Fluorescent Lights for Starting and Growing Plants

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As reported in N. Y. S. F. G. Bul. 189, it was found that under an 18 hour day provided by 4, 4-foot, 40-watt, warm white fluorescent tubes, plants placed 6-inches from the light source were superior to those started in the greenhouse. Since this study was reported, additional trials have been conducted using combinations of fluorescent light sources and also commercially available fluorescent tubes specifically designed for plant growth.

The results of these studies are of particular value to bedding plant growers for starting plants. The results might also prove valuable for other horticultural uses.

Three varieties of petunias—Alaska, High Noon and Midnight Blue were sown August 2, 1962 to a uniform soil mixture in plastic packs, 5 x 6⅝ inches in dimension. A single variety of Begonia semperflorens and Salvia, Early Brilliant Red were sown July 12, 1962.

The plastic packs were watered thoroughly, placed in polyethylene bags, and placed in the experimental treatments.

The experimental treatments, with the exception of the greenhouse treatments, were fluorescent light sources. Four foot, 40-watt fluorescent tubes were placed 8-inches above the containers. The tubes were spaced one-inch apart in commercial reflectors. Two reflectors, that contained a total of eight tubes were used to light a 30-inch wide bench. The daylength under the lamps was controlled by time clocks to provide 16 hours of light. A temperature range of 68-75°F was maintained.

The greenhouse grown plants were placed in a 60 night, 70 day temperature greenhouse and received the natural light intensity and day length that prevailed.

The treatments are listed in Table 1.

As soon as the cotyledon leaves developed, the plastic bags were removed from the containers and the plants continued in the treatments.

On August 22, the seedlings were transplanted to 2¼ inch plastic pots. Six plants were selected for growing on under the various light treatments. The plants received normal greenhouse cultural procedures.

September 15 the plants were evaluated and repotted to 3 inch plastic pots.

On October 3, 1962, eight weeks after sowing the experiment was terminated and the plants evaluated. Rec-

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ords of height, number of buds and flowers, and fresh weight were taken. The plants were photographed to show the differences in treatment (Figs. 1, 2, 3, 4, 5).

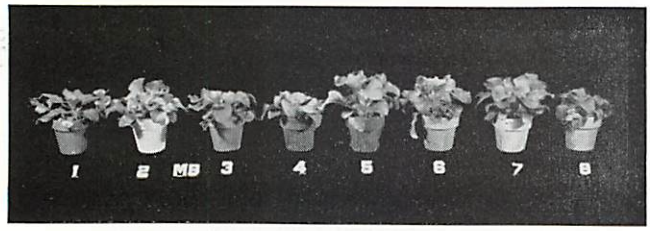

Fig. 1. Petunia variety Midnight Blue grown in eight light treatments. Sown 8-2-62; transplanted to 2¼ inch pots 8-22; transplanted to 3 inch pots 9-15. Photographed 10-3-62.

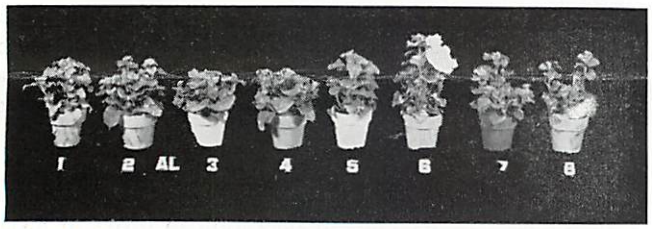

Fig. 2. Petunia, variety Alaska Giant grown in eight light treattreatments. Sown 8-2-62; transplanted to 2¼ inch pots 8-22; transplanted to 3 inch pots 9-15. Photographed 10-3-62.

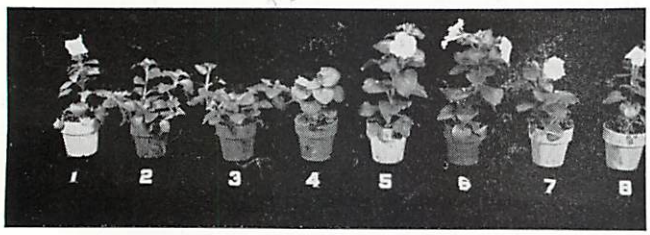

Fig. 3. Petunia, variety High Noon grown in eight light treatments. Sown 8-2-62; transplanted to 2¼ inch pots 8-22; transplanted to 3 inch pots 9-15. Photographed 10-3-62.

