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COOPERATIVE EXTENSION WORK
IN AGRICULTURE AND HOME ECONOMICS
U. S. Department of Agriculture
and the University of California Cooperating

Name of Project: Evaluation of Cut Flower Shipping Methods. County Project No. 213
County: San Diego

Leader: Seward T. Besemer, Farm Advisor

Cooperators: Clayton Emsbach, Harry Moore, Tak Muto, H. J. Niedens,
E. G. Thornton, Dr. Harry Kohl, Jr. (U.C.L.A.)

Project Conducted: June 19-26, 1960 at Cornell University.

PURPOSE: The San Diego cut flower industry depends to a large extent on out-of-state shipments for marketing its products. There is much conjecture on the part of growers and shippers concerning occasional failure of flowers to arrive in peak condition and maintain a normal keeping life at the eastern destination. This project was devised to coincide with the time that the farm advisor was planning to be at Cornell University.

OBJECTIVES: To receive, observe and evaluate the condition of flowers upon arrival and following arrival at Cornell University when shipped from Encinitas, California.

PROCEDURE: Six trial shipments by local growers and shippers at Encinitas were air-freighted to arrive at Ithaca, New York, during the week of June 19 to June 26, 1960. Shipments included comparison of containers, methods of packing, preconditioning of flowers by the grower or shipper, flowers cut at different stages of maturity, and various treatments to affect keeping life at Ithaca. Flowers were graded daily to record their decline in keeping life. Detailed procedure and results of each shipment follows.

BESMER 160

SHIPMENT #1A - Container Types - Corrugated Paper Hamper

Type of Flowers: Column Stock - white

Treatment by Shipper:

Flowers cut 6/16 at Oxnard, bought off L. A. market 6/17, refrigerated overnight 6/17, packed early 6/18, in shipment 6/18 and 6/19.

Treatments at Ithaca:

Unpacked 6/20, first graded 6/21 (6th day from harvest)

A1 (36 fls.) stems recut and crushed, plain water, room temperature (80° F)

A2 (36 fls.) stems not recut and crushed, " " " " " "

A1c (36 fls.) stems recut and crushed, plain water, 40° for 24 hours, then room temperature.

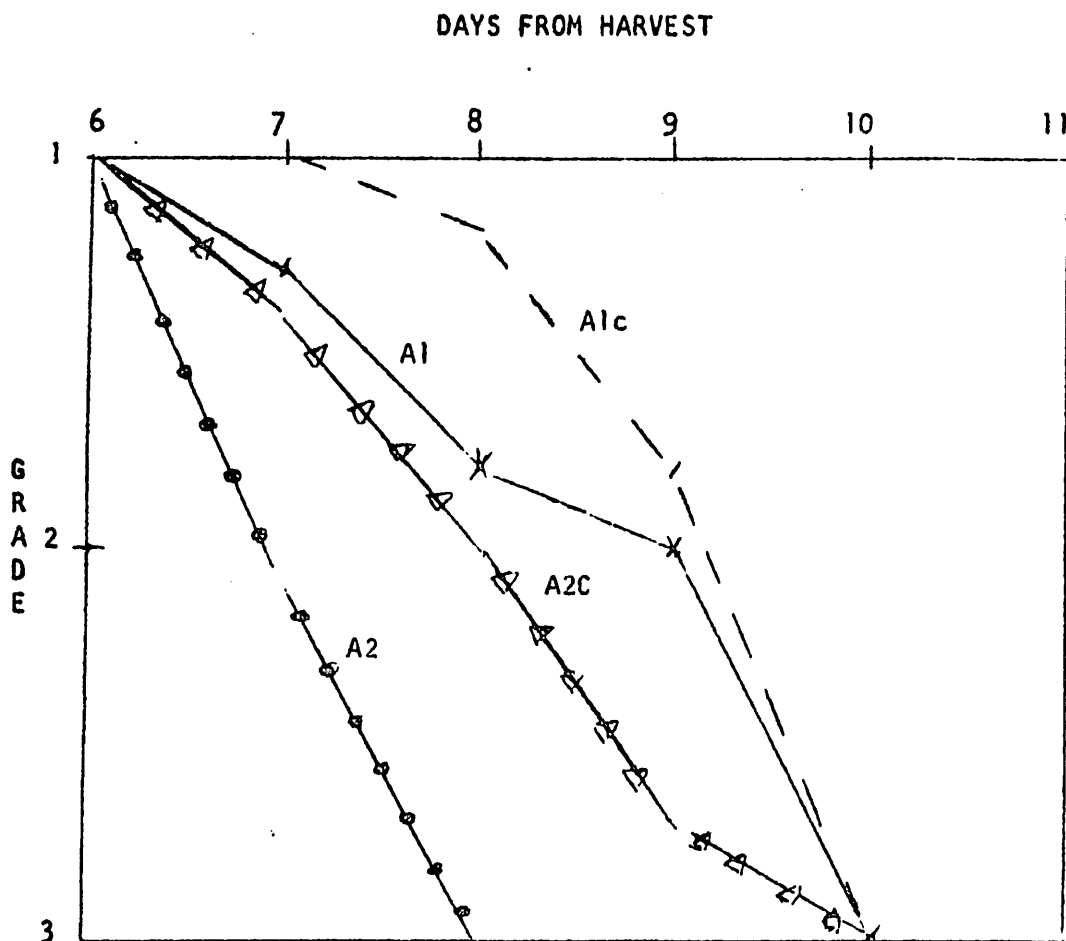
A2c (36 fls.) stems not recut and crushed, " " " " " " " "

Results:

Box in excellent condition. Flowers in generally good condition when unpacked.

Stocks did not take water unless stems were crushed (A1 vs. A2)

Cooling plus crushing stems (A1c) is most effective for best keeping; however, cooling only increases life of flowers by the time cooled (A1c vs. A1)



SHIPMENT #1 B - Container types - Styrene Hamper

Type of flowers: Column Stock - white

Treatment by Shipper:

Flowers cut 6/16 at Oxnard, bought off L. A. market 6/17,
refrigerated overnight 6/17, packed early 6/18, in shipment 6/18 and 6/19.

Treatments at Ithaca

Unpacked 6/20, first graded 6/21 (6th day harvest)

B1 (36 fls.) stems recut and crushed, plain water, room temperature (80° F)

B2 (36 fls.) stems not recut or crushed, " " " " " "

B1c (36 fls.) stems recut and crushed, plain water, 40° F for 24 hours, then room temperature

B2c (36 fls.) stems not recut and crushed, " " " " " " " "

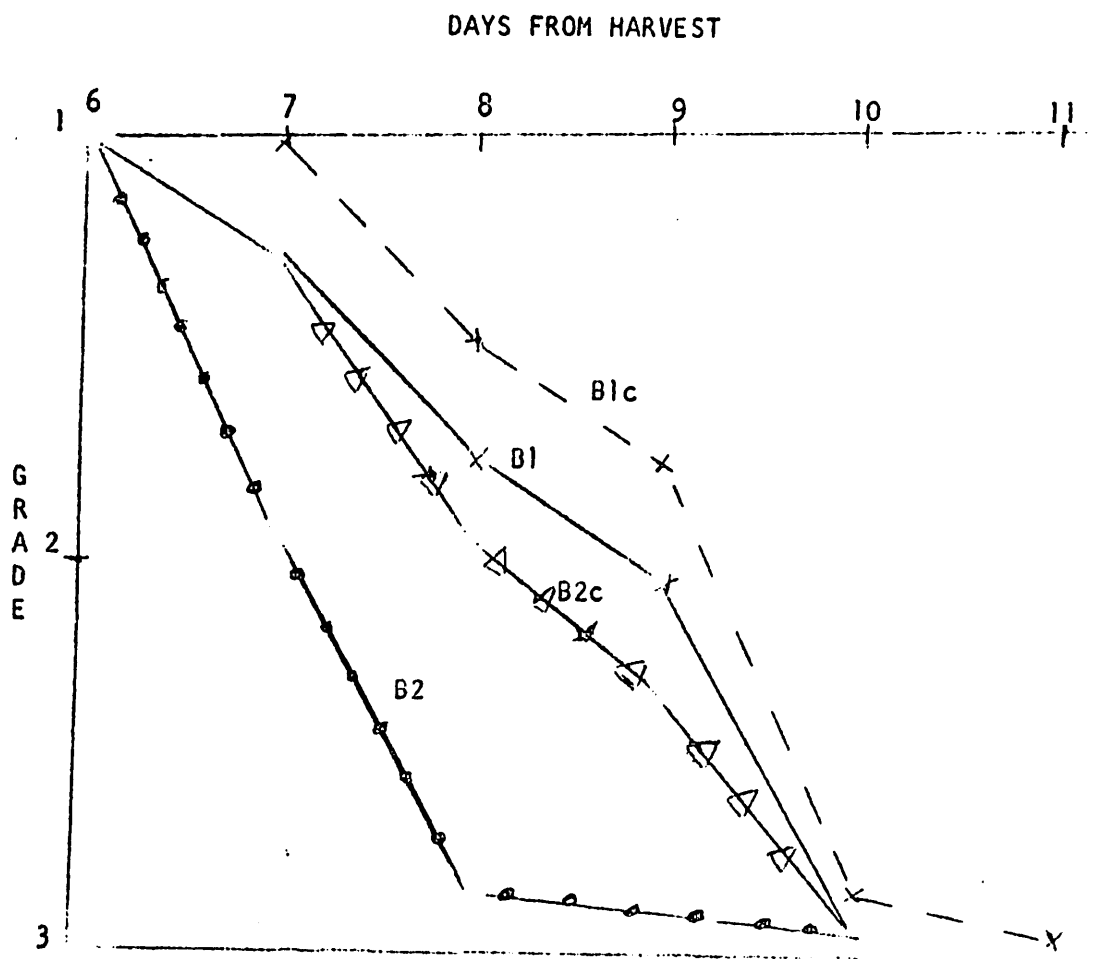
Results

Box in excellent condition. Flowers in generally good condition when unpacked.

Stocks did not take water unless stems were crushed. (B1 vs. B2)

Cooling plus crushing stems (B1c) was most effective for best keeping; however,
cooling only increases life of flowers by the time cooled (B1c vs. B1)

No difference between keeping life of flowers in two types hampers. (#1B vs. #1A)



SHIPMENT #2A - Packing Methods - Iced Box (ice in ends at flower heads)

Type of Flowers: Carnations

Treatment by Shipper:

Flowers cut 6/16, put in plain water in cooler at 46° F for 14 hours, packed at 3:30 p.m. 6/17, put in 31° F until shipping time, in shipment 6/18 and 6/19.

