Postharvest Handling Methods for Bird-of-paradise Flowers (Strelitzia reginae Ait.)

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Additional index words. flower preservatives, pulsing, flower storage, bud-opening

Abstract. Pulsing of cut bird-of-paradise flowers greatly enhanced the longevity and floret opening of both un­stored and stored flowers. Best results were obtained by pulsing tight flowers with 10% sucrose, 250 ppm
8-hydroxyquinoline citrate and 150 ppm of citric acid for 2 days at 22°C. Flowers cut at a very tight stage (4—5
days before commercial cutting stage) can be opened successfully in the same solution. Best storage temperature
is 8°C. Flowers can be stored for up to 1 month without losing quality, if pulsed before storage and if the blooms
are dipped in a fungicide solution (benomyl or 2(4-thiosalicyl)-benzimidazide (TBZ) at 200 ppm). Flowers can also
be stored at a tight stage and then opened in the pulsing solution after storage.

Bird-of-paradise flowers are large and heavy, creating pack­
ing difficulties and excessive expenses in air shipment of
flowers. Truck or boat shipments may be of great benefit if suitable methods were available, like those developed recently
for other cut-flowers (5).

Bird-of-paradise shows irregular periodicity in the blooming
season, which varies at different locations (4). The physiology
of flowering of this plant is poorly understood (4), and no
methods are known for controlling flowering. A reliable method
for long term flower storage might enable some regulation
in market supply.

Recently methods have been developed (1, 3, 5, 6, 7, 11)
for pulsing and bud-opening of several flowers. “Pulsing” is a
procedure to load flower tissues with sugar and certain other
chemicals, usually before shipment. This pretreatment consid­
erably improved the longevity and opening of the flowers (1,
3, 5, 11). “Bud-opening” is the procedure of opening flowers
that are harvested “immature” or at an earlier stage than normal. The advantages in handling bud-cut flowers, have been
described earlier (8). The experience gained in pulsing, bud-open­ing and shipment of other flowers was utilized in this
study on the evaluation of methods for pulsing, bud-opening,
shipment, and storage of bird-of-paradise cut flowers.

Materials and Methods

The experiments were conducted with bird-of-paradise flow­ers field grown in Encinitas, (Southern) California. Inflorescences
(flowers) were cut at 3 stages: a) commercial stage with the first
floret showing color, b) tight stage, about 2 days earlier than
“a,” florets still enclosed in the bracts, angle of the flower to
the stem is 35 to 45°, c) very tight stage, 4—5 days earlier than
“a,” angle of flowers to stem 50—60°. After harvest, flowers
were bunched, packed as in commercial practice and held at the
prevailing room temp until shipped. They were shipped by air
to Sacramento, remained overnight in the airport, and were
transferred the next morning by car to Davis where they were
used for the various experiments. Flowers were cut to a uniform
length of 80 cm before treatment. After the pretreatments,
simulated shipments or storage, the base of the flower stalk was
recut (2 cm) and stems were placed individually in deionized water to determine longevity and floret opening. Stalks dipped
high concn (1000 ppm) of AgNO3 solution were not recut at
the base. Truck shipment simulation was done by holding
flowers wrapped in paper for 4 days at 22°C. Longevity of
the flowers was judged as the time when the last floret of the
inflorescence withered. The starting time for all longevity judg­ments began after the pretreatments and when the flowers
were transferred to deionized water. Pulsing, bud-opening, and
evaluation of flower longevity were conducted under constant cool­
white fluorescent light (ca. 1000 lux), 22° and 65—80% relative humidity. Ten replications were used for each treatment, and
each experiment was conducted at least twice.

One concluding experiment was made in June, 1976 at the
grower’s facilities in Encinitas, and evaluated in San Diego under
and light conditions as in Davis, but the relative humidity
was 40—70%.

Experimental Procedure and Results

1. Evaluation of pulsing solutions and conditions.

A. Sugar concn. Flowers were pulsed for 24 hr in solutions
containing 50 ppm AgNO3, 150 ppm of citric acid (CA) and
various concn of sucrose. After pulsing, flowers were held in
fiberboard boxes at 22°C for 48 hr to simulate air shipment and
then evaluated. Optimal results were obtained with 20% sucrose
(Table 1). No injury was observed even in 25% sucrose.
However, the differences between 10% and 20% sucrose were
not significant; therefore, it was decided to use 10% sucrose in
further treatments as a standard concn.

