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Short communication

Role of Ethylene on Sprouting of Onion Bulbs (*Allium cepa* L.).

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Introduction

Ethylene is a volatile hormone that has received considerable interest as a regulator of plant growth and is involved in numerous aspects of plant life. It has long been recognized as a crucial factor in the storage of horticultural products, and was employed in various cultural and postharvest practices long before it was identified as the causative agent (Abeles et al., 1992).

It has been shown that sprouting of onion bulbs is controlled by some hormones which inhibit (abscissic acid) or promote (cytokinins) growth, and ethylene may also inhibit or promote bud growth by regulating these factors. However, its role in breaking dormancy and promoting sprouting of onion bulbs remains unclear (Woltering & Sterling, 1986; Abeles et al., 1992).

Exogenous ethylene (ethephon) has been used to overcome the dormancy of both *Gladiolus* (Halevy et al., 1970) and *Liatris* (Keren-Paz et al., 1989) corms. In addition to promoting sprouting of gladiolus, ethephon increases the effectiveness of fungicides, apparently by increasing their penetration into corm tissues (Simchon et al., 1972).

In this investigation, we have studied the role of ethylene (ethephon) and silver thiosulfate (STS), a patent inhibitor of ethylene action, on the sprouting of onion bulbs during storage.

Materials and methods

Plant material

Onion bulbs 'Rouge Amposta' were grown in the Mascara area (Algeria), harvested in August and dried in the field for 2 weeks. They were then sorted for uniformity and absence of defects. The bulbs were divided into four groups: ethephon-treated, ethephon-treated with cold treatment, STS treatment (without cold treatment) and control (no treatment).

Ethephon treatment

Onions were injected with a solution of 100 ppm of ethephon (2-chloroethylphosphonic acid; Sigma Chemical Co., St Louis, USA). One injection of 1 ml was applied into the centre of each bulb.

Cold treatment

Prior to ethephon treatment, onion bulbs were cooled for 3 weeks at 9°C and 90% relative humidity (RH). Then the bulbs were kept at a temperature of 18°C for 24 h.

Silver thiosulfate treatment

STS was prepared according to Veen (1979). Non-cooled bulbs were dipped by their base in a 0.2 mM STS solution during 24 h. Then, they were dried at 40°C for 15 min.

Storage

Onions were packed in commercial plastic (PVC) trays of 12 kg, and stored for 6 months in a dark room at 18°C and 70% RH.

Ethylene measurement

Ethylene was measured by a gas chromatograph (Delsi. 200 model) equipped with a flame ionizing detector at 110°C and fitted with an activated alumina column (2 m × 4 mm; Altech) at 90°C. The carrier gas was N_2 with a flow rate of 30 ml min^{-1} and the integrator was Intersmat.ICR. 1B.

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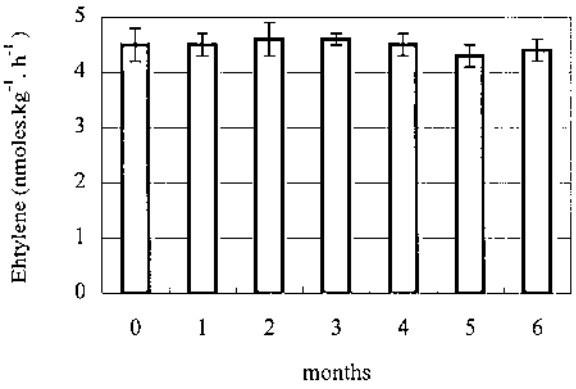

Fig. 1. Ethylene production of onion bulbs during storage.