Treatments at Ithaca:

Unpacked 7:45 p.m. 6/19, first graded 6/21 (6th day from harvest)

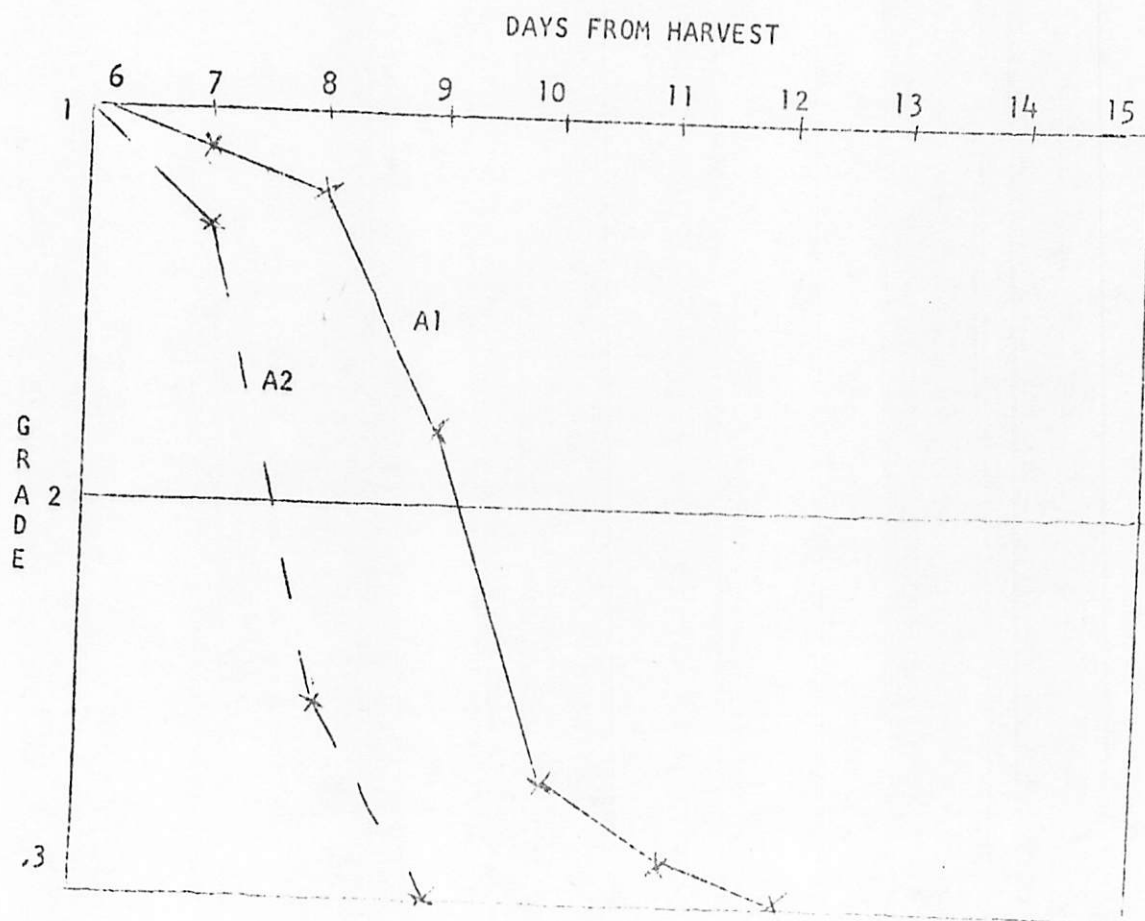
A1 (3 varieties - 190 fls.) - stems recut, plain water, room temperature (80° F)

A2 (3 varieties - 189 fls.) - stems not recut, " " " " " "

Results:

Box ends collapsed due to watersoaking. Some flower heads broken. Some flowers damp where water leaked from ice containers.

Recutting stems (A1 vs. A2) resulted in 1 to 1½ days longer keeping life.



SHIPMENT #2B - Packing Methods - Box with no ice.

Type of Flowers: Carnations

Treatment by Shipper:

Flowers cut 6/17, put in plain water at 46° F for 5 hours prior to packing, packed at 3:30 p.m., held at 31° F until shipping time, in shipment 6/18 and 6/19, unpacked at Ithaca 3:00 p.m. 6/20, first graded 6/21 (5th day).

Treatments at Ithaca:

B1 (3 varieties - 196 fls.) stems recut, plain water, room temperature (80° F).

B2 (3 varieties - 194 fls.) stems not recut, " " " " " "

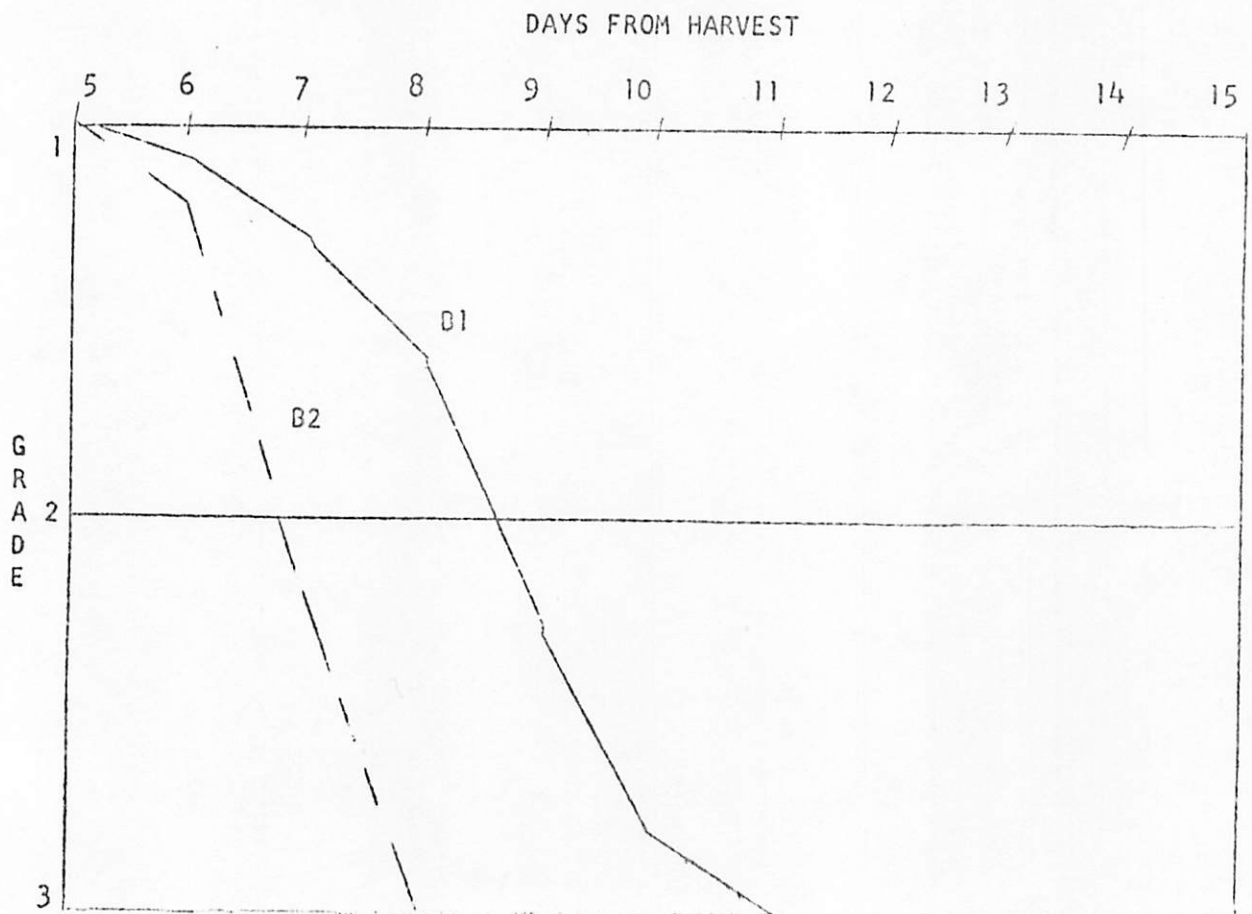
Results:

Box in excellent condition - no crushing.

Flowers in as comparably good condition as #2A upon arrival.

Recutting stems (B1 vs. B2) resulted in 1 to 1½ days longer keeping life.

No obvious difference in keeping ability of flowers shipped with no ice (#2B) vs. those with ice (#2A)



SHIPMENT #3A - Conditioning Prior to Shipment - Iced Box (ice in center)

Type of Flowers: Carnations

Treatment by Shipper:

Flowers cut 6/17, treated overnight (12 hours) in cooler at 40° F in plain water, in shipment 6/18 and 6/19.

Treatments at Ithaca:

Unpacked 6/20, first graded 6/21 (5th day)

a1 (2 varieties 50 fls.) stems recut, plain water, room temperature (80° F)

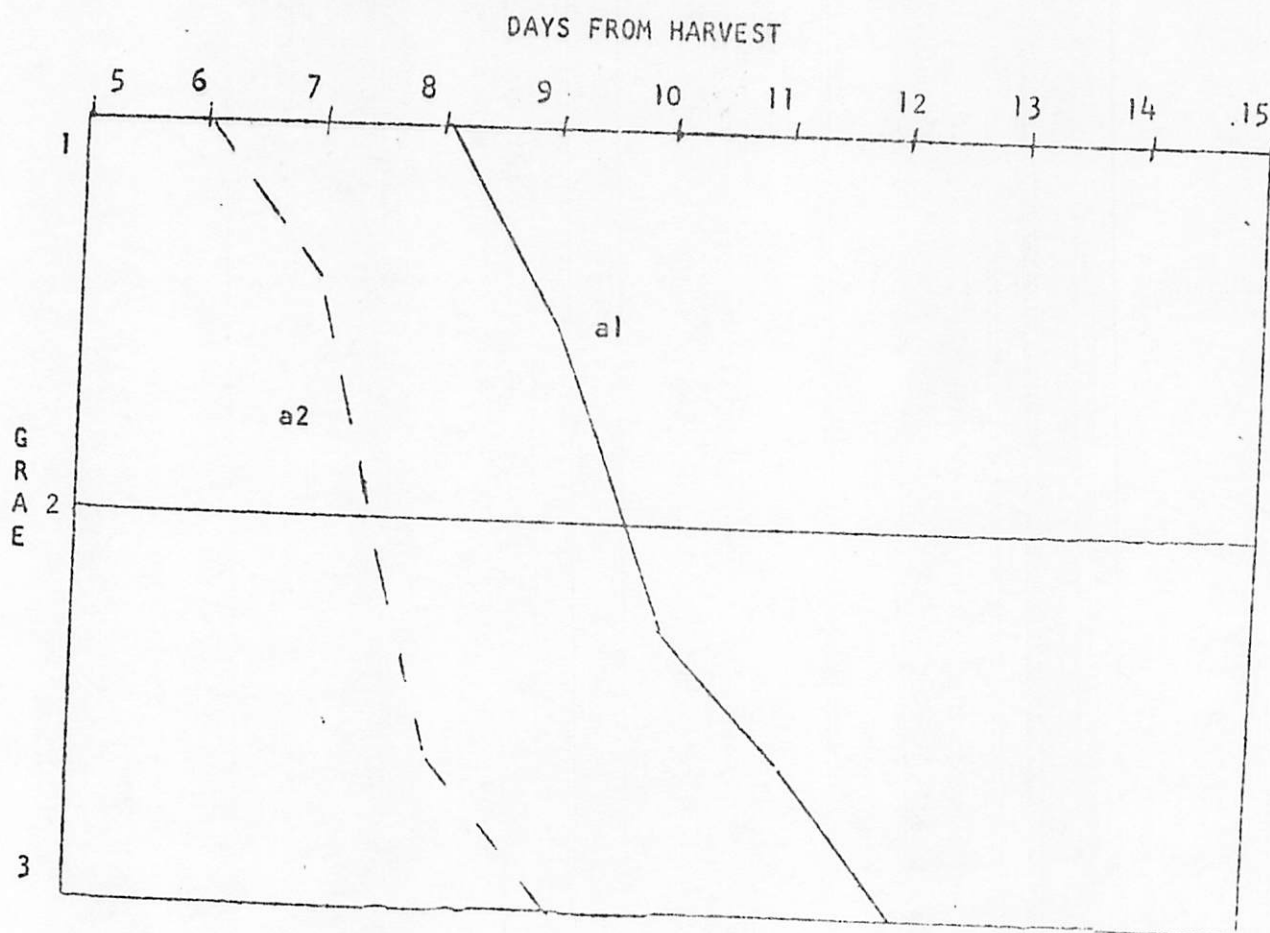
a2 (2 varieties 49 fls.) stems not recut, " " " " " "

Results:

Box in fair condition - dished in at top somewhat - no flower breakage.

Moisture absorbed by pads at center - no soaking of box.

Recutting stems (a1 vs. a2) resulted in 2 days longer keeping life.



SHIPMENT #3A (Cont'd). Conditioning Prior to Shipment - Iced Box.

Type of Flowers: Carnations

Treatment by Shipper:

Flowers cut 6/17, treated overnight (12 hrs.) in cooler at 40° F, in water with preservative #2, in shipment 6/18 and 6/19.