B. Other solution components. In the first experiments
(Table 1) we uniformly added AgNO3, as a bacteriacide and CA
for acidification of the solution to the various sugar concn.
Since these 2 components are commonly used in pulsing solu­

Table 1. Effects of various sucrose concn used in pulsing bird-of-paradise flowers on longevity and no. of florets opened per flower stem.

<table>
<thead>
<tr>
<th>Sucrose concn (%)</th>
<th>Longevity (days)</th>
<th>No. of florets opened per stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>8.6d</td>
<td>1.5c</td>
</tr>
<tr>
<td>2.5</td>
<td>12.1c</td>
<td>2.1c</td>
</tr>
<tr>
<td>5.0</td>
<td>14.7b</td>
<td>3.0b</td>
</tr>
<tr>
<td>10.0</td>
<td>16.8ab</td>
<td>3.5ab</td>
</tr>
<tr>
<td>15.0</td>
<td>17.5a</td>
<td>3.8a</td>
</tr>
<tr>
<td>20.0</td>
<td>18.0a</td>
<td>4.0a</td>
</tr>
<tr>
<td>25.0</td>
<td>16.2b</td>
<td>3.2ab</td>
</tr>
</tbody>
</table>

2Pulsing was done for 24 hr all treatment solutions (including 0 sucrose)
contained 50 ppm AgNO3 and 150 ppm CA.
YMean separation within columns by Duncan’s multiple range test, 5% level.

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Flower Growers, Encinitas, Ca. for donation of the flowers used in these
studies. The capable technical assistance of Mr. J. Kubota is gratefully
acknowledged.

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3Professor and Farm Advisor, University of California, Davis and San
Diego, respectively.

The advice in the use of fungicide and the donation of the chemicals by
Dr. A. H. McCain, Dept, of Plant Pathology, Univ. of Calif., Berkeley,
is gratefully acknowledged.
tions (3, 5, 6, 8). However, it is now known (2, 3, 5) that various flower species respond differently to some chemicals. In a series of experiments, we tested several chemicals in a random order, to evaluate their efficiency as a pulsing pretreatment. The optimal order of each chemical was selected for inclusion in later experiments. We present (Table 2) only the results of a concluding experiment in which the best components and concentration were included as well as flowers of tight stage that were pulsed for 1 day, with optimal results.

Flowers harvested at a tight stage were sprayed with 200 ppm benomyl before shipment to Davis. They were pulsed for 48 hr (Table 3), in water or in solutions containing 10% sucrose and other chemicals. After pulsing, flowers were packed and held at 22°C for 4 days, as a simulation of non-refrigerated truck shipment, and then evaluated.

All the pulsed flowers, regardless of the chemicals used, were significantly superior to unpulsed (water only) flowers (Table 2). However, the best pulsing solution of those tried was 10% sucrose, 250 ppm HQC and 100 ppm CA. This solution was therefore used in further experiments.

C. Duration of pulsing. Flowers were harvested at 2 stages, commercial and tight, and treated differently. The commercial stage flowers were not pulsed or pulsed for only 24 hr; the tight flowers, however, were pulsed for 48 hr or for 72 hr. After pulsing, flowers were packed and held at 22°C for 4 days (truck shipment simulation) and then evaluated.

Flowers pulsed for 2 or 3 days were superior to those pulsed for only 1 day (Table 3). The difference between flowers pulsed for 2 and 3 days was not significant.

D. Solution temp. Pulsing for 2 days was superior to 1 day, (Table 3), apparently due to greater solution absorption. The question arose whether raising the solution temperature would facilitate better loading of the chemicals and enable shortening the pulsing period to 1 day, with optimal results.

Flowers of commercial stage were pulsed for 1 day at 22°C, 33°C or in a solution warmed to 58°C which was allowed to gradually cool to room temp (22°C). Dry and water controls were included as well as flowers of tight stage that were pulsed for 2 days. Flowers were handled as in the previous experiment (Table 3).

Pulsing with warm solutions for 24 hr had little or no effect on longevity and opening of the flowers (Table 4).

II. Other chemical pretreatments.

A. Short term treatment with AgNO₃. Pretreatment of flower stem bases of carnation and chrysanthemums (7) for a few minutes in high concn of AgNO₃ (1000—1500 ppm) greatly improved the longevity and opening of these flowers, and also after transcontinental truck shipments (5). In the following experiment we tested the value of Ag stalk impregnation on bird-of-paradise.

