage 68	72.8	50.4	61.6
Soil, perlite, and peat 67	77.0	57.4	67.2
Soil, perlite, and peat 68	71.4	61.6	66.5
Soil, perlite, and sewage-garbage 67	64.4	62.1	63.3
Soil, perlite, and garbage 68	65.8	44.8	55.3
Soil, perlite, peat, and sewage-garbage 67	86.8	67.2	77.0
Soil, perlite, peat, and garbage 68	85.4	53.2	69.3
Mean	71.9	56.5	64.2

Table 11. Flower Spike Length (cm) of Potomac Pink and Veracruz Snapdragon Cultivar Grown in Various Media

Media	Potomac Pink	Veracruz	Mean
	Cm.	Cm.	Cm.
Soil and peat 67	14.1	18.0	16.1
Soil and peat 68	17.3	19.3	18.3
Soil and sewage-garbage 67	18.5	22.8	20.7
Soil and garbage 68	19.0	22.5	20.8
Soil, peat, and sewage-garbage 67	26.0	17.3	21.7
Soil, peat, and garbage 68	21.8	20.3	21.1
Soil, perlite and peat 67	34.5	22.8	28.5
Soil, perlite, and peat 68	18.5	21.3	19.9
Soil, perlite, and sewage-garbage 67	20.8	23.8	22.3
Soil, perlite, and garbage 68	20.3	19.3	19.8
Soil, perlite, peat, and sewage-garbage 67.	23.5	20.8	22.2
Soil, perlite, peat, and garbage 68	22.3	19.8	21.1
Mean	21.4	20.6	21.0

Table 12. Stem g/cm of Potomac Pink and Veracruz Snapdragon Cultivars Grown in Various Media

Media	Potomac Pink	Veracruz	Mean
	G.	G.	G.
Soil and peat 67	.22	.15	.19
Soil and peat 68	.16	.18	.17
Soil and sewage-garbage 67	.20	.16	.18
Soil and garbage 68	.18	.16	.17
Soil, peat, and sewage-garbage 67	.20	.15	.18
Soil, peat, and garbage 68	.21	.14	.18
Soil, perlite, and peat 67	.22	.16	.19
Soil, perlite, and peat 68	.20	.18	.19
Soil, perlite, and sewage-garbage 67	.18	.18	.18
Soil, perlite, and garbage 68	.19	.13	.16
Soil, perlite, peat and sewage-garbage 67.	.25	.19	.22
Soil, perlite, peat, and garbage 68.	.24	.15	.20
Mean	.21	.16	.19

Table 13. Plant Height (cm) of Kansas and Pan-American Pink Snapdragon Cultivars Grown in Various Media

Media	Kansas	Pan-American Pink	Mean
	Cm.	Cm.	Cm.
Soil and peat 67	131.9	117.0	125.0
Soil and peat 68	129.7	117.0	123.4
Soil and sewage-garbage 67	135.1	122.1	128.6
Soil and garbage 68	130.9	117.6	124.3
Soil, peat, and sewage-garbage 67	132.2	106.2	119.2
Soil, peat, and garbage 68	134.9	110.3	122.6
Soil, perlite, and peat 67	129.8	122.4	126.1
Soil, perlite, and peat 68	133.9	118.1	126.0
Soil, perlite, and sewage-garbage 67	135.1	115.6	125.4
Soil, perlite, and garbage 68	131.1	118.1	124.6
Soil, peat, perlite, and sewage-garbage 67	135.9	110.2	123.2
Soil, peat, perlite, and garbage 68	133.4	114.8	124.1
Mean	132.8	115.8	124.3

Table 14. Plant Weight (g) of Kansas and Pan-American Pink Snapdragon Cultivars Grown in Various Media

Media	Kansas	Pan-American Pink	Mean
	G.	G.	G.
Soil and peat 67	85.4	120.4	102.9
Soil and peat 68	79.8	112.0	95.9
Soil and sewage-garbage 67	95.2	121.8	108.5
Soil and garbage 68	89.6	112.0	100.8
Soil, peat, and sewage-garbage 67	84.7	110.6	97.7
Soil, peat, and garbage 68	89.6	123.2	106.4
Soil, perlite, and peat 67	84.0	102.2	93.1
Soil, perlite, and peat 68	95.2	113.4	104.3
Soil, perlite, and sewage-garbage 67	96.6	119.0	107.8
Soil, perlite, and garbage 68	86.1	123.2	104.7
Soil, perlite, sewage-garbage, and peat 67	87.5	117.0	102.3
Soil, perlite, garbage, and peat 68	86.1	124.6	105.4
Mean	88.3	116.2	102.3