Treatments at Ithaca:

Unpacked 6/20, first graded 6/21 (5th day).

b1 (2 varieties - 48 fls.) stems recut, plain water, room temperature (80° F)

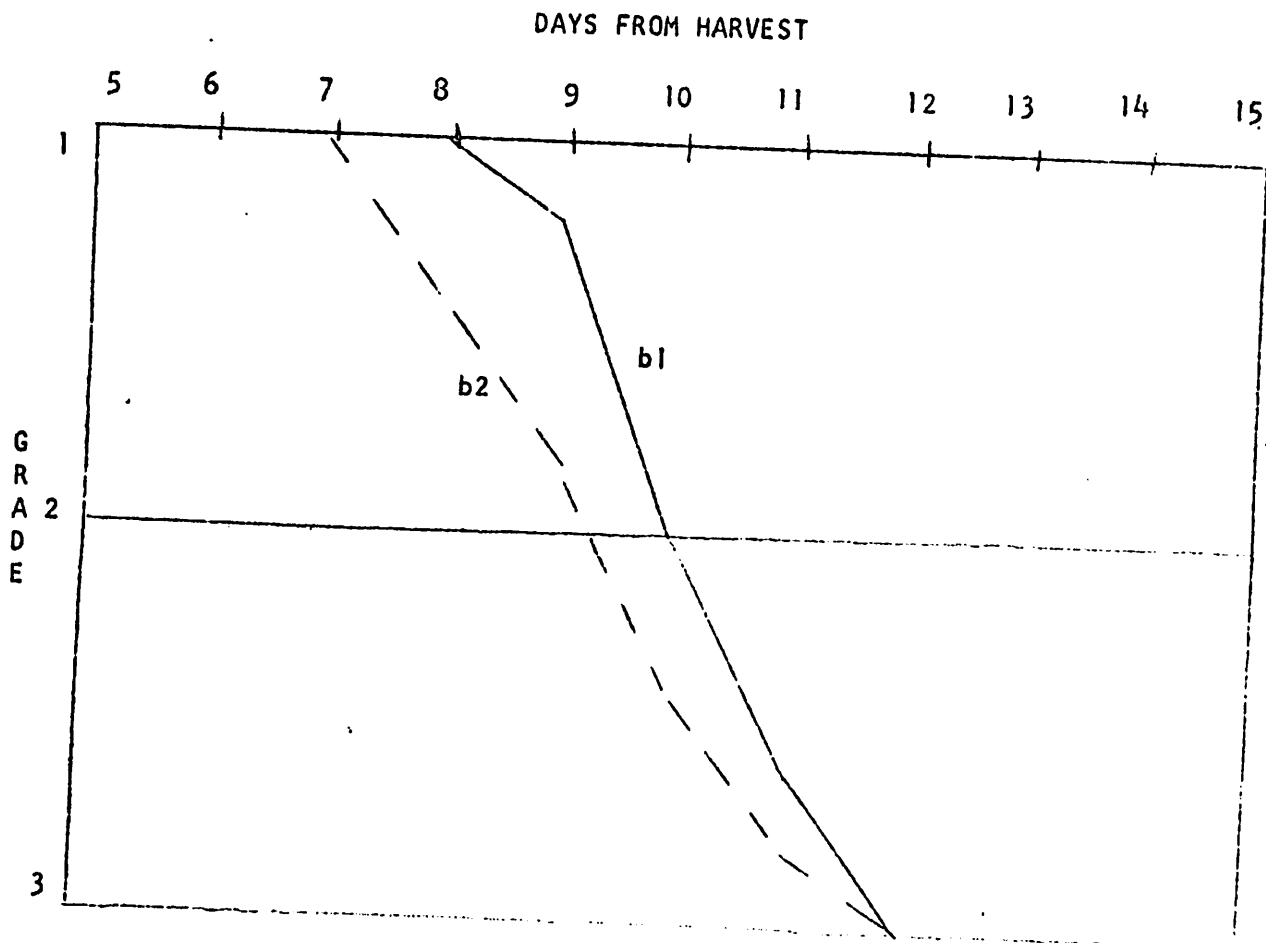
b2 (2 varieties - 50 fls.) stems not recut, " " " " " "

Results:

Recutting stems (b1 vs. b2) resulted in only 1 day longer keeping life.

Recutting stems not as important if preservative is used.

Keeping life slightly better than cooler and plain water (a1 & a2).



SHIPMENT #3A (Cont'd.) Conditioning Prior to Shipment (Iced Box)

Type of Flowers: Carnations

Treatment by Shipper:

Flowers cut 6/17, treated overnight (12 hours) at room temperature (60-65° F) in plain water, in shipment 6/18 and 6/19.

Treatments at Ithaca:

Unpacked 6/20, first graded 6/21 (5th day)

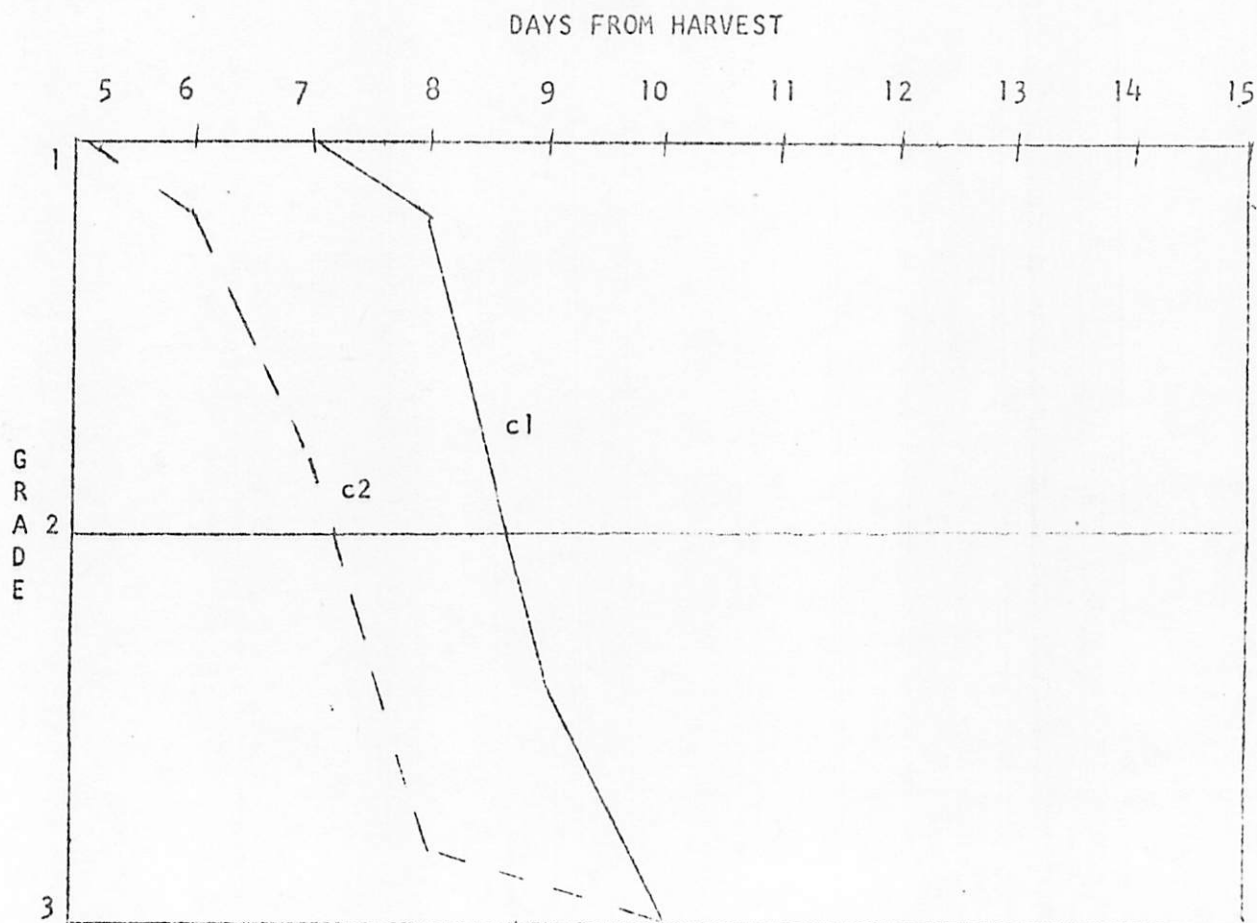
c1 (2 varieties - 49 fls.) stems recut, plain water, room temperature (80° F).

c2 (2 varieties - 49 fls.) stems not recut, " " " " "

Results:

Recutting stems (c1 vs c2) resulted in about 2 days longer keeping life.

Rate of downgrade was faster than where flowers were cooled overnight (a1 & a2)



SHIPMENT #3A (Cont'd.) Conditioning Prior to Shipment - Iced Box

Type of Flowers: Carnations

Treatments by Shipper:

Flowers cut 6/17, treated overnight (12 hours) at room temperature (60-65° F) in water with preservative #2, in shipment 6/18 and 6/19.

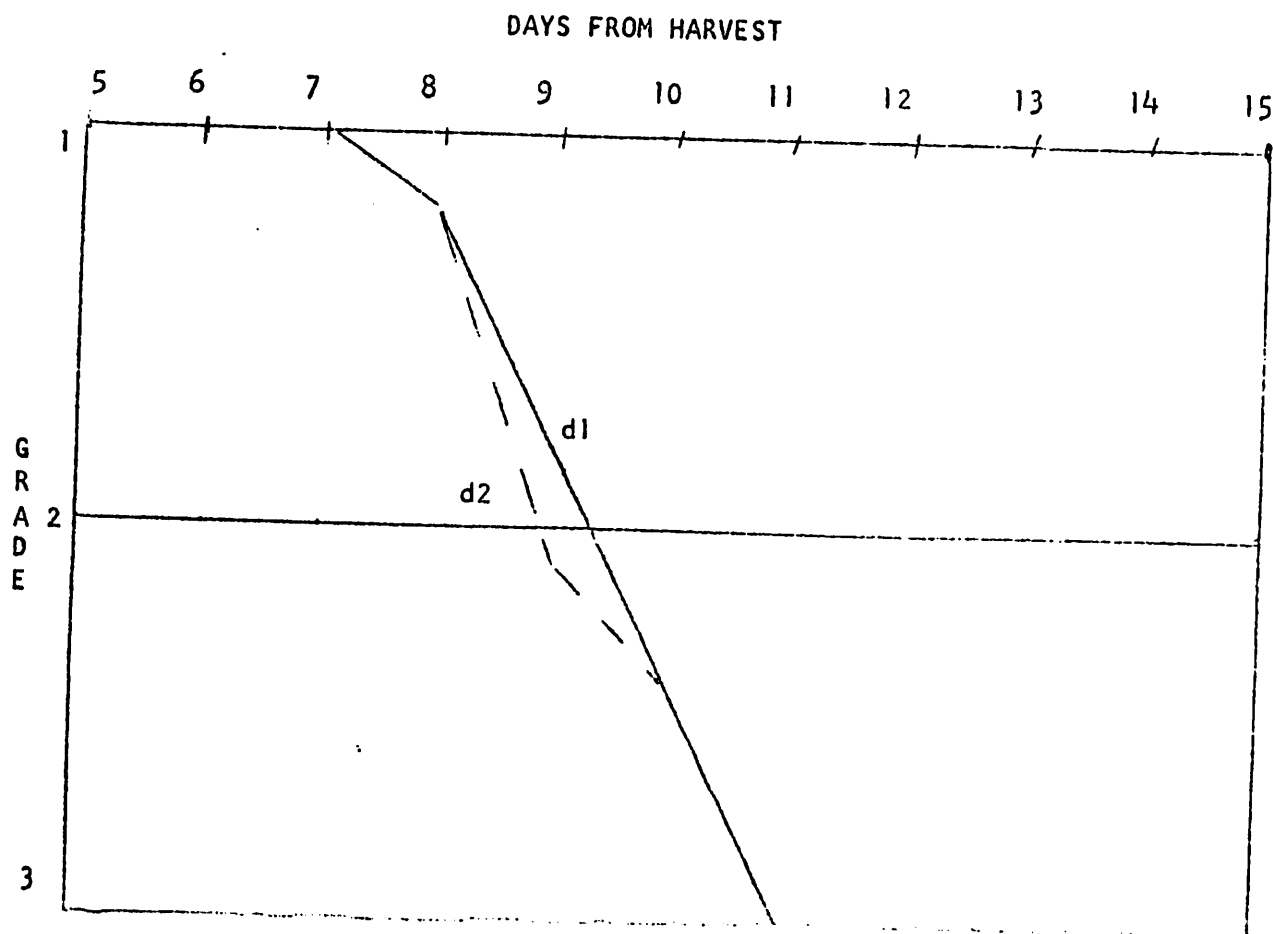
Treatments at Ithaca:

Unpacked 6/20, first graded 6/21 (5th day)

d1 (2 varieties - 49 fls.) - stems recut, plain water, room temperature (80° F).
d2 (2 varieties - 48 fls.) - stems not recut, " " " " " "

Results:

Recutting stems (d1 vs. d2) had no effect on increasing keeping life when preservative was used. Keeping life of both recut and uncut stems was satisfactory and only very slightly less than when flowers were cooled and preservative also used (b1 and b2).