Flower stalk bases (10 cm) were immersed for 15 min in 1000 ppm AgNO₃ solution. This treatment was given alone or in combination with a subsequent pulsing treatment for 24 hr. The Ag dip reduced the longevity and opening of unpulsed flowers and had no effect on pulsed ones (Table 5).

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**Table 2. The effects of various chemicals used in pulsing bird-of-paradise flowers on longevity and no. of florets opened per flower stem.**

<table>
<thead>
<tr>
<th>Pulsing solution</th>
<th>Longevity (days)</th>
<th>No. of florets opened per stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water only</td>
<td>6.7c</td>
<td>1.6c</td>
</tr>
<tr>
<td>10% sucrose + SDT (500 ppm)</td>
<td>10.3b</td>
<td>3.3b</td>
</tr>
<tr>
<td>10% sucrose + HQC (250 ppm)</td>
<td>10.4b</td>
<td>3.1b</td>
</tr>
<tr>
<td>10% sucrose + CA (150 ppm)</td>
<td>12.2a</td>
<td>4.1a</td>
</tr>
<tr>
<td>10% sucrose + HQC + CA</td>
<td>9.6b</td>
<td>2.9b</td>
</tr>
<tr>
<td>10% sucrose + AgNO₃ (50 ppm)</td>
<td>10.1b</td>
<td>3.0b</td>
</tr>
<tr>
<td>10% sucrose + Ag + CA</td>
<td>10.4b</td>
<td>3.0b</td>
</tr>
<tr>
<td>10% sucrose + Ag + HQC</td>
<td>10.8b</td>
<td>3.1b</td>
</tr>
<tr>
<td>+ Al (300 ppm)</td>
<td>11.6ab</td>
<td>3.9a</td>
</tr>
<tr>
<td>10% sucrose + HQC + CA + SDT</td>
<td>11.6ab</td>
<td>3.9a</td>
</tr>
</tbody>
</table>

**Table 3. Effect of duration of pulsing on longevity and floret opening of bird-of-paradise.**

<table>
<thead>
<tr>
<th>Duration of pulsing</th>
<th>Longevity (days)</th>
<th>No. of florets opened per stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pulsing (dry)</td>
<td>8.4c</td>
<td>1.7c</td>
</tr>
<tr>
<td>1 day</td>
<td>12.1b</td>
<td>2.9b</td>
</tr>
<tr>
<td>2 days</td>
<td>14.3a</td>
<td>3.7a</td>
</tr>
<tr>
<td>3 days</td>
<td>14.8a</td>
<td>3.9a</td>
</tr>
</tbody>
</table>

**Table 4. Effect of pulsing commercial stage flowers for 24 hr at the various temp on longevity and florets opening of bird-of-paradise.**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Longevity (days)</th>
<th>No. of florets opened per stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pulsing (dry)</td>
<td>8.4c</td>
<td>1.7c</td>
</tr>
<tr>
<td>1 day water - 22°C</td>
<td>8.3c</td>
<td>1.5c</td>
</tr>
<tr>
<td>1 day pulse - 22°C</td>
<td>12.1b</td>
<td>2.9b</td>
</tr>
<tr>
<td>1 day pulse - 33°C</td>
<td>12.6b</td>
<td>3.1b</td>
</tr>
<tr>
<td>1 day pulse - start 58°C</td>
<td>11.9b</td>
<td>3.2ab</td>
</tr>
<tr>
<td>2 days pulse - 22°C</td>
<td>14.3a</td>
<td>3.7a</td>
</tr>
</tbody>
</table>

**Table 5. The effect of emersing flower stalk bases in AgNO₃ solution (1000 ppm for 15 min), with (+) and without (−) pulsing after the Ag treatment on longevity and opening of bird-of-paradise flowers.**

<table>
<thead>
<tr>
<th>Initial AgNO₃ emersion Subsequent pulsing</th>
<th>Longevity (days)</th>
<th>No. of florets opened per stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>−</td>
<td>8.6b</td>
<td>1.5b</td>
</tr>
<tr>
<td>+</td>
<td>7.2c</td>
<td>1.4b</td>
</tr>
<tr>
<td>+</td>
<td>14.4a</td>
<td>3.9a</td>
</tr>
<tr>
<td>+</td>
<td>14.1a</td>
<td>4.0a</td>
</tr>
</tbody>
</table>

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with several fungicides. Dipping or spraying blooms with 200 ppm benomyl or TBZ almost completely overcame the problem. Including 500 ppm of either fungicide in the pulsing solution was also beneficial but to a lesser extent than the bloom dip treatment (Fig. 1).

