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Viability Test For Dormant Roses

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Several million rose plants from the west coast, the southwest, the midwest and the east are shipped, stored, processed, packaged and sold each year in a dormant condition. It is difficult for the buyer at any step along marketing process to accurately assess the viability or growth potential of the roots or tops of representative plants. The color of the bark or of the tissue beneath the bark is often considered indicative of growth status but this is not a valid test. Producers, storage operators, garden centers and the consumer are all interested in the development of a reliable and practical technique for a viability test. Tests for viability, however, indicate only plant growth potential of the moment, plant performance is in the hands of the grower.

A technique developed by Dexter (1) in 1932 is based on the principle that living plant cells have a differentially permeable membrane surrounding the cell contents which retains soluble salts and soluble substances at a higher concentration within than exists in the solution bathing the cell walls.

When living plant cells are injured by low temperatures or other means the characteristic differential permeability is modified or lost when death occurs thus the salts and soluble constituents of the protoplasm are free to diffuse out of the cell.

Dexter's technique as modified by Enmert (2) and Wilner (3) has been applied to samples of rose tissue by using a specific weight of rose tissue (approximately 10 grams) and by placing it in 3 times the sample weight of distilled water. The plant samples are cut into 1 inch sections. Diffusion is allowed to take place for 24 hours. The conductivity of the distilled water plus the diffusate (salts from the cells) is then measured using an electrode and a conductivity bridge (Solubridge similar to that used for soil tests). The rose tissue is then killed by autoclaving and after a second 24 hour period of diffusion a final reading is taken. The final reading gives the maximum conductivity for the rose tissue sample. The ratio of the original sample reading to the final reading for maximum conductivity is expressed in per cent. (Therefore, the name Percent Conductivity Test.)

In studies made by the authors, the results obtained from the Percentage Conductivity technique were compared with the actual growth of root and stem sections from the original sampling. The rose root or stem sections were injured to varying degrees by either low temperature, desiccation, or exposure to carbon tetrachloride, a toxic gas, to determine if the type of injury would affect the relationship between Percentage Conductivity values and the subsequent growth of the rose root or stem sections.

Rosa 'Better Times' stem sections were collected from greenhouse grown plants and *Rosa multiflora* and *Rosa* 'Dr. Huey' root sections were collected from dormant plants which had been in controlled low temperature storage for 5 to 6 months. *Rosa multiflora* root sections were also collected in August from growing plants. The injured stem sections were divided; half were tested by the Percentage Conductivity test and the other half were placed in a propagation bench having artificial light and intermittent mist. The dry weight of new shoot growth was recorded after three weeks. The same method was used for the root sections. The group to be grown on were dusted with "Hormodin 2" (a commercial rooting powder containing 3-indolebutyric acid), placed in sphagnum moss and maintained at 80°F. The number of root sections growing from each treatment was recorded after three weeks.

Results

Low Temperature Injury

Since freezing is a common cause of injury during the storage and shipment of dormant roses, a useful viability test must be able to measure the degree of injury from low temperatures. Varying degrees of low temperature injury in *Rosa* 'Better Times' stem tissue were obtained by treatments ranging from 38°F (control) to 0°F. Percentage Conductivity determinations and growth measurements were made on stem sections from each low temperature treatment. The results are shown in Figure 1. As low temperature injury increased, (indicated by a decrease in dry weight of new growth) the Percentage Conductivity values increased. The stem sections exposed to 38°F temperature exhibited good growth and had a Percentage Conductivity value of 9.9%. The stem sections exposed to 10°F temperature had no new growth and a Percentage Conductivity value of 39.2%.

A similar relationship was found when *Rosa* X *noisetiana manettii* root sections were exposed to low temperatures (Figure 2). When root sections were subjected to 38°F, all 10 root sections grew, and the Percentage Con-

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ductivity value was 9.3%. When the root sections were subjected to 20°F, there was no growth and a Percentage Conductivity value of 39.3%.

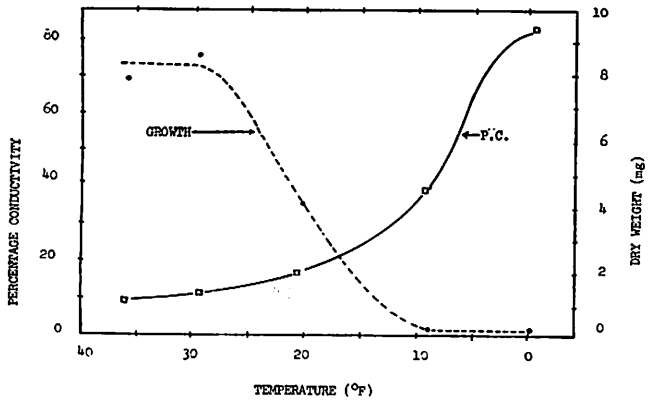

Figure 1. Low temperature injury on the stem tissue of *Rosa* 'Better Times' as exhibited by growth (measured in dry weight) and the Percentage Conductivity Test.