SHIPMENT #3A (Cont'd.) Conditioning Prior to Shipment - Iced Dox

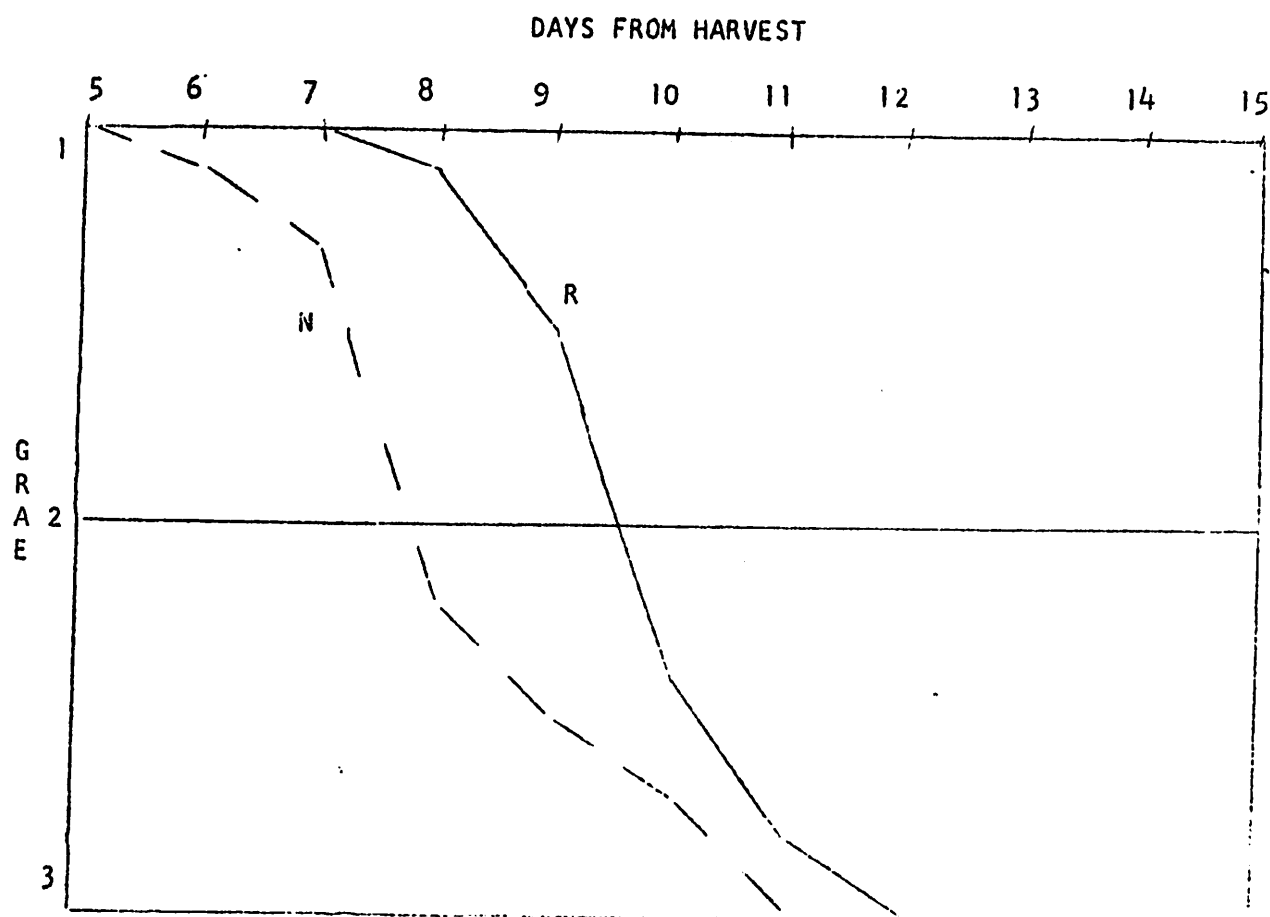
Recutting Stems vs. Not Recutting Stems (by recipient in East)

R - Stems recut at Ithaca, all treatments (a1, b1, c1, d1)

N - Stems Not recut at Ithaca, all treatments (a2, b2, c2, d2)

Results:

Recutting stems at eastern destination results in about two days longer keeping life.



SHIPMENT #3A (Cont'd.) Conditioning Prior to Shipment - Iced Box

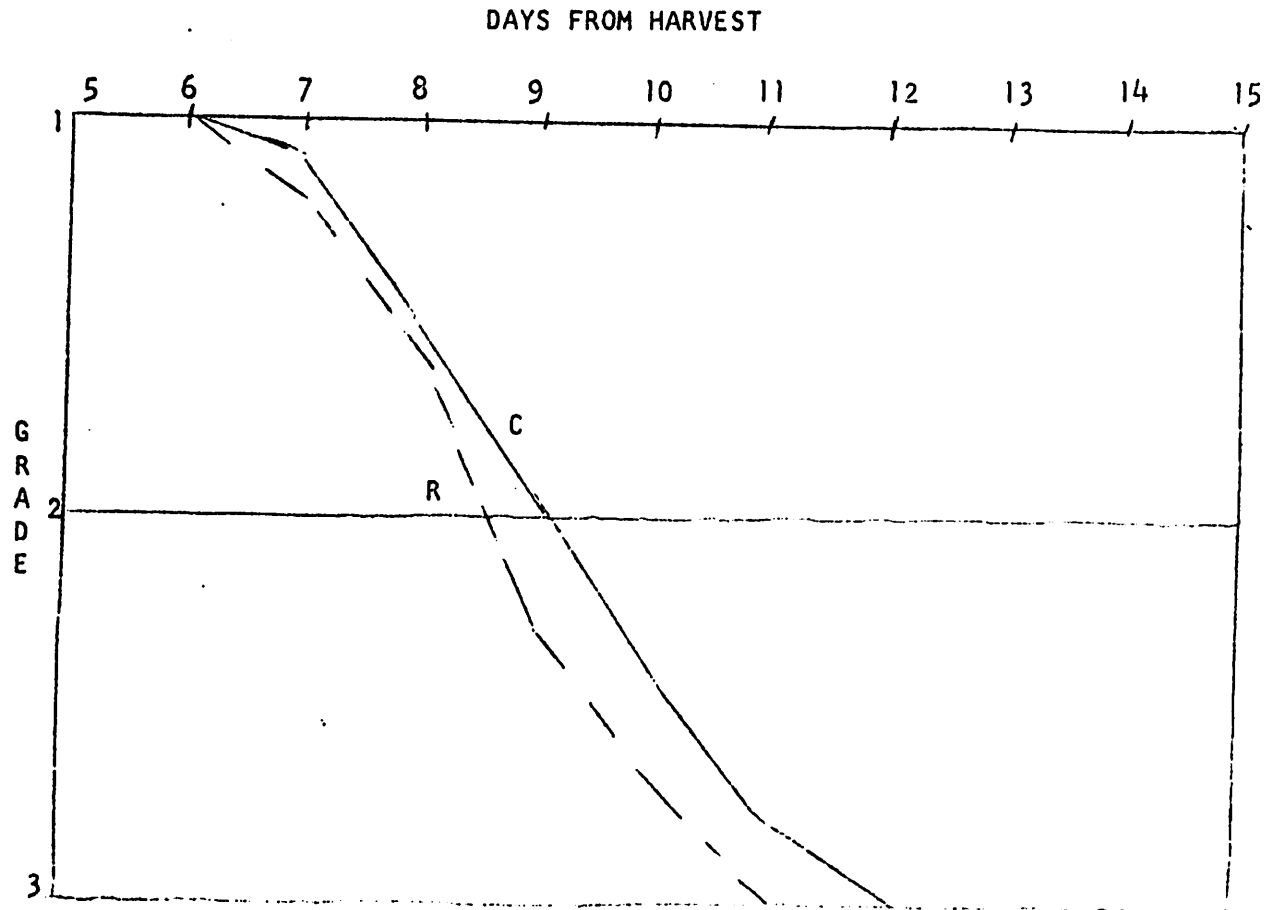
Cooling vs. Room Temperature (by shipper)

C - Flowers cooled overnight (12 hours) at 40° F prior to packing (a + b)

R - Flowers at room temperature (60-65° F) overnight (12 hours) prior to packing (c + d)

Results:

Cooling overnight by shipper, as a single factor, had little or no effect (C vs. R) on overall keeping life or rate of decline of flowers at eastern destination.



SHIPMENT #3A - Conditioning Prior to Shipment - Iced Box

SUMMARY OF FOUR TREATMENTS BY SHIPPER

Treatments by Shipper:

- a - Cooler overnight (12 hours) at 40° F, plain water.
- b - Cooler overnight (12 hours) at 40° F, water with preservative #2.
- c - Room temperature (12 hours) at 60-65° F, plain water.
- d - Room temperature (12 hours) at 60-65° F, water with preservative #2.

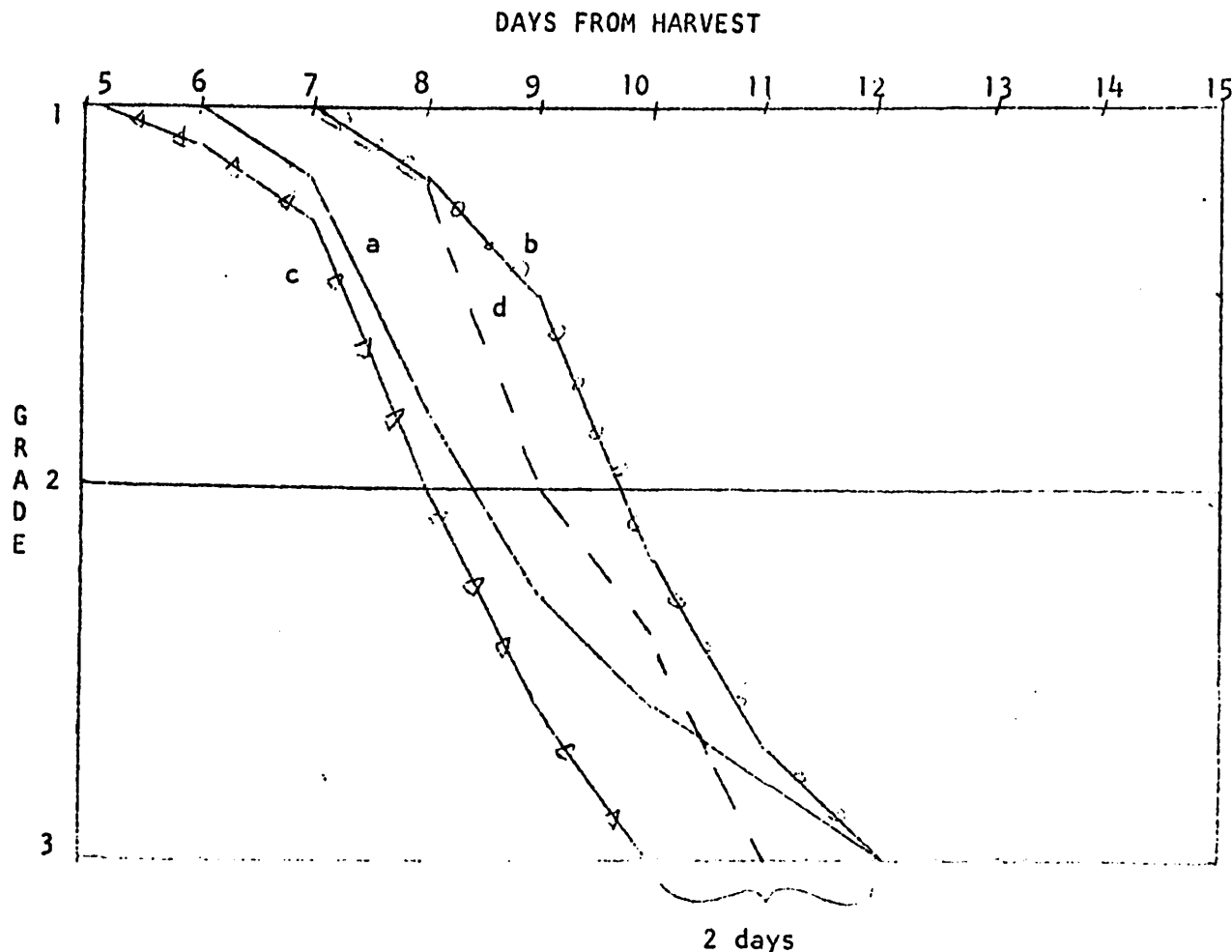
Treatments at Ithaca:

All treated same - $\frac{1}{2}$ each lot recut stems, $\frac{1}{2}$ left uncut, all put in plain water at room temperature (80° F).