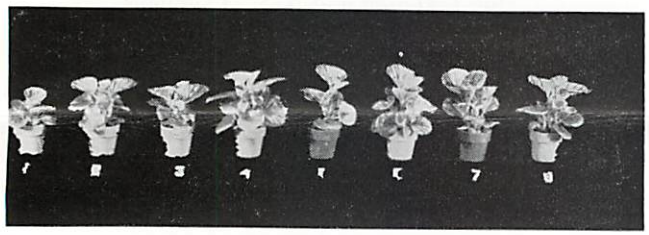

Fig. 4. Begonia semperflorens grown in eight light treatments. Sown 7-12-62; transplanted to 2¼ inch pots 8-22; transplanted to 3 inch pots 9-15. Photographed 10-3-62.

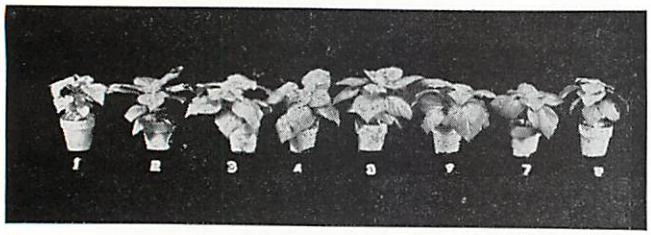

Fig. 5. Salvia, Early Brilliant Red, grown in eight light treatments. Sown 8-2-62; transplanted to 2¼ inch pots 8-22; transplanted to 3 inch pots 9-15. Photographed 10-3-62.

Table 1. Light sources of eight treatments

Treatment No.	Light Source
1	Natural light (Greenhouse)
2	Warm white fluorescent
3	Cool white
4	Gro-lux I (Sylvania)
5	Mark VI (Sylvania Experimental Lamp)
6	Combination natural white fluorescent and daylight fluorescent
7	Plant-gro (Westinghouse Experimental Lamp)
8	Combination warm white and cool white fluorescent

Lamps in combination were alternated in the fixtures

Results

The results of the study showed wide differences in plant response to the various light sources. The data recorded are reported on the basis of the plants used as test subjects. For petunias, the number of breaks and the fresh weight are of greatest significance. The maximum height measurements frequently indicated a single leader type of development. This habit of growth is not desirable for petunias.

Average number of breaks:

Midnight Blue: Cool white, greenhouse and warm white were the three best treatments, Table 2. The averages were 4.5, 4.3 and 4.2 breaks respectively. Gro-Lux I and Mark VI treatments were the poorest with 1.2 and 1.5 breaks respectively.

Alaska Giant: For this variety, Gro-Lux I, cool white and the plant-gro treatments were best with an average of 5.8, 5.5 and 5.2 breaks respectively. Mark VI and the combination of cool white and warm white were poorest with 3.5 and 3.2 respectively.

High Noon: The cool white treatment with 10.3 breaks was superior to any other treatment. Next best performance was obtained with the warm white light, 3.8 breaks. The poorest treatment was the Mark VI lamp with an average of 1.0 breaks. This was a single leader type growth. Second poorest was the greenhouse environment with 1.5 breaks.

Table 2. Effect of eight light sources on the average number of breaks on three petunia varieties. Averages of six plants.

Treatment	Mid. Blue	Alaska Gt.	High Noon
1	4.3	3.8	1.5
2	4.2	4.7	3.8
3	4.5	5.5	10.3
4	1.2	5.8	2.0
5	1.5	3.5	1.0
6	2.3	4.3	2.0
7	3.3	5.2	3.2
8	3.7	3.2	3.2
Avg.	3.1	4.5	3.4

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Fresh Weight: The criterion of fresh weight gives an indication of the maximum growth obtained during the course of the study. As with the average number of breaks, no specific light source could be indicated as superior for the crops. However, only a tenth of a gram difference in Midnight Blue prevented concluding that on the basis of fresh weight the combination natural white and day light lamps environment was the best. Examination of the data in Table 3 shows that for Begonia and Salvia the fresh weight of the plants produced under this light source was much higher than under any other light source.