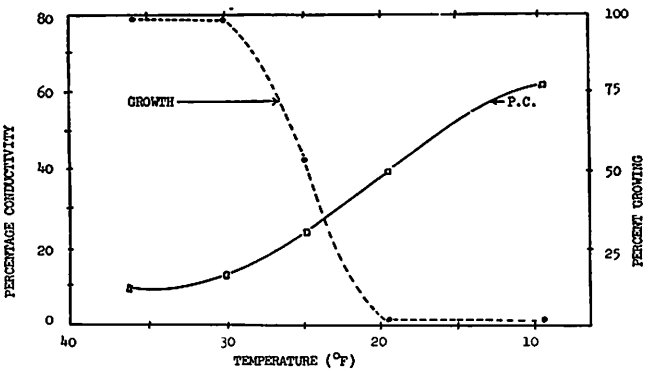

Figure 2. Low temperature injury on the root tissue of *Rosa multiflora* as exhibited by growth (measured in per cent of the number showing growth) and the Percentage Conductivity Test.

This indicates that the subsequent growth of rose root or stem sections injured by low temperature could be predicted with the Percentage Conductivity technique.

Desiccation Injury

Rosa 'Better Times' stem sections and *Rosa* 'Dr. Huey' root sections were injured to varying degrees by desiccation or drying. As can be seen in Table 1 the Percentage Conductivity values increased as desiccation injury increased. The Percentage Conductivity values for *Rosa* 'Better Times' stem sections increased from 10.6% for the control treatment to 60.4% when the plant tissue had lost 32.9% of its fresh weight and no growth occurred. The Percentage Conductivity values for the *Rosa* 'Dr. Huey' root sections increased from 19% for the control (0% loss in fresh weight) to 46.0% when the root sections had lost 35.2% of their fresh weight. The higher control treatment value (19%) for the *Rosa* 'Dr. Huey' roots may have been due to desiccation injury in storage previous to performing the experiment.

Table 1. Percentage Conductivity values and Growth of Rose stem and Root *sections injured* by Dessiccation.

Rosa 'Better Times' Stem Sections

	Per Cent of Moisture Loss				
	0	11.4	20.8	32.9	41.5
Percentage Conductivity	10.6	9.9	13.2	60.4	59.3
Growth Mean dry Weight (g)	0.09	0.09	0.05	0.0	0.0

Rosa 'Dr. Huey' Root Sections

	Per Cent of Moisture Loss						
	0	7.8	20.8	24.3	35.2	37.7	48.6
Percentage Conductivity	19.9	19.0	26.3	30.5	46.0	51.6	57.0
Growth no. of sections growing	10	10	10	5	0	0	0

Other Types of Injury

Carbon tetrachloride vapors were used to injure rose tissue in order to obtain a different type of injury than normally encountered in storage and shipment. *Rosa* 'Better Times' stem sections were injured to varying degrees by increasing the length of exposure to a saturated atmosphere of carbon tetrachloride. As illustrated in Table 2, a direct relationship was found between Percentage Conductivity values and injury. As growth was reduced (injury increased) the Percentage Conductivity values increased. *Rosa multiflora* root sections were also injured to varying degrees by carbon tetrachloride vapors. Again a direct relationship between injury and Percentage Conductivity values was found, as illustrated in Table 2. The control Percentage Conductivity value was high (16.6%) but was accompanied by a rather poor growth response (3 died) apparently this was due to injury previous to the experiment.

Table 2. Percentage Conductivity Values and Growth of Rose Stems and Root Sections Injured by Carbon Tetrachloride.

Rosa 'Better Times' Stem Sections

	Hours of Exposure						
	0	2	4	6	8	10	12
Percentage Conductivity	9.7	10.8	12.0	32.5	64.1	56.0	65.2
Growth Dry Weight (g)	0.07	0.10	0.05	0	0	0	0

Rosa multiflora Root Sections

	Hours of Exposure					
	0	½	1	2	4	6
Percentage Conductivity	16.6	18.3	19.0	31.2	53.9	50.8
Growth no. of sections growing	7	6	8	2	0	0

Discussion

It is apparent that the Percentage Conductivity test provides a basis for predicting injury or determining viability in rose roots as well as stems. The type of injury seems to have no effect on the reliability of the technique. The critical Percentage Conductivity value for the growth of rose root or stem in these tests was between 30.5% and 32.5%. Slightly above this value there was no growth. This was found to be true in additional experiments not

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Can We Control Cucumber Mosaic Virus On Gladiolus*

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Symptoms

Cucumber mosaic virus (CMV) has caused considerable losses to commercial and amateur plantings of gladiolus in many parts of the United States. The symptoms of CMV are a streaking of the leaves suggestive of severe thrips injury (Fig.1) and a streaking or color break in the flowers (Fig. 2). In the second year this is usually followed by a loss in vigor of affected plants and their failure to flower. The flower symptoms may vary from yellow streaks as in varieties Spic and Span (salmon), and Happy End (light red), bluish or silvery streaks as in Valeria, (scarlet), white blotches in Friendship (light pink), a fading from deep rose to white as in Elmer's Rose or even purplish flecks as in J. Wagnaar (dark red). Some varieties such as Mt. Index and Friendship also show CMV symptoms as a pitting of the corms. It is necessary to husk the corms to detect this. The losses from CMV have caused considerable concern to gladiolus growers.

Figure 1. Cucumber Mosaic Virus symptoms on Gladiolus leaves.

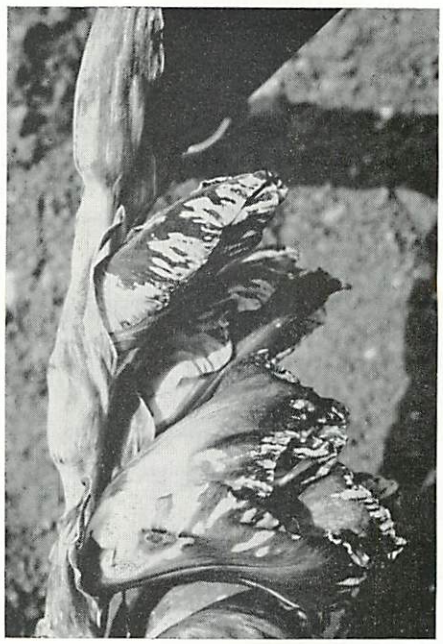

Figure 2. Cucumber Mosaic Virus causes streaking or color break in the flowers.

