Snapdragons and Calceolarias Gas Themselves

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If flowers fall from your snapdragons when you remove them from the box, or if flowers drop from your calceolarias when you unwrap them, perhaps they have "gassed" themselves with self-produced ethylene! You can correct this trouble by controlling the atmosphere in the package.

The evolution of ethylene gas from certain plant materials is a well established fact. English and American workers have shown that ethylene is given off by apples, bananas, pears, and avocados. The general effect of the gas produced is to stimulate ripening of the fruit. Denny and his co-workers at Boyce Thompson Institute found that ethylene gas or some similar material was produced by parts of some ornamental plants, including leaves of Rosa rugosa and calla, stems of peony and hollyhock, and petals of verbena, geranium and petunia.

The deleterious effects of ethylene gas on ornamentals are well known and have been summarized by Krone, Post, and others. Lumsden, of the U.S.D.A., mentioned that snapdragon blossoms in contact with very dilute ethylene gas at 36°F, 50°F, and 70°F were discolored and dropped more rapidly than flowers at similar temperatures but not exposed to ethylene. (The effect was more marked at higher temperatures.) Lindner, working at the University of Hawaii, found evidence of the production of a gaseous poison, presumably ethylene, by prepackaged flowers of Vanda (Joaquim) orchids. The gas caused self-injury characterized by a fading and wilting of the flowers. One bad flower appeared to generate enough toxin to cause the rest of the flowers in the pack to fade and wilt.

A Toxin from Calceolarias

To further investigate the possibility of production of poison gas by some of our commercial florist crops we started preliminary experiments using cut flowering stems of calceolaria as test material. Experiments conducted included: enclosure of flowers in airtight containers with natural air; with air that had initially been enriched with oxygen; and with air from which carbon dioxide was continuously removed. In addition, air circulation experiments were conducted. In one series, fresh air from the compressed air line was constantly passed through an airtight container of flowers, while in another, the enclosed air surrounding the flowers was constantly recirculated. In every experiment similar flowers were left standing in the open laboratory air for comparison.

The amount of flower drop was selected as the best criterion of experimental effect. After 3-4 days of treatment, drop was observed. The percentage flower drop, based on at least

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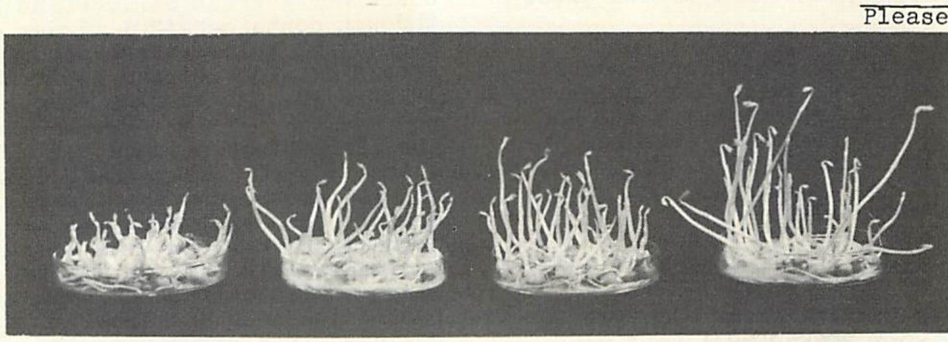

Small amounts of ethylene gas virtually stop the growth of pea seedlings and may cause bending of the seedling stems. The picture shows the effect of gas from various snapdragon treatments on repression of pea growth. The plates of peas were tested with (left to right) gas from snaps enclosed in container from which carbon dioxide was constantly removed; gas from snaps enclosed in container to which oxygen had been added; gas from snaps enclosed in container with natural air. The dish of seeds on the right was grown in plain air and showed the best growth.

* This experiment was suggested by Dr. Kenneth Post and carried out under his direction. His assistance and that of C. R. Gross, Department of Pomology, Cornell; Dr. Arthur Bing, Department of Floriculture, Cornell; and Dr. C. E. Williamson, Ornamentals Research Laboratory, Farmingdale, L. I., is gratefully acknowledged.

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three repetitions of each experiment, follows:

Treatment	Percent Flower Drop
Flowers in open laboratory air . .	0
Flowers in airtight containers - continuous fresh air flow through container.	17
Flowers in airtight containers - no air change.	44
Flowers in airtight containers - air continually recirculated . .	50
Flowers in airtight containers - carbon dioxide constantly removed.	56
Flowers in airtight containers - oxygen initially added	86

The results indicated that flowers were producing some toxic material which hastened their own flower drop. When the container was constantly swept by a stream of fresh air, flower drop was reduced in comparison to experiments where the container was sealed. Oxygen addition and carbon dioxide removal appeared to increase the flower drop. Both treatments probably increase respiration.