Results:

The two treatments with flower preservative (b & d) by shipper resulted in about 2 days longer keeping life at eastern destination.

Cooling plus preservative (b) was little or no better than preservative and room temperature (d). It appears that preservative is more effective than cooling.



SHIPMENT #3A (Cont'd.) Conditioning Prior to Shipment - Iced Dox.

SUMMARY BEST VS. POOREST TREATMENTS

BEST

b1 - Cooler overnight (12 hours) at 40° F, water with preservative #2 by shipper; stems recut, plain water*, room temperature (80° F) at Ithaca.

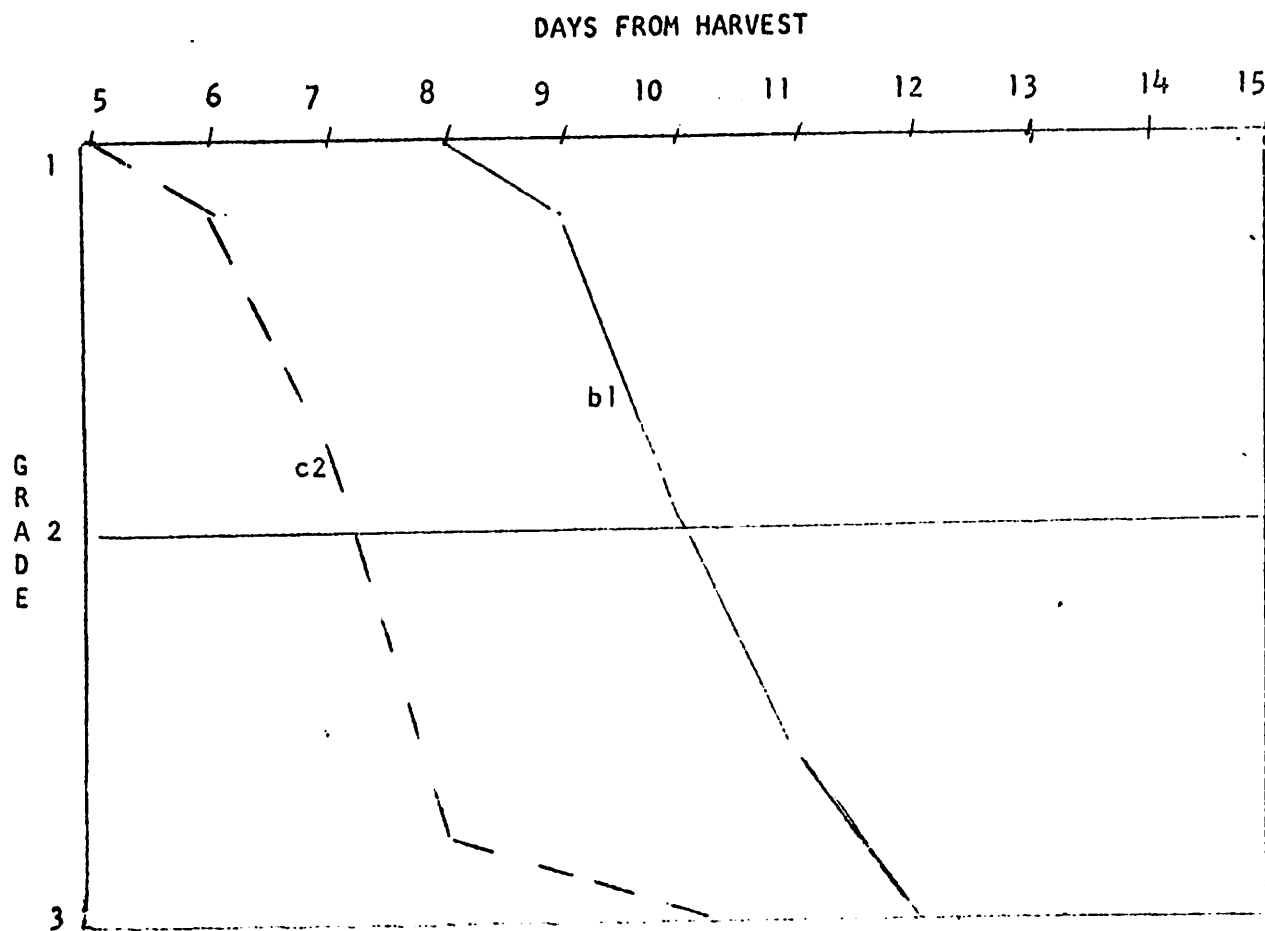
POOREST

c2 - Room temperature overnight (12 hours) at 60-65° F, plain water by shipper; stems not recut*, room temperature (80° F) at Ithaca.

* No preservative was used in this shipment at Ithaca.

Results:

Recutting of stems at Ithaca probably caused greatest increase in keeping life. Preservative plus cooling by shipper (b1) slightly better than cooling alone.



SHIPMENT #3B - Method of Packing,- Box not iced.

Type of Flowers: Carnations

Treatment by Shipper:

Flowers cut early a.m. 6/18; graded, bunched and packed (flowers never in water) for immediate shipment; in shipment 6/18 and 6/19.

Treatments at Ithaca:

Unpacked 2:00 p.m. 6/20. First graded 6/21 (4th day from harvest).

a1 Stems recut, plain water, room temperature (80° F).

a2 Stems not recut, " " " " " "

b1 Stems recut, water with preservative #2, room temperature (80° F).

b2 Stems not recut, " " " " " "

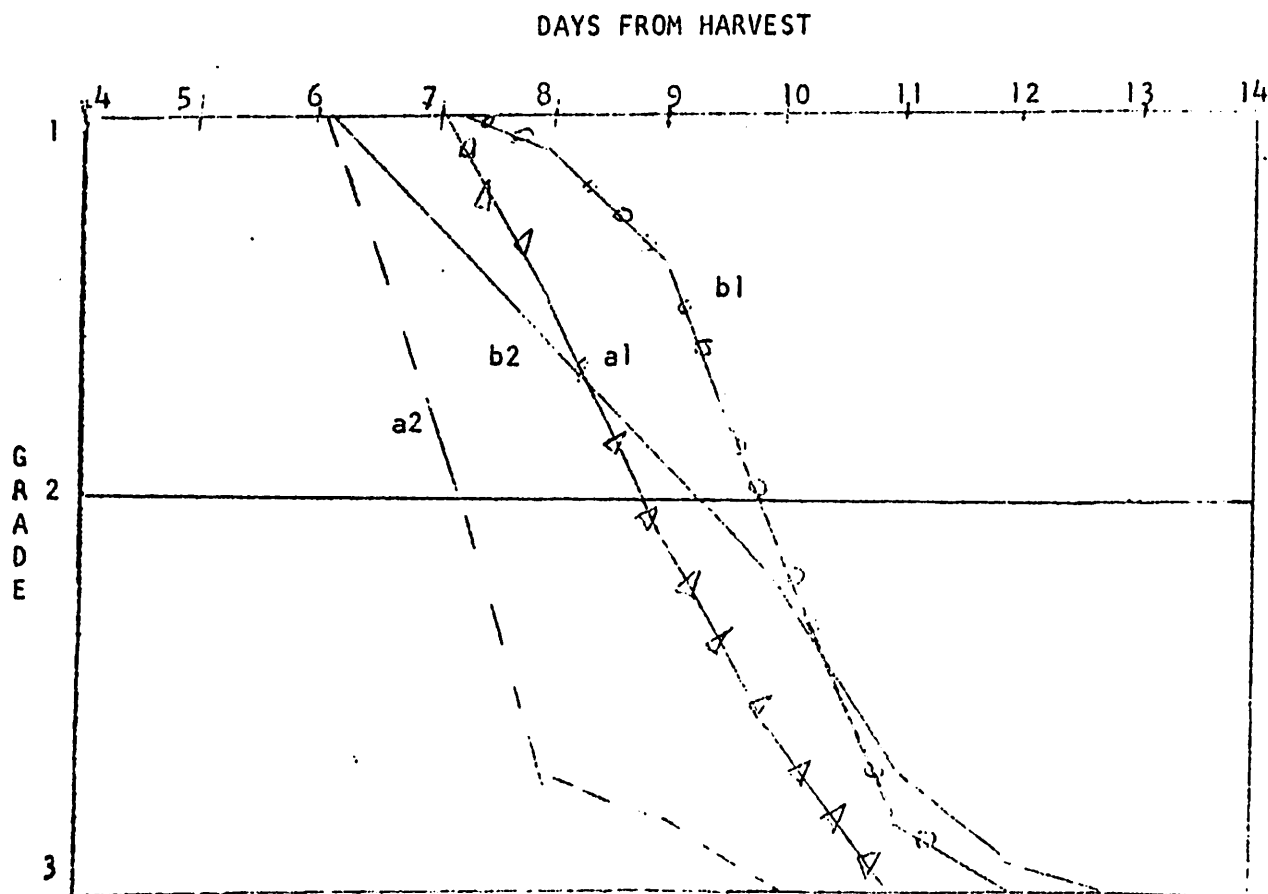
Results:

Flowers in excellent condition on arrival, no difference observed when compared to iced box.

Flowers kept as well as comparative treatments in iced box (#3B - a1 vs. #3A - c1). (#3B - a2 vs. #3A - c2).

Preservative and stems not recut (b2) nearly as good as when stems were cut and plain water only used (a1).

Use of preservative and cutting stems resulted in about 2 days longer keeping life (b1) compared to when stems were not recut and put in plain water (a2).



SHIPMENT # 4A - Methods of Packing - Iced Box

Type of Flowers: Carnations

Treatment by Shipper:

Flowers cut 6/16, cooler 42° F for 24 hours (6/17), in shipment 6/18 and 6/19.