Cause of Disease

CMV, like other viruses, is a non-living, highly complex protein molecule capable of increasing in a host plant and causing a plant reaction as an infectious disease. CMV is carried in the corms and plants and is transmitted from plant to plant by aphid vectors. Plants infected with CMV cannot be cured nor can the virus be inactivated, removed, or killed by any easy means. Several species of aphid including the common green peach aphid, potato aphid, and cabbage aphid transmit CMV from diseased to healthy plants. As they suck out the sap from a virus infected plant they bring the virus into their bodies. When they feed on another plant they inject the virus carrying probe into the next plant and infect it. These aphids usually do not stay on the same gladiolus plant very long but feed on one plant and then another. This makes it difficult to kill them fast enough to prevent their visiting several plants before dying.

Other plant viruses can be transmitted by handling the plants or by other insects such as leaf hoppers which transmit the aster yellows that affects asters, chrysanthemums, and occasionally gladiolus.

The CM virus can be carried over-winter in many

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*This article is based to a large extent on conversations between the author and George V. Johnson, Floyd F. Smith, and Philip Brierley of the U.S.D.A. Agricultural Research Service who are cooperating on the CMV research project.

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reported here.

A Percentage Conductivity value indicative of slight injury was not easily obtained. This was apparently due to variations in the control treatment. It is noteworthy that an increase in Percentage Conductivity values was always found when the growth was reduced.

The Percentage Conductivity values discussed here are applicable to stored rose stem or root sections. Further experiments measuring the growth of entire plants are necessary before the growth of entire plants can be predicted. It also seems very likely that the Percentage Conductivity technique used here could be shortened considerably, making it a more practical technique.

It seems quite likely that the Percentage Conductivity test could be developed into a very useful tool to determine the practical possibilities of new storage procedures, shipping methods, etc. It would also make a very useful grading procedure and could insure the quality and viability of dormant roses.

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Cucumber Mosaic Virus

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native perennial and woody plants. The next season aphids pick up the virus and transmit it to gladiolus or to healthy vegetables such as celery or potato where it builds up in amounts and serves as a ready source for aphids to transmit to gladiolus. Of course, gladiolus plants from infected corms are a ready source of virus.

Control Measures

The CMV is spread by aphids from gladiolus to gladiolus or from some other plants to gladiolus. There are several probable methods of controlling the disease none of which are easy nor can good results be guaranteed.

The first step in controlling CMV is to plant healthy stock isolated from contaminated gladiolus plants. Healthy corms are not readily selected from lots that have some virus in them because of the time required for CMV virus symptoms to show up. Corms grown from cormels (even from infected corms) under conditions where aphid spread is not a factor—such as in a cloth house—often produce healthy plants which could be selected for further propagation. CMV does not readily travel from the plant into the newly forming cormels.

Plant gladiolus corms in areas as remote as possible from old market gardens, suburban gardens, fence rows, or ditch banks, where there is a likely reservoir of CMV in perennial plants. The most favorable areas are those isolated by substantial barriers of grassy plants, particularly corn and sorghum. These plants rarely become infected by CMV and in addition grain aphids are relatively poor vectors of CMV.

Roguing or the removal of contaminated plants can be helpful under conditions where there is very little or no further spread of the virus. Symptoms may show up after a variable interval of time after inoculation. The flower symptoms can show up from an early season infection but foliar symptoms from all but an early infection may not show up until the following season. This makes it difficult to rogue in a field where there is continuous spread by aphids and especially if flower spikes are cut before the virus can be detected. However, where spread is not rapid and plants are allowed to flower, roguing could reduce the percentage of infected plants. Dr. Forsberg in Illinois (1) was able to reduce the percentage of CMV from 22 to 2% by roguing.

Reducing the aphid population with a good spraying program should reduce the chances of spreading CMV. It would be necessary to spray often enough to get good coverage on the newly formed succulent leaves.

Other Viruses

Bean Yellow Mosaic is a common virus in gladiolus. It is readily spread to and is much more harmful to plantings of snap beans than gladiolus. The symptoms on gladiolus are light and dark green angular mottling especially in younger leaves. This can best be seen when looking through a leaf to the sun. Flower symptoms are a variable streaking of lighter or darker tones of color depending upon the variety. Usually the flower break is not sufficient to reduce the value of flowers and yield is not appreciably affected by Bean Yellow Mosaic so gladiolus growers are not much concerned about it.

Aster Yellows is a relatively rare virus disease of gladiolus in the Eastern U. S. although it is quite common on many Composite plants. The symptoms are green flowers the first year, many weak sprouts on the corms the next spring followed by grassy growth. The leaf hoppers that transmit the virus do not normally feed on gladiolus in the humid east so spread is usually not a problem. However, in the west in dry areas the leaf hoppers may be attracted to irrigated gladiolus fields. Discarding diseased plants gives good control.