Snap Flower Drop

Two varieties of garden snapdragon and the greenhouse grown variety, Cheviot Maid, were used in the tests reported here. Since these varieties showed similar responses, we do not differentiate between them in this report. It is probable that there are differences in the response of other varieties to these treatments. Therefore, these results should not be considered typical of all snapdragons until more types have been investigated. Percentage flower drop was again used as the criterion of the effect of the treatment.

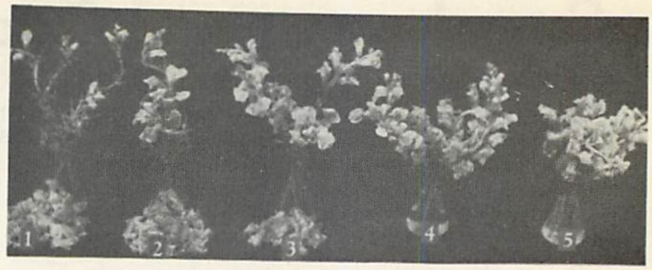
In addition to the experiments mentioned above for calceolarias, tests with snapdragons included more recirculation treatments and treatments in which brominated charcoal or plain charcoal was introduced in the containers. Also, airtight containers with added carbon dioxide were used.

Overcoming Effects of the Toxic Gas

Continually passing fresh air over the flowers effectively prevented flower drop. As little as 1/20 ounce of the brominated charcoal, when added to containers, was effective in preventing flower drop. However, the material caused wilting of the flowers. Dry ice, which raised the carbon dioxide content to 10-20 percent, reduced flower drop; but this treatment also was slightly detrimental, as used. Further tests will undoubtedly indicate safe and efficient means of utilizing these materials.

What We Think the Tests Mean

Snapdragons and calceolarias produce a toxic material, very probably ethylene. The effect of the gas is to cause flower drop of



The appearance of snapdragons at the conclusion of a representative experiment. Flowers that have dropped in individual treatments have been placed at the base of the spikes. The conditions to which the flowers had been subjected were: #1. Flowers in airtight container - carbon dioxide removed (96% drop). #2. Flowers enclosed in airtight container (60% drop). #3. Flowers enclosed in container - carbon dioxide added (18% drop). #4. Flowers enclosed in container - carbon dioxide removed - brominated charcoal added (1% drop). #5. Flowers enclosed in container - brominated carbon added (0% drop).

At the conclusion of an experiment (continued) #6. Flowers enclosed in container - internal air circulation - carbon dioxide removed (88% drop). #7. Flowers enclosed in container - fresh air continually passed through container (20% flower drop not shown here). #8. Flowers enclosed in container - carbon dioxide removed - air internally circulated through brominated charcoal (0% drop).

the plants that produce it. When the atmosphere is continually changed, apparently the gas is removed and the flower drop is only slight. However, when the air is merely internally circulated, the gas is not removed and many flowers drop. Tests with pea seedlings indicated that the material produced by the snaps is ethylene. Carnations, when enclosed in a container with snapdragons, showed a sleepy response and severe wilting. This is very similar to ethylene injury.

An increase in oxygen concentration or a decrease in the carbon dioxide caused greater flower drop. These treatments increase plant respiration, which in turn may increase the amount of toxin produced and finally increase the flower drop. Carbon dioxide added to enclosures lowered flower drop, probably because it decreased respiration. Adding carbon dioxide to a box or package of snaps may be a good way of overcoming flower drop. A better prevention may come through the introduction of brominated charcoal in the containers. Gross and Smock, of Cornell's

Pomology Department, have found that brominated charcoal will remove ethylene from apple storage air. We suspect that brominated charcoal has been effective in our work because it removed ethylene.

The table below summarizes percent flower drop observed in various tests. The treatments are listed in the order of their numerical appearance on the graph. In all treatments, with the exception of number 1, the flowers were enclosed in containers of about 1/5 cu. ft. capacity.