III. Bud-opening of flowers.

In the pulsing experiments (Table 3) flowers harvested at a tight stage (about 2 days prior to the normal harvesting stage) developed in the pulsing solution and exhibited excellent quality after simulated truck shipment. In the following experiment the possibility of opening flowers cut at a tighter stage was explored.

Flowers were harvested at a very tight stage (about 4–5 days before the normal harvesting stage), and opened in various sucrose concentrations. When the flowers reached the commercial stage they were transferred to water, and longevity was determined from that time.

Table 6. The effect of solutions containing various concentrations of sucrose on the opening and longevity of bird-of-paradise flowers opened from a very tight stage.

<table>
<thead>
<tr>
<th>% sucrose in opening solution</th>
<th>Number of days to reach commercial stage</th>
<th>Longevity (days)</th>
<th>No. of florets opened per stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5.5b</td>
<td>9.3d</td>
<td>2.0bc</td>
</tr>
<tr>
<td>2.5</td>
<td>3.4c</td>
<td>11.4c</td>
<td>2.2b</td>
</tr>
<tr>
<td>5.0</td>
<td>2.7c</td>
<td>14.2b</td>
<td>3.0ab</td>
</tr>
<tr>
<td>10.0</td>
<td>3.6c</td>
<td>18.2a</td>
<td>3.5a</td>
</tr>
<tr>
<td>20.0</td>
<td>3.8c</td>
<td>17.1a</td>
<td>3.3a</td>
</tr>
<tr>
<td>Water only, tight stage</td>
<td>7.0a</td>
<td>6.2e</td>
<td>1.2c</td>
</tr>
<tr>
<td>Water only, commercial stage</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The optimal sucrose concn for bud-opening is 10% (Table 6). Very tight flower buds (4–5 days before commercial stage) can be opened in solution in a period slightly less than that required for reaching a similar stage in the field. The quality (longevity and opening) of these flowers was excellent and even better than those harvested at the commercial stage and then placed in water.

IV. Storage of flowers.

The first tests in storage of flowers were carried out before the results of the pulsing experiments were available and before the necessity of using a fungicide treatment was evident (see above I and IIb). These preliminary experiments indicated, however, that for short-term storage (up to one week), the best temp is 5°C, but for longer periods of storage the optimal temp is 8°C.

A long-term storage experiment was conducted in April, 1976. Flowers were harvested at 2 stages: commercial and tight. The blooms were dipped in 200 ppm benomyl before packing and shipping to Davis. The flowers at the commercial stage were transferred immediately to the various storage temp. The tight flowers were pulsed for 2 days before storage. During the pulsing period the tight flowers opened to the commercial stage. Flowers were stored in bunches of 5 and wrapped in news-
papers. The bunches were placed in fiberboard boxes lined with a polyethylene sheet. After 28 days flowers were removed from storage, the bases of the stalks were recut (2 cm) and placed in water.

The best long term storage temp is 8°C (Table 7). Prestorage pulsing greatly enhanced the longevity and opening of the flowers. Pulsed flowers stored for 4 weeks at 8°C were of comparable quality or better than the non-pulsed commercial stage flowers. The value of pulsing before storing is illustrated in Fig. 2. Necrotic lesions are evident on the bracts of the flowers stored at 6°C but not at 8°C (Fig. 2).

The previous experiment was done with flowers of commercial stage (either cut or developed to that stage during pulsing of tight stage). In the following experiment, we examined the possible effect of pulsing flowers at the tight bud stage and opening them after storage as was found with other flowers (6).

Flowers of tight and very tight stages were dipped in 200 ppm benomyl before shipping to Davis. They were stored for 12 days at 8°C and then placed in water or in a solution of 10% sucrose, 250 ppm HQC and 150 ppm CA until they opened to the commercial stage. They were then transferred to water for inflorescence longevity and opening measurements.

Buds stored in tight stage were of excellent quality when placed in the opening solution after storage (Table 8). Buds of the very tight stage required a longer period of time to open and were of inferior quality to tight stage buds. However, even those very tight buds were comparable to non-pulsed, not-stored flowers harvested at the commercial stage.