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YOUR EDITOR,

Bob Langhans

Flashing Light

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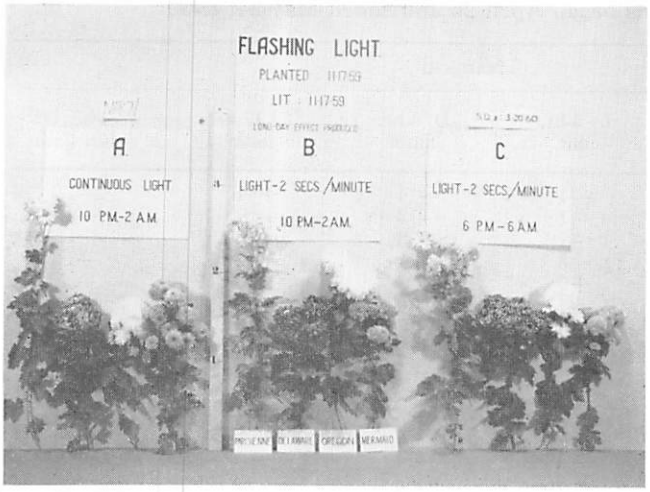

Figure 3: A comparison of the delaying effect of (A) continuous light for 4 hours, (B) flashing light for 4 hours, and (C) flashing light for 12 hours on flower development of the chrysanthemum varieties Parisienne, Delaware, Oregon and Mermaid (left to right).

to be the case. Nevertheless, even where the proportion of the lit period during the light break has to be increased 4 or 5 times the saving in power costs is still large.

Flashing Light with 16 Varieties of Chrysanthemum

The importance of intensity when using intermittent light was emphasized by Kenneth Post (6) 20 years ago, when he summarized the work of Hume (5), published in 1940. Recent work which further demonstrated its significance (2, 3, 4, 10, 11, 12) was still to be completed and published elsewhere when a trial was begun at Cornell in 1960 to obtain more information on varietal responses to flashing light.

The chrysanthemum varieties which were used, together with their response groups, are listed in Table 3. There were 12 plants of each variety per treatment, except in the case of Oregon, Fred Shoesmith and Balcombe Perfection, where 6 plants per treatment were used. The 16 varieties were chosen and provided by Yoder Brothers as representing varying degrees of response to supplementary light for maintaining them in a vegetative condition. Varieties such as Lipstick and White Pink Chief are known to produce crown buds occasionally even under conventional methods of providing long days.

Rooted cuttings were planted in a greenhouse with a night temperature of 60°F on April 26, 1960. The following treatments were begun at once:

(A) 9 hours of natural daylight, from 8 am until 5 pm, as a control,

(B) natural daylength,

(C) 9 hours of daylight, plus 4 hours of continuous supplementary light, from 10 pm until 2 am,

(D) 9 hours of daylight, plus 8 minutes of supplementary light, applied for 2 seconds per minute, from 10 pm until 2 am,

(E) 9 hours of daylight, plus 24 minutes of supplementary light, applied for 2 seconds per minute, from 6 pm until 6 am, and

(F) as for (D), except that the intensity of the supplementary light was reduced from 10-20 foot-candles to 3-7 foot-candles.

The supplementary incandescent light for Treatments C, D, and E was provided by 60-watt lamps, arranged and operated as already described. Forty-watt lamps were used to provide the light of reduced intensity for Treatment F. Black cloth was used to shade all the benches, except that of Treatment A (natural daylength), from 5 pm until 8 am, allowing these treatments 9 hours of natural daylight per day. With Treatment A, natural daylength in Ithaca from the start of the treatments on April 26, until they ended on May 24, varied from about 14 hours 55 minutes to 16 hours 5 minutes (7). An electronic counter was used to indicate any failure of the flashing equipment.

When the 4-week treatments ended all plants were given short days of 9 hours' duration to induce flowering. Records were kept of plant development.

Results

Table 3 shows the number of short days by which the average flowering time for each variety differed from that indicated by its response group, following the daylength treatments. Comparison with Table 4, which shows the height at which each variety flowered, demonstrates the relationship between flowering *time* and flowering *height*. It can be seen that where a variety flowered prematurely, due to an insufficient quantity of light to keep it vegetative, it generally did so with a stem length considerably less than that of the control. In such a case, therefore, not only was flowering incorrectly timed, but the market grade was reduced by insufficient length of stem. The control plants, under short days from the start so that flowering was not delayed, all flowered within a few days of what would be expected of the respective response to which each variety belonged, and all did so on very short stems.

Comparing the effect of the light treatments, Tables 3 and 4 show that, with few exceptions, 24 minutes of light applied as flashes during a 12-hour period was as effective in delaying flowering and providing satisfactory stem length as the conventional 4 hours of continuous illumination. The only varieties which flowered a week or more earlier under the 12-hour flash than they did under 4 hours of light (and reflected this in short stems) were Lipstick, White Pink Chief and Mermaid. These are 7-, 8- and 10-week varieties, respectively. Among the other varieties the greatest variation in flowering time between the two treatments was no more than 3 days.

Comparing the effect of 8 minutes of light, provided by the flashing light during a 4-hour period, with continuous illumination during the same 4 hours, Table 3 shows us that it, too, was as effective with the great majority of varieties used as the continuous light-break. The varieties which flowered about a week earlier under the flashing light were Lipstick, White Pink Chief, Mermaid and Balcombe Perfection, and their earlier flowering resulted in the shorter stems shown in Table 4. Of the remaining varieties, again, none was more than 3 days earlier in flowering than those under the continuous light.