Table 15. Flower Spike Length (cm) Kansas and Pan-American Pink Snapdragon Cultivars Grown in Various Media

Media	Kansas	Pan-American Pink	Mean
	Cm.	Cm.	Cm.
Soil and peat 67	25.8	20.9	22.4
Soil and peat 68	23.4	20.7	22.1
Soil and sewage-garbage 67	31.3	23.2	27.3
Soil and garbage 68.	28.2	22.2	25.2
Soil, peat, and sewage-garbage 67.	24.5	19.7	22.1
Soil, peat, and garbage 68	25.8	21.0	23.4
Soil, perlite, and peat 67	27.1	21.7	24.4
Soil, perlite, and peat 68	22.4	19.8	21.1
Soil, perlite, and sewage-garbage 67	29.1	21.1	25.1
Soil, perlite, and garbage 68.	24.6	22.0	23.3
Soil, perlite, peat, and sewage-garbage 67	24.0	19.5	21.8
Soil, perlite, peat, and garbage 68.	25.7	20.6	43.2
Mean	26.0	21.0	23.5

Table 16. Stem g/cm of Kansas and Pan-American Pink Snapdragon Cultivars Grown in Various Media

Media	Kansas	Pan-American Pink	Mean
	G.	G.	G.
Soil and peat 67	.26	.48	.37
Soil and peat 68	.16	.50	.33
Soil and sewage-garbage 67	.30	.58	.44
Soil and garbage 68	.22	.46	.34
Soil, peat, and sewage-garbage	.21	.48	.35
Soil, peat and garbage 68	.22	.47	.35
Soil, perlite, and peat 67	.25	.51	.38
Soil, perlite, and peat 68	.32	.43	.38
Soil, perlite, and sewage-garbage 67	.32	.45	.39
Soil, perlite, and garbage 68	.23	.53	.38
Soil, perlite, peat, and sewage-garbage	.19	.58	.39
Soil, perlite, peat, and garbage 68.	.30	.56	.43
Mean	.25	.50	.38

Summary

The growth and quality of Group III and Group IV snapdragons grown in garbage-amended media often exceeded that of snapdragons grown in peat-amended media. Plants performed slightly better in sewage-treated garbage media than garbage media.

Growth Comparisons of Snapdragons Grown under "Lifelite", Polyethylene and No Covers

Procedure

"Lifelite", a red plastic film reported to have beneficial effects on plant growth, was compared with clear polyethylene and no plastic in an experiment on greenhouse snapdragons. Snapdragon seedlings of the cultivar Potomac Pink, Potomac Yellow, and June Bride were benched on April 17, 1969. The plants were transplanted into a bench containing 1:1:1 soil, perlite and peat media. The bench was divided into sections for covering with the plastics: (1) "Lifelite", (2) Clear polyethylene, (3) No plastic. The plastic coverings were stapled to welded wire mesh and remained at a height of approximately six inches above the plants for six weeks. This method of installation did not screen out light entering from the side of the bench. The treatments were replicated twice.

The plants were grown at a minimum night temperature of 60°F. in an unshaded greenhouse. A fertilization program of 150 p.p.m. N, P, and K applied at each watering was used.

Data were taken at flowering on plant weight, plant height, flower spike length and stem strength. Twenty plants were cut at the soil line from the center of each plot for all data except stem strength. Stem strength was determined by cutting five stems directly in back of the last floret, stripping the stems of all leaves and cutting each stem to a standard length of 50 cm and weighing. A g/cm determination was then calculated as an index of stem strength.

Results

In comparison to no plastic covering, "Lifelite" and polyethylene reduced the length of the flower spike approximately 1.3 cm, Table 21. The check produced the longest flower spikes. The height of the plants grown under "Lifelite" exceeded the height of plants grown under polyethylene and no plastic by approximately 5 cm. Plant weight and the g/cm of stem was slightly greater in "Lifelite" plants than in plants receiving no treatment or covered with polyethylene treatments produced plants with approximately the same fresh weight. Stem strength, as measured by g/cm was somewhat greater in the polyethylene treated plants than in the check plants.