Treatment at Ithaca:

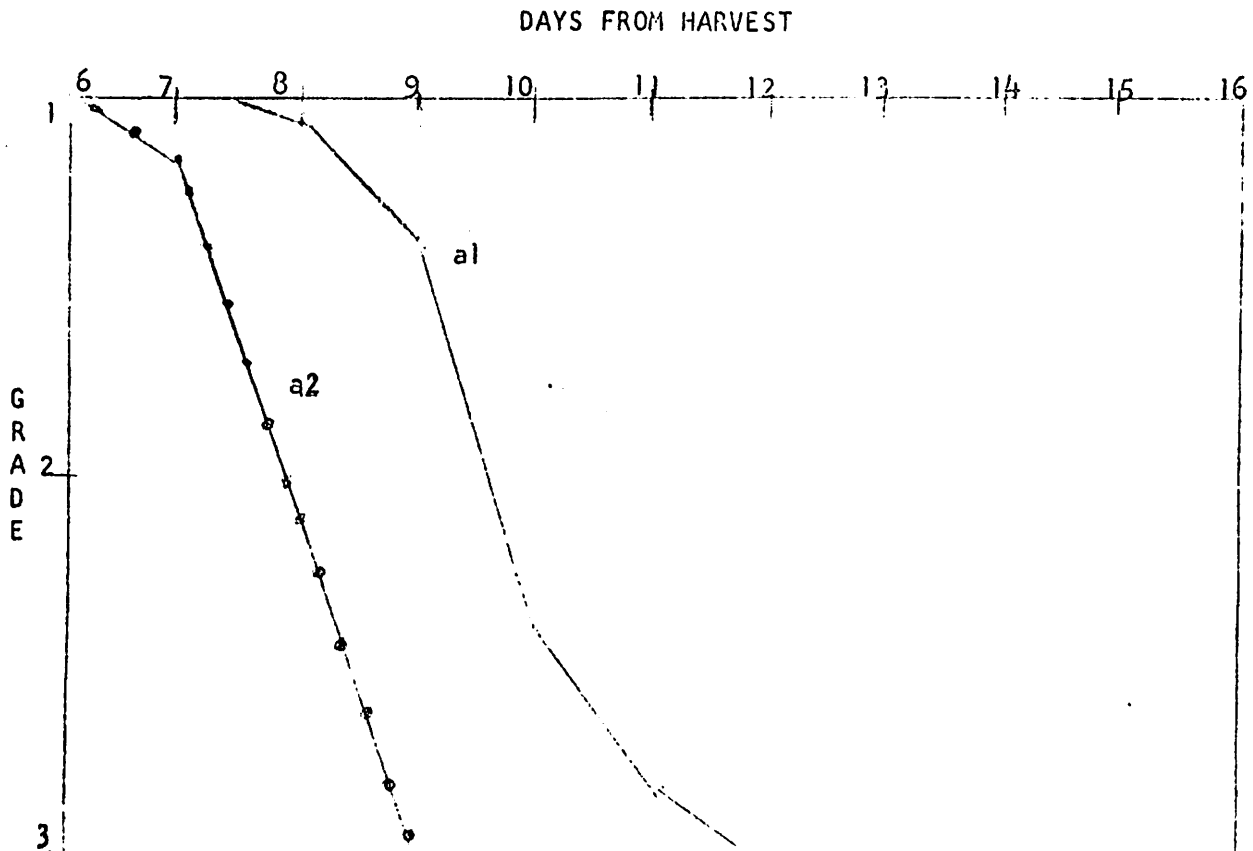
Unpacked 12:30 p.m. 6/20, first graded 6/21 (6th day).

a1 (4 varieties - 100 fls.) Stems recut, plain water, room temperature (80° F)

a2 (4 varieties - 100 fls.) Stems not recut " " " " "

Results:

Box in good condition. Moisture absorbed by pads in center of box - flowers not wet. Recutting stems resulted in about two days longer keeping life.



SHIPMENT #4B - Upright stock hamper with ice in bottom.

Type of flowers: Carnations

Treatment by Shipper:

Flowers cut 6/16, cooler 24 hours (6/17), in shipment 6/18 and 6/19.

Treatments at Ithaca:

Unpacked 12:30 p.m. 6/20. First graded 6/21 (6th day).

b1 stems recut, plain water, room temperature (80° F), water changed at 24 hours.

b2 " " , water with preservative #2, at room temperature for 24 hours, then plain water.

b3 " " , plain water in cooler (40° F) for 24 hours, then fresh plain water and room temperature.

b4 " " , water with preservative #2 in cooler (40° F) for 24 hours, then fresh plain water and room temperature (80° F).

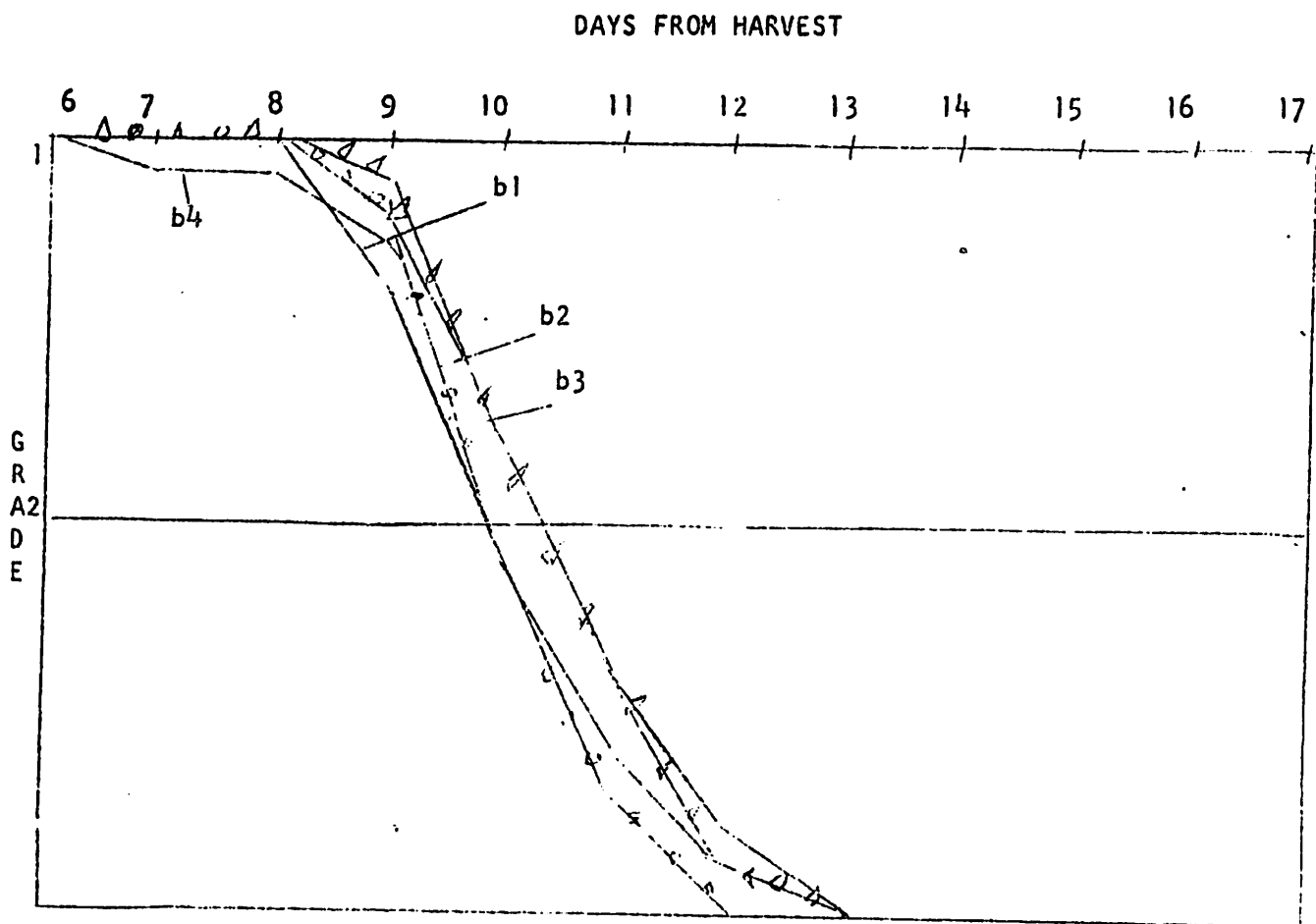
Results:

Hamper badly watersoaked at bottom - bottom coming apart.

Flowers wet from water in box. Hamper probably placed on side.

All treatments very similar - all stems were recut.

Preservative and cooling had no effect on keeping life - apparently 24 hours of each treatment was not sufficient to help flowers.



SHIPMENT #5A - Harvest Maturity - Iced Box

Type of Flowers: Carnations

Treatment by Shipper:

Flowers cut a.m. 6/17, cooler and plain water 20 hrs, in shipment 6/18 and 6/19.

a - Tight bud with petals vertical.

b - Slightly fluted petals (1-1½ inches across top).

c - Petals at 120°-135° angle to stem.

d - Petals at 90° angle to stem.

e - Petals reflexed, full bloom.

Treatment at Ithaca:

Each maturity group was subdivided as follows:

a1, b1, c1, d1, e1 - Stems recut, plain water, room temperature (80° F).

a2, b2, c2, d2, e2 - Stems not recut, " " " " "

a3, b3, c3, d3, e3 - Stems recut, water with preservative #2, room temp. (80° F).

Each treatment at Ithaca consisted of 24 flowers - 8 Red Sims, 8 Pink Sims,
8 White Sims

All stems recut and solutions changed on 6/25.

Flowers first graded 6/21 (5th day from harvest).

Results:

Box in good condition - paper pads had absorbed moisture from ice.

Flowers in excellent condition - all had developed slightly in shipment;

a was like b, b like c, and c, d, and e were similar in appearance.

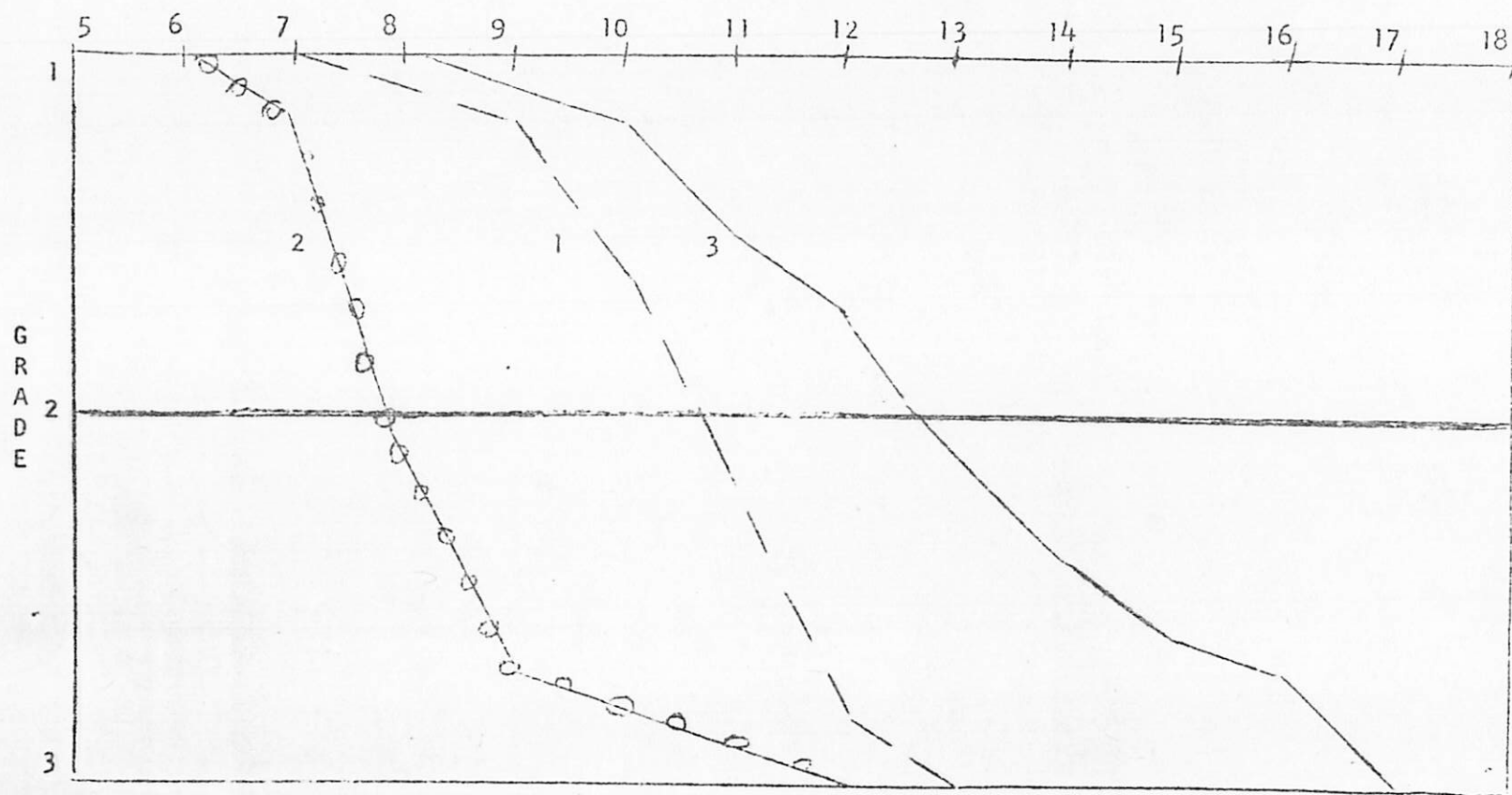
Tight buds (a) did not open fully even with flower preservative in water and recut stems.