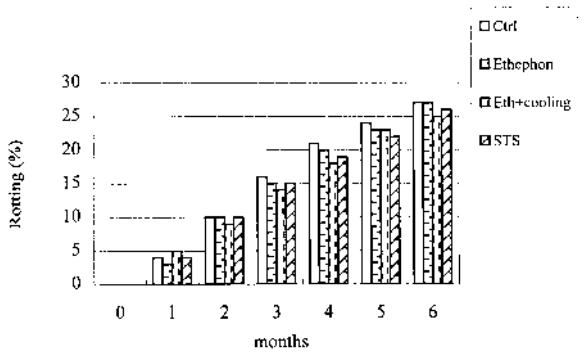

Fig. 3. Effect of ethephon and silver thiosulfate (STS) on rotting of onion bulbs during storage.

Statistical analysis. Each experiment was performed in triplicate in two successive years (1995 and 1996). Statistical analysis of the data was conducted using Statgraphics 7.0 statistical software.

Results and discussion

Ethylene production

The ethylene production of onion bulbs was low during the storage period. After 2 months of storage, there was an increase of 0.1 nmoles kg^{-1} h^{-1} in the ethylene production and sprouting was observed. During the 6 months of storage, the average ethylene production rate was 4.49 nmoles kg^{-1} h^{-1}, with a maximum variation of only 0.3 nmoles kg^{-1} h^{-1} (Fig. 1).

According to Kobo et al. (1990), the sensitivity of onions to ethylene is very low and its production is less than 10 nmoles kg^{-1} h^{-1}.

Sprouting

Sprouting of the control bulbs and the non-cooled bulbs treated with ethephon was normal during storage, with a level of 50% after 3 months and 100% after 6 months. Sprouting occurred earlier for cooled bulbs treated with ethephon, 50% after 2 months and 100% after 4 months (Fig. 2).

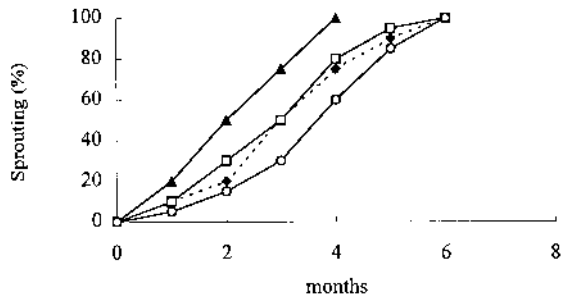

Fig. 2. Effect of ethephon and silver thiosulfate (STS) on sprouting of onion bulbs during storage. (◆ = Ctrl; □ = Ethephon; ▲ = Eth + cooling; ○ × STS)

Sprouting of STS-treated bulbs was slightly delayed. Only a 50% sprouting rate was observed after 4 months, and no significant difference was noted for sprouting rate (100%) in STS-treated or other bulbs after 6 months.

It appears that ethephon had almost no effect on sprouting of bulbs, whereas STS slowed down sprouting but did not inhibit it. Cold treatment combined with ethephon stimulated more sprouting than ethephon without cold treatment.

The postharvest role of ethylene is not very clear in sprout growth. According to Thomas & Rankin (1982), high doses of ethephon (3 g l^{-1} × 3 applications per day) increase the percentage of sprouting of some onion cultivars after 6 months' storage. Even if the effect of ethylene on sprouting of onion bulbs during storage remains unclear, cold treatment of bulbs promotes perceptibly the break of dormancy (Dennis, 1987).

Rotting

During storage, no statistical difference in rotting was observed between ethephon-treated and control bulbs, or ethephon and STS-treated onion bulbs (Fig. 3). Rotting of onion bulbs during storage depends upon numerous preharvest and postharvest factors: cultivation, harvesting, handling and storage conditions (Ryall & Lipton, 1972).

In conclusion, the results of this study indicate that ethephon by itself does not have a significant effect on the break of dormancy and sprouting of onion bulbs. In combination with cold treatment, however, ethephon promotes sprouting and its role in the development of the inner bud seems effective. Silver thiosulfate delays this development slightly. Further investigations are necessary to elucidate the interaction of ethylene with other hormonal factors in inner bud physiology and its involvement during rest and sprouting periods.

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