All 3 of the supplementary light treatments discussed so far, except in the case of 4 "questionable" varieties

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Table 3: The number of days by which time of full bloom of 16 chrysanthemum varieties varied from that of their response groups following 6 daylength treatments. Treatments began April 26 and ended May 24, 1960.

Variety	Response Groups (weeks)	Treatment					
		A. 9-hr. day	B. Natural day	C. 4-hr. cont.	D. 4-hr. flash	E. 12-hr. flash	F. 4-hr. low-int. flash
Lipstick	7	+ 3	— 7	—1	— 4	+ 1	—17
White Pink Chief	8	+ 2	—11	—1	—13	— 9	—24
Bluechip	9	+ 4	— 5	—1	— 8	— 5	—11
Good News	9	+10	— 3	—8	— 1	— 2	—17
Indianapolis White	9	+ 2	—12	+9	— 8	— 3	—25
Beauregard	10	+ 4	— 8	—1	—10	—10	—19
Dark Orchid Queen	10	— 1	—10	—5	—10	— 7	—20
Iceberg	10	+ 5	— 8	—1	— 2	— 8	—14
Mermaid	10	0	— 1	—4	— 7	— 8	—24
Oregon	10	+ 4	— 4	—7	— 7	— 4	—19
Shasta	10	+ 3	—12	—7	— 8	— 8	—17
Whitetop	10	+ 4	— 8	—7	— 7	— 8	—13
Yellow Delaware	10	+ 3	— 1	—1	— 1	— 1	— 7
Fred. Shoesmith	10	+ 3	— 1	—1	— 5	— 1	—12
Balcombe Perfection	11	+ 6	— 1	—7	— 8	— 1	—15
Bonnaffon Deluxe	11	— 8	— 8	—7	— 8	— 8	—26

Table 4: The average flowering height in inches of 16 chrysanthemum varieties, following 6 daylength treatments. Treatments began April 26, and ended May 24, 1960.

Variety	Response Group (weeks)	Treatment					
		A. 9-hr. day	B. Natural day	C. 4-hr. cont.	D. 4-hr. flash	E. 12-hr. flash	F. 4-hr. low-int. flash
Lipstick	7	8	16	21	18	17	10
White Pink Chief	8	21	37	39	28	32	20
Bluechip	9	20	38	38	35	36	28
Good News	9	18	31	31	25	30	18
Indianapolis White	9	18	31	29	24	29	20
Beauregard	10	26	33	39	36	36	28
Dark Orchid Green	10	22	30	32	27	31	24
Iceberg	10	29	40	40	35	38	36
Mermaid	10	12	21	23	19	21	14
Oregon	10	11	21	25	19	22	16
Shasta	10	28	43	43	42	40	32
Whitetop	10	29	41	40	35	40	35
Yellow Delaware	10	12	22	23	22	23	19
Fred. Shoesmith	10	22	30	29	20	27	22
Balcombe Perfection	11	19	25	31	21	27	19
Bonnaffon Deluxe	11	14	21	23	21	23	17

already mentioned, were comparable with the natural long-day treatment, both as regards flowering time and stem length. Figures 4, 5 and 6 show the varieties Lipstick, Bonnaffon Deluxe and Yellow Delaware as they appeared in the short-day, 4-hour continuous and 4-hour flash treatments, respectively, on July 1, 5½ weeks after the treatments ended.

However, where the intensity of the flashing supplementary light was reduced from 10-20 to 3-7 foot-candles, it was found to be ineffective in preventing flower bud initiation in any variety for the full 4 weeks of its application. Results in terms of both flowering time and stem length were similar to those obtained without supplementary light, where the plants were under short-day conditions all the time. Nevertheless, varietal variation is again shown by Tables 3 and 4, since even this weak light was sufficient to delay flowering (as compared with the short-day treatment) in Yellow Delaware and Bluechip for 18 and 13 days, respectively. Other varieties were delayed for shorter periods, and Lipstick, White Pink Chief, Mermaid and Balcombe Perfection were delayed for only 8, 2, 4, and 7 days, respectively. This corresponds with the difficulty found in keeping these varieties vegetative with flashing light of higher intensity.

Conclusions

Intermittent light of 10-20 foot-candles' intensity, applied for 2 seconds each minute during either a 12- or 4-hour period in the middle of the night, was sufficient to keep all but 4 of 16 chrysanthemum varieties vegetative. Included in these 4, White Pink Chief has since been described by Waxman (11) as a "questionable" variety. Subsequent work (2, 3) has shown that, at an intensity of

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Figure 4: Varieties Lipstick, Bonnaffon Deluxe and Yellow Delaware (front to rear) under 9-hour days (treatment A), as they appeared on July 1, 5½ weeks after treatment ended.

Figure 5: Varieties Lipstick, Bonnaffon Deluxe and Yellow Delaware (front to rear) previously under 4 hours of continuous supplementary light (treatment C), as they appeared on July 1, 5½ weeks after treatment ended.

Figure 6: Varieties Lipstick, Bonnaffon Deluxe and Yellow Delaware (front to rear) previously under 4 hours of flashing supplementary light (treatment D), as they appeared on July 1, 5½ weeks after treatment ended.

5 foot-candles, White Pink Chief required light for 20% of the illuminating time to keep it vegetative, while Mermaid, another of our problem varieties, required light of the same intensity for as much as 40% of the time.

Although so few varieties exhibited differences in response when light of an intensity of 10-20 foot-candles was flashed for 3.3% of the time, this was *not* the case when the light intensity was reduced to 3-7 foot-candles. Even with the varieties which were most sensitive to light, flowering was delayed until a date no later than 7 days to that previous indicated by the appropriate response group.