Slightly fluted buds (b3) with stems recut and preservative #2 in water, opened fully in about 3 days and had good keeping life for another 4 or 5 days.

Flower preservative is necessary to add keeping life to tight flowers that are opened at destination.

COMPARISON THREE TREATMENTS AT ITHACA

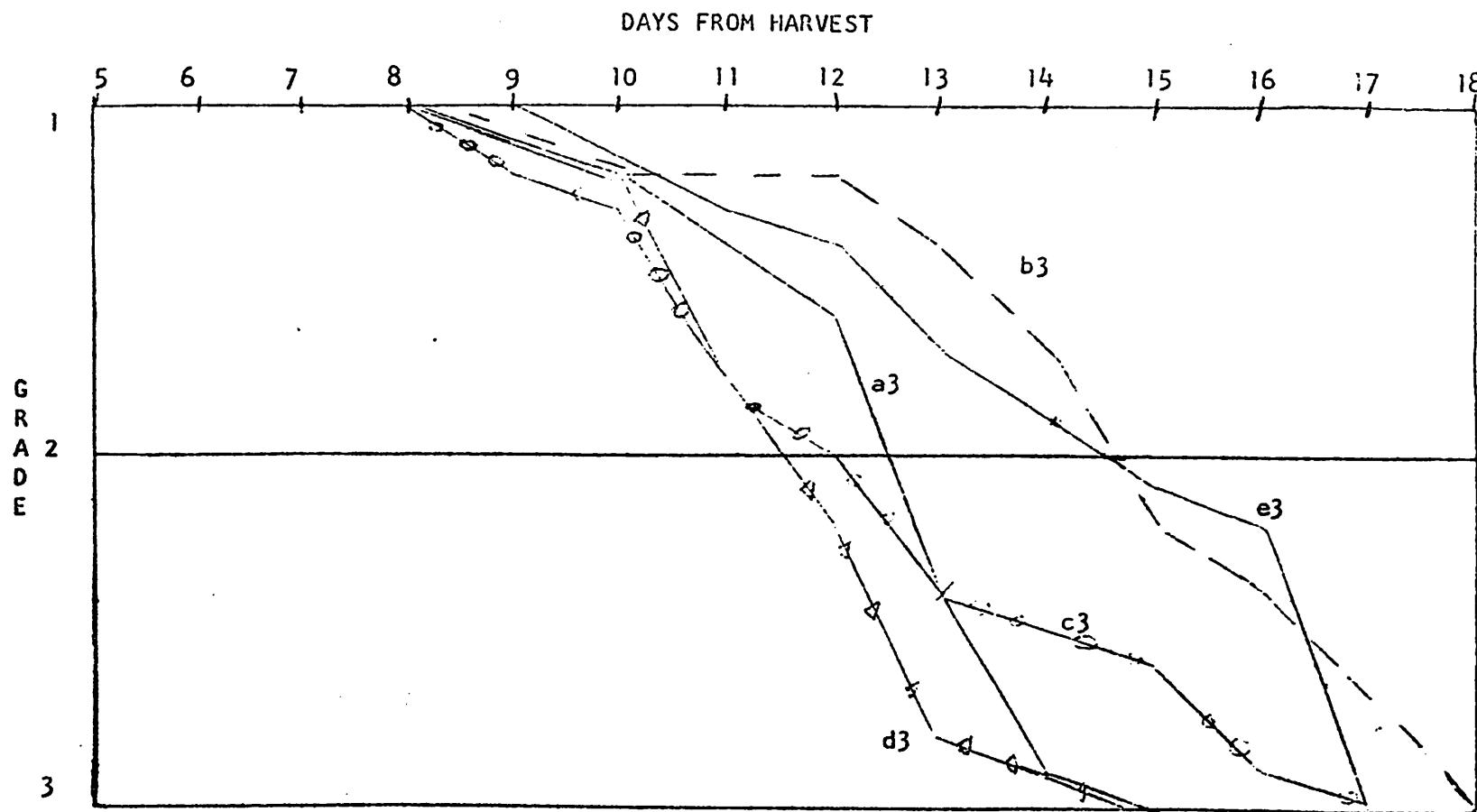
DAYS FROM HARVEST



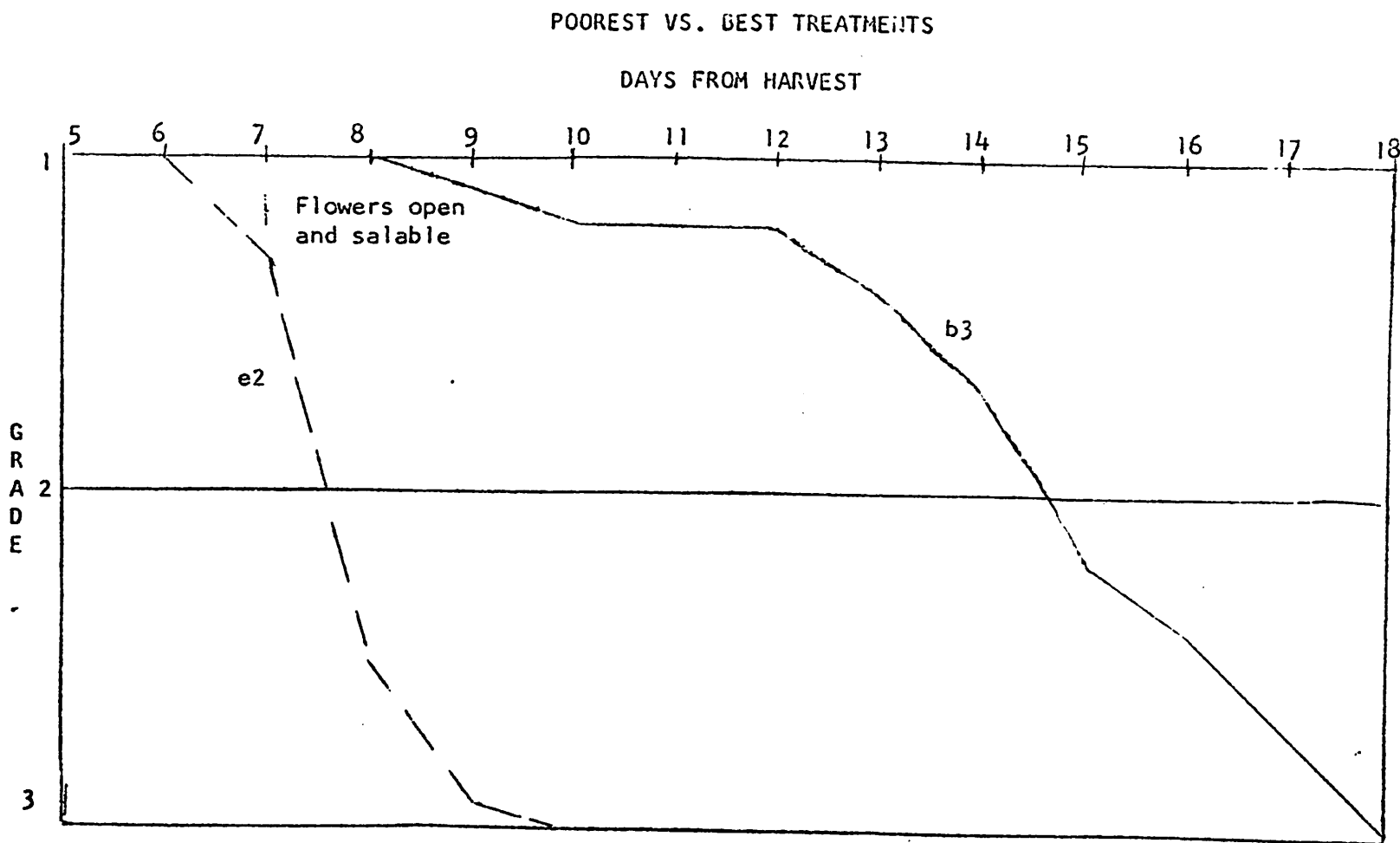
- 1 - Stems recut, plain water, room temperature (80° F) at Ithaca (a1, b1, c1, d1, e1)
- 2 - Stems not recut, plain water, room temperature (80° F) at Ithaca (a2, b2, c2, d2, e2)
- 3 - Stems recut, water with preservative #2, room temperature (80° F) at Ithaca (a3, b3, c3, d3, e3)

SHIPMENT #5A (Cont'd.)

COMPARISON OF HARVEST STAGES WHERE ALL STEMS WERE RECUT, PLACED IN WATER WITH PRESERVATIVE #2
AT ROOM TEMPERATURE (80° F) AT ITHACA



SHIPMENT 5A - (Cont'd.) HARVEST MATURITY - ICED BOX



b3 - slightly fluted petals when harvested, stems recut and put in water with preservative at Ithaca.

e2 - petals reflexed (full bloom) when harvested, stems not recut and put in plain water at Ithaca.

SHIPMENT #6 - Chrysanthemum Buds for Maturing at Destination

Type of flowers: Standard Chrysanthemums - white

Treatment by Shipper:

Flowers cut 6/18, packed in box with no ice. Eight plus dozen barely filled 1/3 of flat-type box. In shipment 6/18 and 6/19.

Treatments at Ithaca:

Flowers remained at air temperature (about 80° F) at airport for 17 hours.

Unpacked at 4:30 p.m. 6/20. Twelve flowers per treatment.

- A1 Recut stems, plain water, 60° (night) greenhouse (days varied to 92° plus sun)
- A2 " " water with preservative #1, 60° (night) greenhouse.
- A3 " " " " preservative #2, 60° (night) greenhouse.
- B1 " " plain water, room temperature Laboratory (80° F constant - no sun).
- B2 " " water with preservative #1, room temperature laboratory.
- B3 " " " " preservative #2, " " " "

Stems recut again and all solutions changed 6/24, 6/28, 7/2.

First grade 6/22 (5th day from harvest.)

All buds averaged 1 to 1½ inches in diameter on arrival at Ithaca.