A final storage experiment, including a large number of flowers, was done in June, 1976 at the end of the flowering season. Flowers were harvested at 2 stages: commercial and tight. Commercial flowers were not pulsed. Tight flowers were pulsed after harvest for 2 days. Flowers were stored for 21 days at 8°C and received 200 ppm benomyl before storage. Controls of unstored, pulsed and non-pulsed flowers were included. Results further demonstrate the value of pulsing of both stored and non-stored flowers (Table 9). The quality of the non-pulsed flowers at the end of the season was generally very poor and many failed to open at all. Pulsing greatly improved the quality of these flowers, even more than of mid-season flowers (Table 7).

**Discussion**

Pulsing is a short-term chemical treatment given to flowers before they reach the retailer and consumer. Optimal formulations and conditions should be developed for each flower to assure best loading (2, 3, 5). Results presented here (Table 2), show that some components common in preservative and pulsing solution of other flowers (3, 5, 6, 7, 8), such as Ag, Al and

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of days to reach commercial stage</th>
<th>Longevity (days)</th>
<th>No. of flowers opened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tight</td>
<td>Water</td>
<td>3.2b</td>
<td>6.5c</td>
</tr>
<tr>
<td>Tight</td>
<td>Solution</td>
<td>3.3b</td>
<td>15.1a</td>
</tr>
<tr>
<td>Very</td>
<td>Tight</td>
<td>4.8a</td>
<td>6.7c</td>
</tr>
<tr>
<td>Very</td>
<td>tight</td>
<td>4.6a</td>
<td>8.6b</td>
</tr>
<tr>
<td>Commercial</td>
<td>Water</td>
<td>9.8b</td>
<td>2.2bc</td>
</tr>
</tbody>
</table>

2Opening solution: 10% sucrose, 250 ppm HQC, and 150 ppm CA.
3Commercial flowers, not stored, put immediately in water.
4Mean separation within columns by Duncan’s multiple range test, 1% level.

**Table 8. Longevity and opening of tight Strelitzia flowers stored for 12 days at 8°C and opened after storage.**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Storage duration</th>
<th>Harvest stage</th>
<th>Pulse</th>
<th>Longevity (days)</th>
<th>No. of flowers open per stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Commercial</td>
<td>–</td>
<td>5.8b</td>
<td>0.7b</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>Tight bud</td>
<td>+</td>
<td>9.4a</td>
<td>1.8a</td>
<td></td>
</tr>
<tr>
<td>21 days</td>
<td>Commercial</td>
<td>–</td>
<td>3.1c</td>
<td>0.6b</td>
<td></td>
</tr>
<tr>
<td>21 days</td>
<td>Tight bud</td>
<td>+</td>
<td>9.3a</td>
<td>2.5a</td>
<td></td>
</tr>
</tbody>
</table>

**Table 9. The effect of pulsing and storage for 21 days at 8°C on longevity and opening of bird-of-paradise flowers (San Diego, June, 1976).**

SDT are of little or no value for treating bird-of-paradise. A good combination was 10% sucrose, 250 ppm HQC and 150 ppm CA. It is, of course, possible that further experiments will result in a better formulation. However, it was demonstrated here that pulsing with the suggested solutions greatly improved the quality of fresh flowers, and of flowers in simulated transcontinental truck shipments, and was an indispensable treatment for stored flowers.

In experiments with other flowers it was found that all metabolic sugars are equally effective in pulsing and opening solutions (1, 2, 5); therefore, only sucrose was included in our tests with bird-of-paradise. The optimal sucrose concn in the solution varies with different flowers from 2–3% (3, 5) in roses to 20% and higher in gladiolus (11) and certain cultivars of chrysanthemum (5). The main reason for this concn variability is the sensitivity of the foliage of some plants to excessive sugar concn (1). In bird-of-paradise, like gladiolus (11), no leaf damage was observed even at the very high concn of 25%. However, 10% sucrose was chosen as a practical concn as was also found for carnations (2).

The solution chosen for pulsing was also optimal for bud-opening. Flowers of bird-of-paradise can be successfully opened off the plant even when cut in a very tight-bud stage, 5 days before normally harvested. In addition to the advantage of handling buds over open flowers during shipment and storage, this technique is especially important for flower crops grown out-doors as bird-of-paradise. Harvesting at an early bud stage, and opening the flowers in a protected location, may reduce the hazard of damage to flowers at their most sensitive stage, by uncontrollable external conditions such as pests, diseases, hail, storms, frost and hot-dry winds.