As a result of these and the other experiments to which we have referred, it seems obvious that the intensity of flashing light should not fall below 20 foot-candles, and for safety the duration of the flashes should be at least 5% of the time during which supplementary light is normally used. We now know (4) that with chrysanthemums this proportion of lighted time can be applied not only at 1-minute intervals, but also at any interval up to one of half-an-hour. The critical, apparently, is less than 1 hour. With the varieties White Pink Chief and Mermaid the lit portion should be 20% and 40%, respectively, of the normal period during which the lights are used. In time it should be possible to classify all the commonly-grown chrysanthemum varieties according to the minimum amount of light energy required to keep them in a vegetative condition.

Flashing Light with Begonias

The use of flashing light was widened in 1960 to include the begonia, a genus which contains both long- and short-day species and hybrids. In 1942 Kenneth Post (6) reported the use of light to lengthen the day and delay the flowering of the short-day species *B. socotrana*, but an intensity of 10 foot-candles was found to be insufficient. Later experiments, in which an intensity of 50 foot-candles was used, prevented flowering almost entirely (7).

Ten plants per treatment of the following types of commercially-grown begonias were used:

(1) *Begonia socotrana* (the Christmas begonia)—a semi-tuberous species, which initiates flower buds during short days (6),

(2) *Begonia* var. Dutch Hybrid—a cross between *B. socotrana* and *B. tuberhybrida*, which is semi-tuberous, and initiates flower buds during long days, and

(3) *Begonia rex*—a rhizomatous species, grown for its foliage. Its flowering response is a specific one in that it initiates flowers in the spring and fall, when natural daylight is about 12 hours (6). It produces vegetative growth in long days, while under extended periods of short days it produces tubers, even on the stems and among the foliage.

The plants were growing in 5-inch clay pots, and were selected for uniformity of size and development. With the exception of *B. rex*, all the plants were already in flower when placed in a greenhouse with a night temperature of 60°F. On January 21, 1960, treatments A–E, previously described, were begun. The treatments ended on May 16, 1960, and during this time the natural daylength in Ith-

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aca varied from about 10 hours and 50 minutes to about 15 hours and 45 minutes (7). Black cloth was used to shade all the benches expect that of Treatment B (natural daylength) between 5 pm and 8 am.

Results

Since all plants except those of *B. rex* were in flower when the treatments began it was found most convenient to record growth differences by photographing representative plants 9 weeks after the start of treatments, and again at the conclusion of the trial, a further 8 weeks later. The 3 types of begonia responded as follows:

(1) *B. socotrana*—Figure 7 shows representative plants 9 weeks after treatments began. Since all the plants were of similar size at the start the effects of the long-day treatments, C, D and E were already becoming apparent. Vegetative growth under the flashing light was as good as, if not better than, that under the continuous light. Figure 8 shows plants after 17 weeks of treatment, when the growth differences were much more pronounced. Plants under the 4-hour flashing light were comparable with those under 4 hours of continuous supplementary illumination, while those which were under 12 hours of flashing light had ceased flowering altogether and had made vigorous vegetative growth. Plants under the short days and natural daylength had borne many flowers at the expense of vegetative growth, which was very restricted. However, in the case of the natural plants, vegetative growth can be seen to be increasing at this time as a result of the lengthening of the natural photoperiod.

(2) *Begonia* var. *Dutch Hybrid*—Figure 9 shows representative plants 9 weeks after the treatments began. More vigorous growth of both flowers and foliage was being made by plants under the long-day treatments than by those under the natural photoperiod and, more particularly, by those under short days. Figure 10 shows plants after a further 8 weeks of treatment, when the grow differences were still more pronounced. But by this time it can be seen that the plants (being long-day responders) were exhibiting characteristics opposite to those of the Christmas begonia. In this case the plants which had been under short days had ceased producing flowers, while those under all the light treatments had made 3 or 4 times as much vegetative growth, in addition to producing numerous flowers.

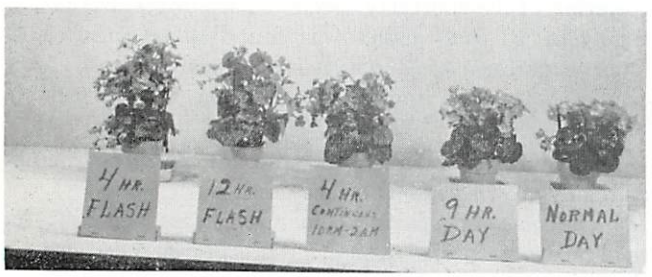

Figure 7: A comparison of growth made by *Begonia socotrana* under flashing light for 4 hours, flashing light for 12 hours, continuous light for 4 hours, natural light for 9 hours, and natural daylength (left to right), after 9 weeks of treatment.

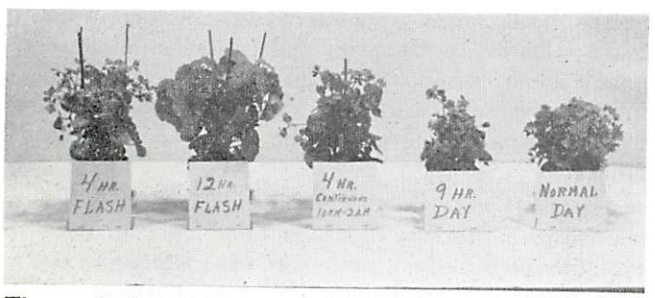

Figure 8: A comparison of growth made by *Begonia socotrana* under flashing light for 4 hours, flashing light for 12 hours, continuous light for 4 hours, natural light for 9 hours and natural daylength (left to right), after 17 weeks of treatment.