Table 21. Growth Comparisons of Snapdragons Grown Under "Lifelite", Polyethylene and No Covers

Treatment	Spike Length	Plant Height	Plant Weight	Per Cm.
	Cm.	Cm.	G.	G.
"Lifelite"	22.3	110.3	63.0	0.213
Polyethylene	22.5	105.8	60.7	0.199
Check	23.5	105.0	59.3	0.184
Mean	22.8	107.0	61.0	0.199

Summary

Growing snapdragons under a "Lifelite" or polyethylene plastic cover did not influence their growth.

Comparison of Summer Flowering Cultivars of Snapdragon Grown Under Two Fertilizer Regimes and Southern Conditions.

Procedure

Greenhouse benches in separate greenhouses were used in this experiment. One bench in one house was topdressed with Osmocote 14-14-14 at the rate of 6 lb. per 100 sq. ft. and the plants fertilized with 200 p.p.m. N, 80 p.p.m. P and 80 p.p.m. K at each watering. The bench in the other house was not topdressed with Osmocote but the plants were fertilized every two weeks with 25-10-10 at the rate of 1 oz. per 3 gal. of water.

Seed of six cultivars of snapdragons were sown on March 4, 1968. Two cultivars, Pan-American Summer Pink and Hawaii were classified as Group III cultivars with a recommended flowering periods of May to mid-June and October to November. Tampico, Potomac Yellow and Potomac White were classified as Group IV cultivars with a recommended flowering period of June to September, however Tampico and Potomac Yellow are also recommended for flowering as Group III cultivars. The seedlings were transplanted on April 5, 1968. A 4 x 4 in. spacing or 16 sq. in. per plant was provided for each plant. Plants were grown in lightly shaded greenhouses. A temperature of 60° F. was maintained when possible. Fan and pad cooling was employed with the thermostat set at 70° F. during the day. Twenty plants of each cultivar were sampled at flowering and records were taken on plant height, flower spike length, and date of flowering.

Results

The height, weight and flower spike length of plants grown under the two fertilizer regimes are presented in Table 17. Growth of plants under the regime consisting of Osmocote and constant feed was not much different than plants fertilized every two weeks. Comparison of the individual cultivars, irregardless of fertilizer regime, is presented in Table 18. Potomac Pink was the tallest growing cultivar (93.5 cm). Potomac Yellow was the shortest cultivar (87.3 cm). The most and least mean plant weight was produced by Potomac Pink (58.6 g) and Potomac Yellow (40.4 g), respectively. Pan-American Pink had the greatest flower spike length (21.3 cm). The smallest flower spike length (15.5 cm) were produced by Potomac White and Potomac Pink, Pan-American Pink and Potomac Yellow flowered in the shortest time (55 days) from benching. Tampico, Potomac White and Hawaii flowered in 58 days. Potomac Pink flowered last (62 days).

Summary

The addition of Osmocote 14-14-14 to a bi-monthly fertilizer program (applied as a preplant) did not greatly improve the growth of summer flowering snapdragons. Considering cultivars regardless of fertilizer regime, Potomac Pink produced the tallest and heaviest plants. Pan-American Pink and Tampico had the longest flower spikes.

Table 17. Comparison of the Plant Height, Weight and Flower Spike Length of Summer Snapdragons Grown Under Two Fertilizer Regimes

Fertilizer Regime	Height	Weight	Flower spike
	Cm.	G.	Cm.
Osmocote plus constant feed	93.5	49.6	18.5
Bi-monthly feed	92.8	44.2	17.5
Mean	93.3	46.9	18.0

Table 18. Comparison of Several Snapdragon Cultivars Grown Under Southern Conditions

Cultivar	Height	Weight	Flower spike
	Cm.	G.	Cm.
Pan-American Pink	93.5	42.4	21.3
Potomac Pink	100.8	58.6	15.5
Tampico	95.3	43.5	21.0
Potomac Yellow	87.3	40.4	16.8
Hawaii	94.8	43.1	17.5
Potomac White	89.5	53.3	15.5
Mean	93.5	46.9	18.0

Growth of Two Potomac Cultivars of Snapdragon Grown Year-Round on Four Liquid Fertilizer Regimes

