Role of Ethylene in Senescence of Cut Oxypetalum Florets

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Summary

Floret senescence of Oxypetalum caeruleum was investigated in relation to ethylene production and its sensitivity to ethylene. Ethylene production increased as the florets senesced, and conversely, their senescence was accelerated by exogenous application of ethylene at 2 or 10 μl·liter⁻¹ for 24 hr, indicating that Oxypetalum florets are sensitive to the gaseous hormone. Treatment with silver thiosulphate complex (STS), an ethylene action inhibitor, extended the vase life of florets. Thus, ethylene is considered to be involved in the senescence of cut Oxypetalum florets.

Key Words: cut florets, ethylene, Oxypetalum caeruleum, senescence, silver thiosulphate complex.

Introduction

Oxypetalum caeruleum, which is native to Brazil and Uruguay, has bright blue, star-like florets that are used for cut flowers. Oxypetalum is mainly produced in Nagano and Kochi Prefectures in Japan. Cut ends of Oxypetalum flowers exude latex which coagulates and causes vascular occlusion, thereby inhibiting water uptake. To avoid this problem, commercial growers usually dip the cut ends in boiling water for 10 to 20 seconds. However, the vase life of cut Oxypetalum flowers is relatively short even if vascular occlusion is inhibited. To our knowledge, postharvest physiology of cut Oxypetalum flowers has not yet been investigated.

The senescence of many cut flowers is controlled by ethylene, a gaseous phytohormone (Woltering and van Doorn, 1988). The vase life of ethylene–sensitive flowers such as carnation (Veen, 1979) and Eustoma (Ichimura et al., 1998) can be markedly extended by silver thiosulphate (STS), an inhibitor of ethylene action. Accordingly, we studied on the role of ethylene in floret senescence of Oxypetalum.

Materials and Methods

Plant material

Seedlings of Oxypetalum caeruleum Decne. were grown in a greenhouse of Nagano Nanshin Agricultural Experiment Station. In some experiments, flower spikes of Oxypetalum were obtained from a commercial grower at Matsukawa, Nagano Prefecture. After harvest in November 2000, the cut ends of flower spikes were immersed in tap water and transported to a laboratory of National Institute of Floricultural Science. Unless otherwise stated, the florets with a peduncle 1 cm in length, which opened on the day of harvest, were cut from the flower spikes and individually transferred to a test tube containing distilled water. The florets were held at 23 °C, 70% relative humidity, in a 12 hr–photoperiod with 10 μmol·m⁻²·sec⁻¹ irradiance from cool–white fluorescent lamps throughout the experimental period.

Measurement of ethylene production

Each floret was placed in a 10-ml Erlenmeyer flask (20.5 ml) and the flasks sealed, and kept at 23 °C. Two hours later, a 1-ml gas sample was withdrawn into a syringe; ethylene concentration was determined with a Shimadzu gas–chromatograph model GC–7A, equipped with an alumina column and flame ionization detector.

Evaluation of ethylene sensitivity

Individual cut florets were transferred after 1 day to a transparent acryl chamber with a septum (70 liter). Ethylene was introduced into the chamber through the septum to give a concentration of 2 or 10 μl·liter⁻¹. The florets were removed after 24 hr from the chamber and their vase life determined as the time from the end of the treatment to when petal color changed or when the opening angles of petals became less than 90° (floret closing).

STS treatment

STS solution was prepared by mixing equal volumes of AgNO₃ and Na₂S₂O₃ · 5H₂O in a molar ratio of 1 to 8, respectively. Florets were cut from flower spikes on the day of harvest; the cut ends of florets were immersed in various concentrations of STS solution, held there for

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Table 1. Effects of ethylene on the vase life of cut *Oxypetalum* florets.

<table>
<thead>
<tr>
<th>Concentration (µl·liter⁻¹)</th>
<th>Vase life (days)¹</th>
<th>Time to change in petal color</th>
<th>Time to flower closing</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.4 ± 0.4²</td>
<td>2.9 ± 0.5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.0 ± 0.0*</td>
<td>1.0 ± 0.5*</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>0.0 ± 0.0**</td>
<td>0.3 ± 0.3**</td>
<td></td>
</tr>
</tbody>
</table>

Cut florets were exposed to ethylene for 24 hr.
² Vase life was determined from the end of ethylene treatment.
³ Values represent mean of 6 flowers ± SE, and those with* and** are significant at P=0.05 and P=0.01, respectively, compared with the control (0 µl·liter⁻¹) by the Dunnett’s test.