Results:

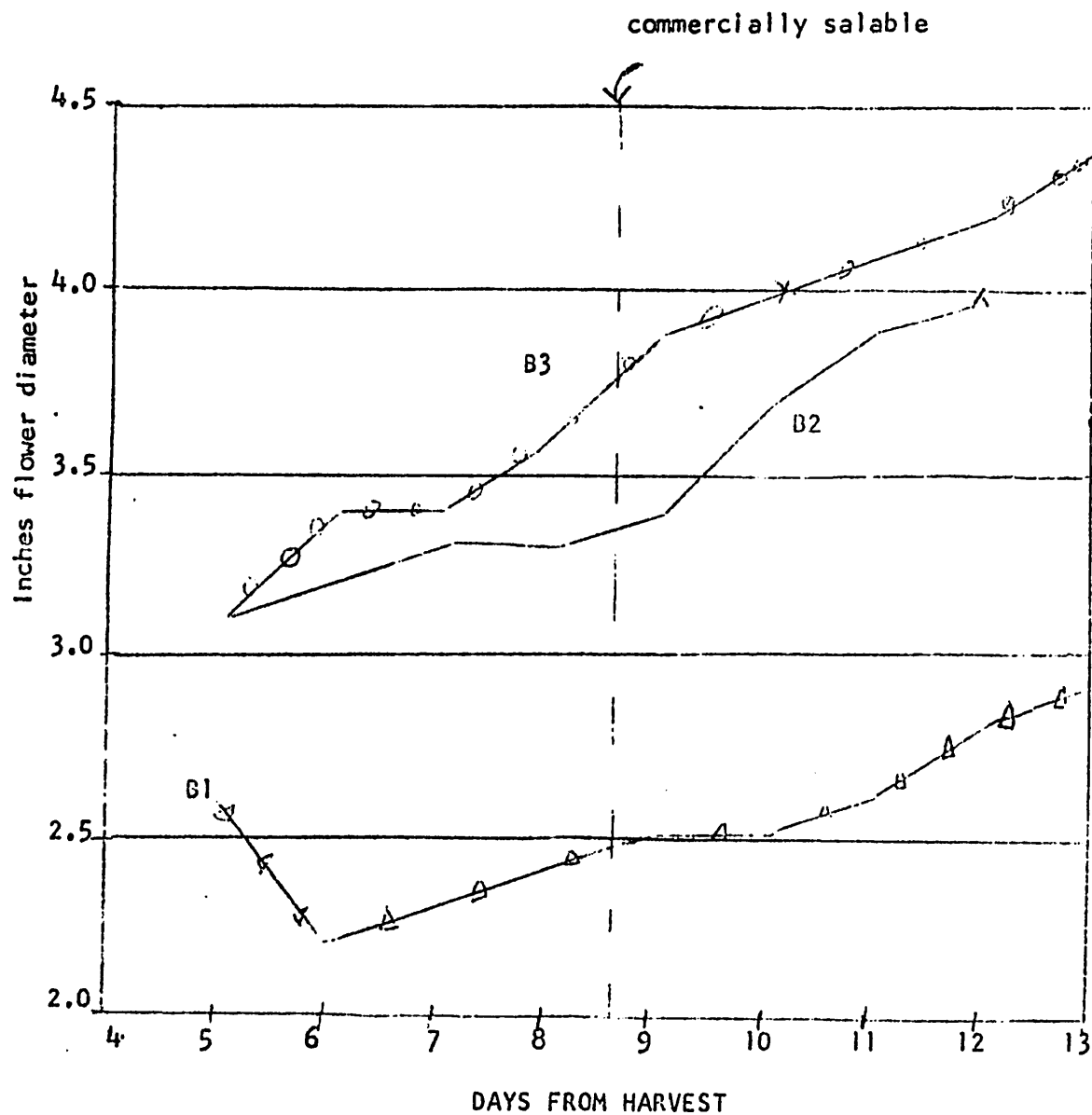
Box in good condition. All flowers and foliage good - only slightly flaccid upon arrival.

Stems in plain water (A1 & B1) took water poorly and flowers and leaves were flaccid most of the time. Greenhouse group (A1) was worse than (B1). Greenhouse atmosphere is more strenuous than laboratory for opening buds. Rate of opening tends to be more rapid in greenhouse unless light and temperature become extreme. B3 (preservative #2) performed best in the laboratory, the foliage appearing to be greener and the flowers more lush; however, in the greenhouse when high temperature and bright sun occurred, the treatment with preservative #2 (A3) collapsed into a severe wilt as compared to A2 with preservative #1. Treatment A3 did recover when cooler days followed.

Five to six days are required to open standard mum flowers. After opening, the flowers had a keeping life of about 8 days, a total time from harvest of 18 days. These flowers could have held up longer but a population of spider mites build up over a weekend and caused the flowers to turn brown and collapse.

SHIPMENT #6 (Cont'd.) Chrysanthemum Buds

COMPARISON OF TREATMENTS IN ROOM TEMPERATURE LAB (80° constant)

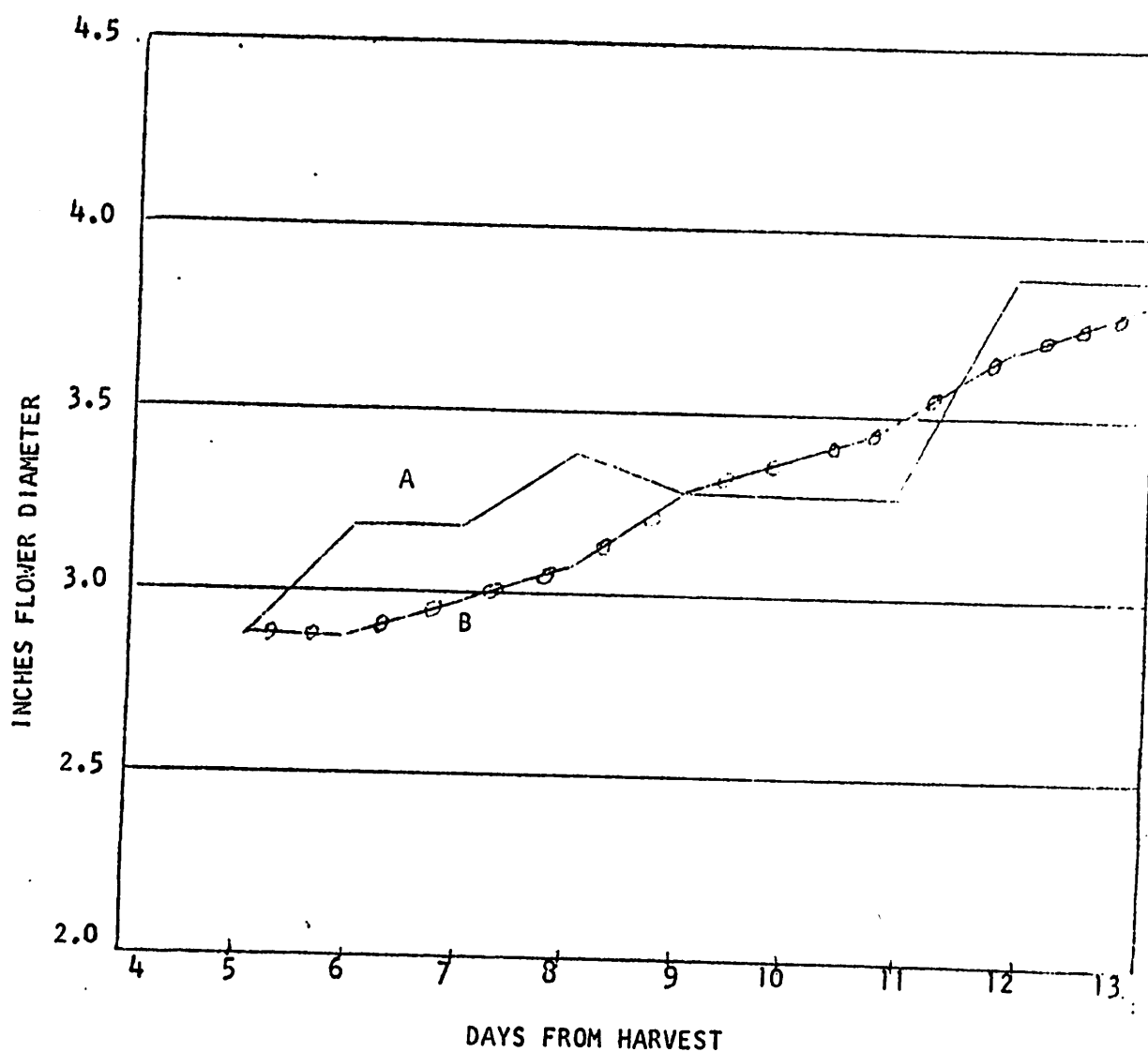


SHIPMENT #6 (Cont'd.) Chrysanthemum Buds

AVERAGE OF GREENHOUSE TREATMENTS COMPARED TO AVERAGE OF LAB TREATMENTS.

A - GREENHOUSE

B - LAB



SUMMARY: Although several techniques compared in these trials were not new, the purpose was to evaluate combinations of old and new methods for the most satisfactory transfer of cut flowers from the grower to the ultimate consumer. All flowers shipped in these trials arrived in good condition. Since there was a wide variety of treatments involved, it might be assumed that if the merchandise is free from problems when shipped it will arrive at its destination in good condition despite methods employed. Results of these trials should therefore contribute to the preparation of healthy merchandise to perform at its greatest keeping life potential and create maximum customer satisfaction.

Column Stocks

Observations - Crushing stems for 2 or 3 inches at the bottom allowed flowers and foliage to regain turgidity after shipment. Stems not crushed remained flaccid whether refrigerated or left at room temperature. Cooling stocks for 24 hours after shipment did not decrease the rate of decline of keeping life but delayed decline by 24 hours. There was no difference in flower condition on arrival or comparative keeping life of stocks shipped in corrugated or styrene-type hampers.

Conclusions - Column stocks are one of the most difficult types of cut flowers to condition after shipment because of their inability to take water. Crushing stems 2 or 3 inches is the best treatment for conditioning. Cooling is advantageous for holding the flowers in a better condition after they have regained turgidity. The use of flower preservative might improve the conditioning process for stocks although it was not tried in this trial.

Carnations

Observations - Recutting of stems at Ithaca increased keeping life about two days with no other treatments involved.

Cooling prior to shipment increased keeping life at Ithaca about one day with no other treatments involved. Following shipment, carnations with recut stems in plain water held well for 10 days at 42° F, but keeping life at room temperature after removal from the cooler was reduced about 50 per cent.

The use of a commercial flower preservative increased keeping life one to two days when used prior to shipment only or following shipment at Ithaca only. There was little or no difference in keeping life between recutting and not recutting stems at Ithaca when preservative was used prior to shipment at Encinitas. The use of preservative for 24 hours only following shipment, even if stems are recut, showed no increase in keeping life. Where flowers remained in water with preservative, keeping life was increased.

Icing of boxes did not appear to be necessary for carnations. Flowers were cut early in the morning, given no water and were packed and shipped immediately in a box with no ice. The keeping life of these flowers was equal to those that were given water prior to shipment and packed in an iced box.

Ice placed in the ends of the box (at the flower heads) did not prove advantageous. In this trial the box ends were seriously watersoaked, collapsed, and caused many flowers to become wet and some flowers to be broken from the stems below the calyx.

An upright stock hamper of carnations with ice around lower stems was observed. The method was shown to be impractical because flower heads became watersoaked. Also, short grades must be combined with fancy grades to efficiently fill space.

A comparison was made of carnation blooms harvested and shipped at different stages of maturity. Very tight buds (petals vertical from calyx) did not open properly even when stems were recut and preservative used. Buds where petals were slightly flared outward opened successfully and had the greatest keeping life of all stages when stems were recut and placed in water with flower preservative at room temperature. Stems were recut and solutions changed in all treatments every 4 to 5 days.

All commercial carnation varieties used in these trials (Red Sims, White Sims, Pink Sims, Anniversary, S. Arthur Sims, Galety, and Tangerine) performed about equal in keeping ability if the flowers were healthy and free of insect damage or disease.

Conclusions - On the basis of results from these trials, the procedure to assure best quality and keeping life of carnations at an eastern destination, would be for the grower or shipper to cool flowers overnight at 38° F to 42° F in water with flower preservative and these could then be shipped in uniced boxes. The best procedure following shipment would be to recut stems, place flowers in water with preservative, and when flowers are fully conditioned, hold them in refrigeration until selling time.

Cutting and grading flowers, then packing and shipping immediately without ice in boxes, appears to be feasible if growers and shippers could determine whether this schedule was possible. Proper conditioning after shipment by recutting stems and using flower preservative would assure best results with this shipping method.

It was apparent that wherever ice is placed in a box, including the center, leaking water can cause collapse of the box in handling, loosening of the braces, and damage to merchandise. Boxes that will not deteriorate with watersoaking and sufficient absorptive padding under the ice should be considered to eliminate losses due to container collapse.

If the wholesaler or retailer who receives shipments of carnations was willing to utilize tighter carnation flowers and condition them properly, several days additional keeping life could be assured. Logically, the grower would benefit by cutting tighter flowers on a regular schedule; (1) he could spray and dust with less injury to flowers, (2) flowers would be younger when cut and less likely to have contracted disease or insect damage. The shipper might benefit by increasing the number of flowers packed per box and also by eliminating the cost and time of icing boxes. The buyer would get

Acknowledgments:

Appreciation is expressed to the following who contributed to this project:

St. Regis Paper Company - 1 stock hamper
American Airlines - air freight
Cornell University - laboratory and greenhouse facilities
Dr. Raymond Fox, Cornell - for special assistance at Cornell University
Dr. Harry C. Kohl, Jr., U.C.L.A. - for recommendations of treatments
for conducting trials of flowers at various maturity stages.