Table 3. Effect of eight light sources on the average fresh weight (gms) of five annuals. Averages of six plants.

Treatment	Petunias			Begonia	Salvia
	Mid. Blue	Alaska	Gt. High Noon		
1	9.4	10.8	9.5	17.8	6.6
2	12.3	16.0	13.4	29.6	11.3
3	11.2	14.6	15.2	27.4	13.4
4	5.7	15.6	8.6	36.5	12.0
5	10.6	11.7	10.6	30.6	12.2
6	13.7	17.9	16.2	48.4	17.4
7	13.8	17.5	13.5	36.6	12.3
8	7.6	9.1	8.0	34.5	9.1
Avg.	10.5	14.2	11.9	32.7	11.8

Height: The figures on height are presented in Table 4. The results obtained varied with the light sources used. With petunias, maximum height is not considered the best since this is frequently due to a single leader type development. For the begonias and salvia, maximum height and fresh weight would indicate the best plants developed.

Table 4. Effect of eight light sources on the average height (cms) of five annuals. Averages of six plants.

Treatment	Petunias			Begonia	Salvia
	Mid. Blue	Alaska	Gt. High Noon		
1	4.8	8.8	14.7	7.0	7.8
2	6.3	13.3	10.4	10.3	6.2
3	3.8	8.8	9.2	10.2	8.1
4	2.3	11.8	6.8	12.7	6.9
5	9.0	12.7	19.3	13.5	8.5
6	8.5	15.3	21.3	13.2	7.8
7	5.8	15.2	12.2	15.0	7.2
8	5.5	12.0	12.8	13.0	9.2
Avg.	5.8	12.2	13.3	11.9	7.7

Number of buds and flowers: For the petunias, the combination of daylight and natural white lamps resulted in the greatest number of buds and flowers produced (Table 5). This treatment was superior to the greenhouse treatment for Midnight Blue and Alaska Giant. High Noon produced the same number of buds and flowers in the greenhouse as in treatment 6, the daylight, natural white lamp combination.

General Observations

In all instances, regardless of the artificial light source

Table 5. Effect of eight light sources on the average number of buds and flowers on three petunia varieties. Average of six plants.

Treatment	Mid. Blue	Alaska Gt.	High Noon
1	0.8	5.0	5.5
2	1.5	1.0	1.0
3	1.0	1.0	0.2
4	0.0	1.2	0.0
5	0.8	1.7	3.2
6	1.7	6.5	5.5
7	0.0	4.0	2.7
8	1.7	3.0	4.2
Avg.	0.9	2.9	2.8

used, growth of the plants was exemplified by dark green, heavy foliage. Even though fertilized regularly, the greenhouse grown plants were chlorotic in appearance. This was undoubtedly due to the shorter days and reduced light, when cloudy weather prevailed, under which they were grown.

Conclusions

The use of artificial light for starting and growing plants is superior to the greenhouse environment during periods of limiting light intensity. By proper selection of fluorescent tubes, the quality of light used for irradiating the plants can be controlled. Intensity and duration of the light are controlled by the placement of the tubes the proper distance from the growing containers and the use of time clocks.

As opposed to a glass greenhouse where heat loss is substantial, any area can be used for starting the plants. Closed, insulated structures would result in large savings of heat required.

Although the results of this study showed variations in response to the different light sources used, the trend was for superior performance where a combination of natural white and daylight fluorescent lamps were employed.

The lamps should be placed 8-inches above the containers. A 16 hour day with temperatures of 65-70°F are recommended.

Although the plants in this study were grown to flowering stage it is suggested that commercial growers use the lights for starting annuals. The seed container should be placed in the light environment as soon as sown until ready for transplanting—two to three weeks after sowing. The usual precautions on transplanting should be taken.