4 hr, and then transferred to distilled water. The vase life of florets was determined as the time from harvest to change in petal color or closing of florets.

**Results and Discussion**

The first sign of floret senescence is change in petal color; the blue begins to change to a faded crimson around 4 days after harvest. The next day the florets will close; finally the closed florets become dry and shriveled.

The rate of ethylene production from the florets was relatively low until 4 days after harvest (Fig.1). It gradually increased thereafter as the floret senesced and reached a peak 8 days after harvest when florets became completely closed. Fresh weight of florets was almost constant until 9 days after harvest and then decreased; thus, the increase in ethylene production is not attributed to a decrease in the fresh weight.

Floret senescence was significantly promoted by exposure to ethylene at 2 and 10 µl·liter⁻¹ (Table 1).

![Changes in ethylene production from cut *Oxypetalum* florets. Values are means of 4 measurements ± standard errors. Arrow indicates time when petal color began to change.](image)

Table 2. Effects of STS concentration on the vase life of cut *Oxypetalum* florets.

<table>
<thead>
<tr>
<th>Concentration (mM)</th>
<th>Vase life (days)¹</th>
<th>Time to change in petal color</th>
<th>Time to flower closing</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.3 ± 0.3²</td>
<td>4.7 ± 0.2</td>
<td></td>
</tr>
<tr>
<td>0.05</td>
<td>4.3 ± 0.3</td>
<td>5.7 ± 0.3</td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td>5.2 ± 0.5*</td>
<td>9.5 ± 1.1**</td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>6.0 ± 0.5**</td>
<td>8.5 ± 0.6**</td>
<td></td>
</tr>
<tr>
<td>0.4</td>
<td>5.5 ± 0.5**</td>
<td>9.5 ± 0.8**</td>
<td></td>
</tr>
</tbody>
</table>

Cut florets were treated with STS for 4 hr.
¹ Vase life was determined from harvest.
² Values represent mean of 6 flowers ± SE, and those with* and** are significant at P=0.05 and P=0.01, respectively, compared with the control (0 mM) by the Dunnett’s test.

According to the criteria of Woltering and van Doorn (1988), sensitivity to ethylene of *Oxypetalum* florets is high.

Treatment with STS at 0.1-0.4 mM significantly delayed changes in petal color and closure of florets (Table 2), indicating that STS inhibits floret senescence of *Oxypetalum*.

The results obtained in this study clearly indicates that floret senescence of *Oxypetalum* is primarily controlled by ethylene. The floret of *Oxypetalum* showed a climacteric increase in ethylene production (Fig.1). Furthermore, treatment with STS extended the vase life of florets (Table 2). These findings indicate that floret senescence of *Oxypetalum* is regulated by autocatalytic ethylene production. A similar climacteric increase in ethylene production is attributed to an autocatalytic reaction in the florets of some plants, such as carnation (Van Altvorst and Bovy, 1995) and *Eustoma* (Ichimura et al., 1998).

Cut flower spikes of *Oxypetalum* are not treated with a preservative by growers but our study reveals that the vase life of *Oxypetalum* florets can be significantly extended by STS (Table 2). To facilitate uptake of STS solution, cut ends of flower spikes should preferably be dipped in boiling water for 10 to 20 seconds prior to the treatment with STS. Because STS contains silver and is a potential environmental pollutant, other ethylene inhibiting compounds, such as 1-methylecyclopene (Serek et al., 1995), aminoxyacetic acid (Broun and Mayak, 1981) and aminothoxyvinyl glycine (Baker et al., 1977) which are effective in extending the vase life of cut carnation flowers might be substituted. Such a study is in progress to test if these inhibitors of ethylene biosynthesis or action would similarly extend the vase life of cut *Oxypetalum* flower spikes.
Acknowledgment

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Literature Cited