Procedure

The Group III snapdragon cultivars, Potomac Pink and Potomac White were grown year-round in four experiments to determine the influence of four fertilizer regimes on growth indices. Experiment dates from benching to flowering were: May 11 to July 16, 1966, August 8 to November 7, 1966, November 16, 1966 to March 7, 1967 and March 20 to May 26, 1967 for Experiments 1, 2, 3, and 4 respectively. Seedlings were benched in a media consisting of equal parts of soil, perlite, and peat. The pH of the media was adjusted to 6.0 using limestone. Additional boron was supplied in each experiment using a single application of Borax at the rate of 14 g per 100 sq. ft. Two fertilizers, 25-10-10 and 20-20-20, and a MP-5 proportioner were used to establish the following fertilizer regimes: (1) Constant (at each watering) 138 p.p.m. N, 50 p.p.m. P and K, (2) Weekly 275 p.p.m. N, 110 p.p.m. P and K, (3) Bi-monthly 550 p.p.m. N, 220 p.p.m. P and K, (4) Monthly 918 p.p.m. N, 367 p.p.m. P and K, (5) Constant (at each watering) 110 p.p.m. N, P, K, (6) Weekly 220 p.p.m. N, P, K, (7) Bi-monthly 440 p.p.m. and (8) Monthly 732 p.p.m. N, P, K. Data were taken on plant height and weight at flowering. Twenty single stem plants were cut at the soil line for measurement. A split-plot design was used in each experiment and the data were statistically analyzed.

Results

Plant height differed in the four experiments with Experiments 1, 2, 3, and 4 having plants with height of 84.3, 102.0, 128.5 and 104.5 cm respectively. Potomac Pink (110.5 cm) had essentially the same height as Potomac White (99.3 cm). The two fertilizers, 25-10-10 (105.0 cm) and 20-20-20 (104.8 cm) did not differ in plant height produced, Table 20. The weekly and monthly fertilizer regime plants did not differ in height. Plants grown on constant, bi-monthly and monthly fertilizer regimes did not differ in height. The weekly and monthly regimes produced the same height plants and different from the other regimes. The height of the two cultivars was similar in combination with the four fertilizer regimes, Table 19.

The mean fresh weight of two cultivars did not differ, Table 20. The fresh weight of the plants differed in the four experiments with Experiment 1, 2, 3, 4 having plant weights of 24.98 g, 42.53 g, 90.67 g and 49.03 g, respectively. The fertilizer regimes of constant, weekly and bimonthly produced the heaviest plants, and did not differ from each other but differed from the monthly regime, Table 20. Potomac Pink plants grown on a constant regime produced the most fresh weight of any cultivar - regime combination, Table 20. The poorest fresh weight occurred with Potomac White plants on a monthly regime.

Summary

A weekly and monthly fertilizer regime produced the tallest plants. Plant height was similar with plants on constant and bi-monthly regimes. Plant weight was greatest with plants grown on constant, weekly and bi-monthly fertilizer regimes. A monthly regime produced plants with less fresh weight than plants on the other regimes.

Table 19. Mean Plant Height (cm) of Two Potomac Cultivars of Snapdragon Grown on Four Fertilizer Regimes

Fertilizer Regime	Potomac Pink	Potomac White	Regime mean
	Cm.	Cm.	Cm.
Constant	109.8 a x/	99.0 a	104.3 b
Weekly	111.5 a	100.8 a	106.0 a
Bi-monthly	110.0 a	98.0 a	104.0 b
Monthly	110.5 a	99.5 a	105.0 ab
Cultivar mean	110.5 a	99.3 b	

x/ Test of significance by Duncan Multiple Range Test. Means within a box followed by the same letter(s) are not significant at the 5% level.

Table 20. Mean Plant Fresh Weight (g) of Two Potomac Cultivars of Snapdragon Grown on Four Fertilizer Regimes

Fertilizer Regime	Potomac Pink	Potomac White	Regime mean
	G.	G.	G.
Constant	54.43 a x/	50.32 c	52.38 a
Weekly	53.42 c	52.25 d	52.84 a
Bi-monthly	54.10 b	50.34 e	52.22 a
Monthly	53.60 c	45.97 f	49.79 b
Cultivar mean	53.89 a	49.72 a	

x/ Test of significance by Duncan Multiple Range Test. Means within a box followed by the same letter(s) are not significant at the 5% level.