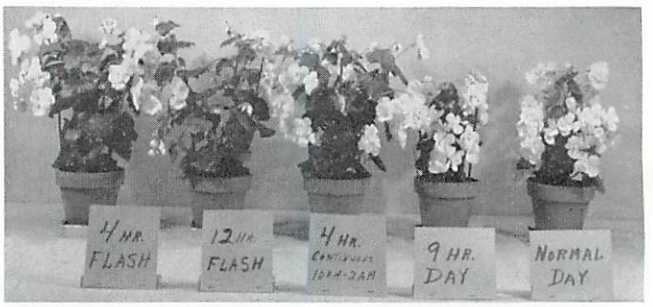

Figure 9: A comparison of growth made by *Begonia* "Dutch Hybrid" under flashing light for 4 hours, flashing light for 12 hours, continuous light for 4 hours, natural light for 9 hours, and natural daylength (left to right), after 9 weeks of treatment.

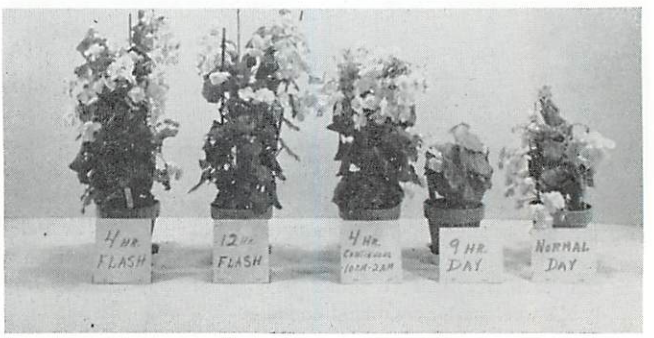

Figure 10: A comparison of growth made by *Begonia* "Dutch Hybrid" under flashing light for 4 hours, flashing light for 12 hours, continuous light for 4 hours, natural light for 9 hours, and natural daylength (left to right), after 17 weeks of treatment.

(3) *B. rex*—Figure 11 shows plants 9 weeks after the treatments began, and it can be seen that the amount of vegetative growth being made by plants under the light treatments was approximately twice that of being made by the short-day plants. Figure 12 shows plants 8 weeks later when the treatments ended, and the lighted plants had leaf areas about twice as great as those of the plants under short days. The lighted plants were in flower, but the rather inconspicuous blossoms canot be seen in the photograph.

Conclusions

Begonias responded well to flashing light. Its application for a total of only 8 minutes during the night pro-

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Figure 11: A comparison of growth made by *Begonia rex* under flashing light for 4 hours, flashing light for 12 hours, continuous light for 4 hours, natural light for 9 hours, and natural daylength (left to right), after 9 weeks of treatment.

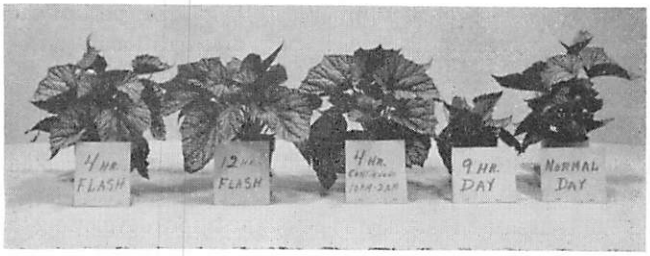

Figure 12: A comparison of growth made by *Begonia rex* under flashing light for 4 hours, flashing light for 12 hours, continuous light for 4 hours, natural light for 9 hours, and natural daylength (left to right), after 17 weeks of treatment.

duced growth and flowering effects equal to those induced by 4 hours of continuous light. With the short-day species leafy growth was produced at the expenses of flowers, while with the long-day hybrid both vegetative and reproductive growth were vigorous. While flower inhibition with *B socotrana* had not been achieved by extending the natural daylength with 10-foot candles of continuous light (6) although it had been accomplished at an intensity of 50 foot-candles (7), *interruption* of the night with flashing light only 10-20 foot-candles in intensity was perfectly satisfactory, provided the treatment was continued for 3 or 4 months.

This points the way to an effective and extremely economical method of bringing long-day begonia varieties into bloom through the winter. It also makes possible the production of propagating material by short-day varieties during the winter. The use of flashing light over the stock plants, and over cuttings in the propagating benches, would be an inexpensive means of increasing Christmas begonias throughout the year.

Of particular interest would be the production of plants of *B. rex* of excellent quality during the winter months, when the intensity of natural daylight is such that there is no need to shade the plants to prevent foliage scorch. Again, a total of only 8 minutes of low-intensity light per night is necessary for the production of large, healthy plants.

We now know of a considerable number of ways in which the use of flashing light can be of advantage to the commercial flower grower. It provides us with a low-cost method of modifying growth and flowering in a wide variety of plants. It can be used to increase stem length in Easter lilies (8, 9), flowering dogwood and weigela (11, 12), and vegetative growth in *Begonia rex*. Flashing light can be used to inhibit flowering in short-day plants such as the chrysanthemum (2, 3, 4, 11, 12), poinsettia and Christmas begonia, and to induce flowering in long-day plants such as China aster, larkspur (5), cornflower, feverfew, petunia and Dutch Hybrid begonia. There seems to be little doubt that trials with other florist crops will widen this list further as time goes on.