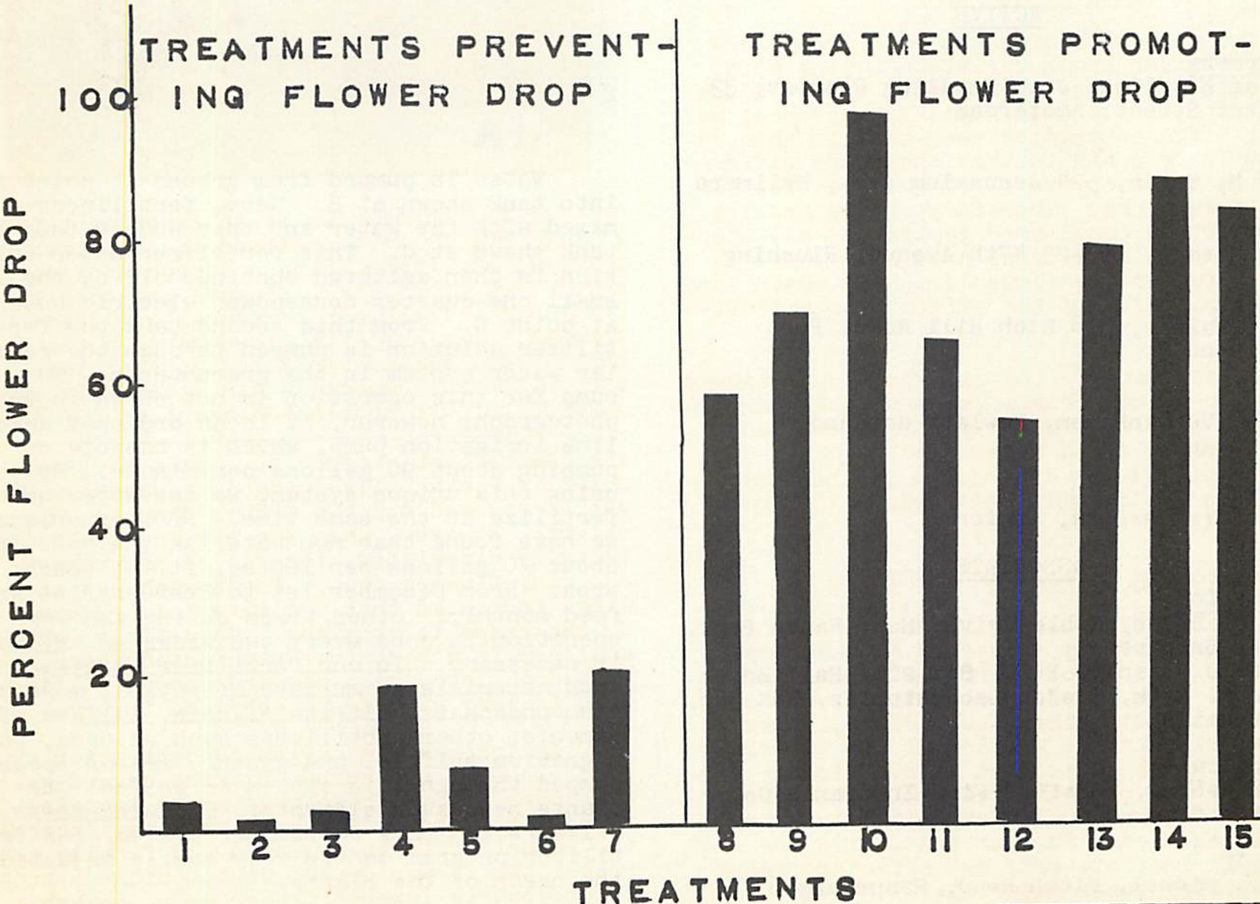
TREATMENTS PREVENTING FLOWER DROP

	% flower drop
1. Flowers in laboratory air	2
2. Brominated charcoal added on bottom of container	0
3. Carbon dioxide removed - brominated charcoal added on bottom of container.	1
4. Carbon dioxide added to container	18
5. Air internally circulated through brominated charcoal	6
6. Carbon dioxide removed - air internally circulated through brominated charcoal	0
7. Fresh air continually passed through container	17

TREATMENTS PROMOTING FLOWER DROP

	% flower drop
8. Flowers in airtight containers. .	60
9. Oxygen added to container	71
10. Carbon dioxide removed from container	96
11. Plain charcoal added on bottom of container.	68
12. Air internally circulated	55
13. Carbon dioxide removed - plain charcoal on bottom of container	79
14. Carbon dioxide removed - air internally circulated	88
15. Carbon dioxide removed - air internally circulated through plain carbon	83

Data from the above table is graphically presented. Treatment numbers on the graph correspond to those in the table.



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Summary

1. Snapdragons and calceolarias produce a toxic gas, probably ethylene.

2. The gas causes flower drop of the plant material that produces it. This is essentially a self-poisoning effect!

3. The gas causes a typical ethylene response with pea seedlings and also puts carnations "to sleep."

4. Flower drop increased when the oxygen content of the container was increased, or when the carbon dioxide content was reduced.

5. Flower drop was reduced when carbon dioxide was added to the container.

6. Additions of brominated charcoal to containers virtually prevented all flower drop. Plain charcoal was not effective in preventing or reducing flower drop.

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