Our studies show that it is possible to store bird-of-paradise flowers for 1 month with very good results. This provides a technique for some regulation of flower marketing and of long term truck or boat shipment of this heavy commodity. For good results there are 3 main requirements: a) blooms should be dipped or sprayed after harvest with a fungicide, b) flowers should be pulsed before or after storage (the latter if stored in the tight-bud stage), and c) flowers should be well wrapped to prevent desiccation and stored at a temp of 8°C.

The relatively high temp (5–8°C) required for handling of bird-of-paradise flowers, may create difficulties in truck shipments of mixed flower products, since the desired shipping temp for the major flower crops (roses, carnations, and chrysanthemums) is 1°C (2, 5). Our recommendation for handling these 3 major flower crops during transcontinental transport is to precool them to 2°C before loading into a refrigerated truck, since reduction of temp of un precooled packed flowers in these refrigerated trucks is a very slow process requiring several days (5). It is therefore unlikely that the temp of un precooled bird-of-paradise flower will drop much below 5°C during transcontinental transit in refrigerated trucks.

Bird-of-paradise flowers stored at too low a temp for

extended periods failed to open properly and showed necrotic lesions on the flowers and bracts (Table 7, Fig. 2). These are typical signs of chilling injury which is common in tropical and sub-tropical crops (10).

**Literature Cited**


**Population Studies of Pratylenchus penetrans and its Effects on Peach Seedling Rootstocks**

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*Additional index words.* Root lesion nematode, Siberian C, Harrow Blood, Veteran, Rutgers Red Leaf, *Prunus persica*

**Abstract.** Field samplings in 3 peach orchards with 4 seedling rootstocks showed that Siberian C seedlings had significantly higher levels of *Pratylenchus penetrans* ([Cobb] Filip. and Stek.) populations in both root tissues and surrounding soil than 3 other seedling rootstocks tested. Little difference in nematode populations could be shown between seedlings of Veteran, Harrow Blood and Rutgers Red Leaf. Greenhouse studies of infected and nematode-free seedlings of these rootstocks confirmed field results. Significant reduction in growth occurred in all the rootstocks tested, with Siberian C seedlings being the most severely affected. Nematode control and plant breeding implications are discussed.

Peach seedling rootstocks are widely used in North America for the propagation of peach (*Prunus persica* (L.) Batsch) cultivars (4, 5, 14). Southwestern Ontario is located close to the climatic limit of peach production (12) and any positive contribution of rootstock to plant winter survival has great economic importance. Layne et al. (6, 7) evaluated various rootstock seed sources under the conditions of southwestern Ontario and demonstrated that orchard performance of peach cultivars was substantially affected by the rootstock selected. Siberian C was found to be more cold hardy as a seedling rootstock than others tested (5). In addition, it appeared to have the potential to confer increased hardiness to commercial scion cultivars (6, 12).

This hardness of Siberian C seedlings, coupled with the early defoliation they confer on scion cultivars, has made this seedling rootstock very popular with peach producers in the Northern U.S. and Canada (5, 6). The relatively short life of peach trees in Southwestern Ontario has resulted in high demand for cultivars on this rootstock for use in new and replacement plantings.

Longevity of peach orchards has been a major economic problem in this area as elsewhere in North America. Undoubtedly, winter injury has been important (12), but there is ample evidence for other causal agents. Nematodes also play an important role in short life of peach as shown by Mountain and Boyce (10), Hendrix and Powell (3) and Zehr et al. (16). In Ontario, the importance of the root lesion nematode, *Pratylenchus penetrans*, has been documented by Mountain and co-workers (9, 10, 11). None of the peach rootstocks currently employed are known to be resistant to the root lesion nematode; Siberian C seedlings have been reported to be more susceptible than others tested (1, 4, 6). This investigation was prompted by the need to quantitatively evaluate peach seedling rootstocks for reaction to *P. penetrans*.

**Materials and Methods**

*Field studies.* Field studies were carried out during 1975 and 1976 in 3 experimental orchard blocks established in 1968 (7). Root and soil samples were collected in Nov., 1975, and June, August and Oct., 1976. Where possible, root and soil samples were taken from the middle tree in each rootstock subplot. Nematodes were extracted from a 50 g sub-sample of soil by the modified Baermann pan method described by Townsend (15). Root extractions were done using a bubbler technique. The nematode counts obtained were analyzed using a log (X + C) transformation with constants chosen as suggested by Proctor and Marks (13).

*Greenhouse studies.* Since field studies at best would be