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A further article, listing the current grower recommendations for all the florist crops so far tested under the flashing light, will be presented in a future issue of the Bulletin.

The New York State Extension Service Snapdragon School

Carl F. Gortzig
Associate County Agricultural Agent
Erie County, New York

The New York State Extension Service Snapdragon School, a cooperative educational effort of the New York State Extension Service and County Extension Services throughout the state, was held June 26-28, 1962 at the Erie County Farm and Home Center, East Aurora. More than 150 commercial snapdragon growers, salesmen, Extension specialists, county agricultural agents and others joined in discussions of the crop.

The thorough coverage of the event in the various trade magazines and Extension Service News publications has given the detailed story of speakers and programs. Rather than review the program details again, we would like to take this opportunity to reflect on the role of crop schools such as the "Snap" School in the management of New York State flower production operations.

The Snapdragon School was the second of a series of crop schools planned by the New York State Extension Service. The series was initiated with a Carnation School held in Massapequa, Long Island, in March, 1961. These schools were planned in response to today's increasingly intensive competitive situation—a situation which re-

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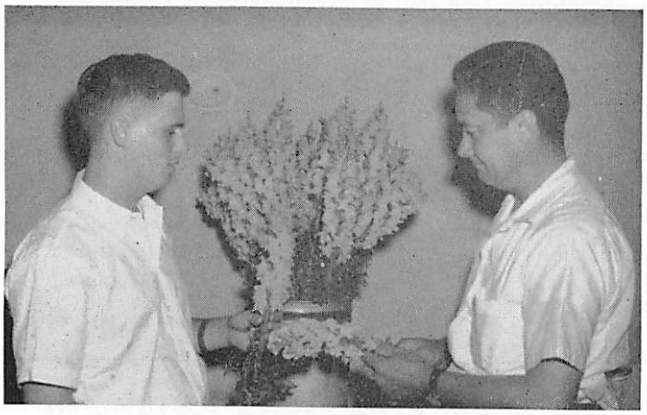
quires that the producer not only be thoroughly familiar with crop technology but also that he be able to constantly analyze his operation to determine how such technology may be applied to decrease costs and to increase operational efficiency. Indeed, command of such knowledge is essential if the grower is to keep his "head above water." Crop schools, and other educational activities in our industry, can no longer be viewed by growers as "a couple of relaxing days away from the business." Today's competitive business climate requires growers to consider such activities as management musts. How else can one hope to keep abreast of new developments and trends?

The "meetin' season" is upon us. Have you included in your management planning, participation in at least one meeting or short course this fall or winter? If not, we urge you to give some thought to it. After all, "the future belongs to those who plan for it."



Prof. John Seeley discusses new snapdragon varieties with, left David Mischler of Mischler's Florists, Williamsville, Chairman, Erie County Extension Service Floriculture Commodity Committee.

Much chatter took place at the Snapdragon School variety display as participants viewed over 60 varieties.

Poinsettia Day - November 29

At the Ohio Agricultural Experiment Station
Wooster, Ohio

A whole day will be spent discussing Poinsettia research and problems. For reservations, write Dr. R. O. Miller at the Experiment Station.

What Is A Cultured-Indexed Geranium?

Jim Boodley

What is a cultured-indexed geranium? Why should I grow them? Both of these questions are being asked more and more frequently by growers of geraniums.

Let's take the first question in this manner. After generations of very careful selection and roguing of culls a few geranium stock plants are selected. This selection is made on the basis of early flowering, floriferousness or many flowers produced and most importantly, freedom from visible symptoms of disease.

Terminal cuttings are removed from these plants. By laboratory techniques, a thin slice of the basal part of the stem is removed and placed in a special treatment. After the proper period of time, the culture dishes are examined for signs of bacterial growth. If the culture is disease free, then the cutting, from which it was taken and had been stored during the period of testing, is rooted under sterile conditions. The plants produced from these cuttings are used as a nucleus block for developing a "mother block."

The culturing procedure is an exacting technique that requires special equipment. It is a procedure that should be left to the specialist and not undertaken by the average grower.

The culture-indexing eliminates plants that have the bacterial stem-rot organism and the root rot organisms including the black leg fungus, *Pythium*. Virus diseases are not eliminated.

The fact that geraniums are cultured-indexed does not mean that the plants are resistant to bacterial stem rot or root rots. If sloppy production procedures are used, the disease organisms can be introduced to the plants and the benefits from culture-indexing will be lost.

Not all geraniums are cultured-indexed. At the present time only a few sources of supply are available.

The second question, "Why should I grow them?" can be answered only by the grower himself. He must consider whether he can include these plants in his present program. If a grower goes into cultured-indexed plants, then he should make the change 100%. It is not good to combine uncultured plants with disease-free ones because of contamination possibilities.

The grower must realize that there is somewhat more cost involved per cutting. However, this cost is extremely small since cultured cuttings are used for stock plant purposes only from which the production cuttings are taken.

Disease-free geraniums root extremely rapidly and produce a flowering plant in a much shorter period than has been possible. This means less time in growing the plants, thus a tremendous saving in labor, heat, etc. Losses are at a minimum, so profits are maximum.

In This Issue

- Some Practical Applications of Flashing Light
- The New York State Extension Snapdragon School
- What is a Cultured-Indexed Geranium?

YOUR EDITOR, BOB LANGHANS