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Effect of Dormancy-breaking Treatments on Respiration of Gladiolus Corms

Takashi HOSOKI*

種々の休眠打破処理がグラジオラス球茎の呼吸に及ぼす影響

細 木 高 志

Introduction

Dormancy of spring- and summer-flowering gladiolus corms was broken by various chemicals and high/low temperature storage.[1—4] However, effect of these treatments on respiration has not been studied well so far. This report describes that dormancy-breaking treatments stimulate respiration of the treated corms.

Marterials and Methods

Dormant corms of spring-flowering gladiolus 'Comet' and summer-flowering gladiolus 'Traveler' were dug 40–50 days after flowering. The daughter corms were removed and kept in the laboratory room for several days. For measuring respiration rates, 300–800g corms were placed into a desiccator in which CO_2 released from the corms were absorbed at 20°C to 2N-KOH solution for several hours.[5] Then, the absorbed CO_2 was precipitated as $BaCO_3$ in 25% $BaCl_2$ solution. The amount of CO_2 respired by the corms was calculated from the amount of 0.2N-HCl required to neutralize the unreacted KOH. The corms were planted in moist perlite, 4–16 hours after treatments, and kept at 20°C.

For ethanol treatment, corms of 'Comet' were exposed at 20℃ to ethanol vapor in a plastic bag for 12 hours. For calcium cyanamide treatment, corms of 'Traveler' were immersed at 30℃ in 3% $CaCN_2$ solution for 2 hours. For ethylene gas treatment, corms of 'Traveler' were exposed at 30℃ to 1% C_2H_4 in a desiccator for 3 days. For nitrogen gas treatment, corms of 'Traveler' were sealed at 30℃ in 100% N_2 gas for 5 days. For hot water treatement, corms of 'Traveler' were immersed in hot water (46℃) for 1 hour. For hulling treatment, corm scales of 'Traveler' were removed completely. For storage treatment, corms of 'Traveler' were stored at 5℃, 30℃ in dry condition and at 20℃ in moist condition in which gladiolus corms maintain dormancy In this experiment, respiration rate was measured at respective temperature during storage.

To observe effect of chemicals, hot water, hulling and storage on sprouting from dormant corms, corms of 'Traveler' and 'Comet' in dormant state were dug up 40–75 days after flowering, and daughter corms were removed and kept in the laboratory room for several days. They were, then, treated with chemicals, hot water, hull removal or storage for 20 days in the same manner as respiration test. The treated corms (10–12 per treat-

* Laboratory of Vegetable and Ornamental Horticulture, Faculty of Agriculture, Shimane University, Matsue 690, Japan

ment) were planted in moist perlite and kept at 20℃. Days to 60% sprouting from planting were checked.

Results

Ethanol vapor treatment induced a sharp increase in respiration after treatment; the rate remained at higher level than untreated control up to 8 days after planting. Control corms showed a steady decline in respiration from planting time to 8 days later. Respiration rates measured during ethanol treatment showed an initial depression but an increase 12 hours after treatment (Fig. 2). Calcium cyanamide induced a great increase in respiration 8 hours after treatment while control corms immersed in water showed no increase in respiration (Fig. 3). Ethylene treatment induced double respiration rate of air-control corms just after the treatment (Fig. 4). Nitrogen treatment showed higher level of respiration than air-control during the treatment (at 4th day); this tendency continued up to 5 days after treatment (Fig. 5). Hot water treatment induced a sharp increase in respiration while control corms immersed in cold water (23℃) induced only slight increase (Fig. 6). Hulling treatment induced an increase of respiration immediately after the treatment; intact corms showed a lower peak (Fig. 7). The rates were nearly equal on the 5th day after treatment. Corms stored at both dry and moist conditions showed gradual decrease of respiration with storage time regardless of storage temperatures (Fig. 8). But, within 24 hours after planting, respiration rates increased in the corms stored in dry condition, those stored at 5℃ respiring faster than those kept at 30℃. No change in respiration rate was noticed in the corms stored moist at 20℃.

For sprouting tests, all the treated corms sprouted 7-22 days earlier than control corms; those of summer-flowering gladiolus 'Traveler' required longer time to reach 60% sprouting, compared with spring-flowering gladiolus (Table 1). Cold storage at 5℃ shortened dormant period of 'Traveler' more effectively than high temperature storage at 30 ℃; moist storage at 20℃ kept corms dormant nearly 4 months.

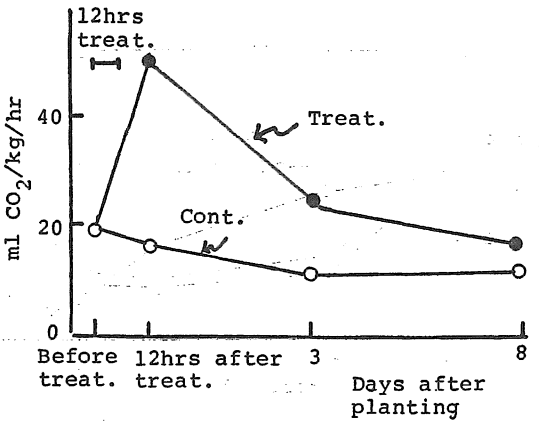

Fig. 1 Effect of ethanol vapor treatment on respiration change in gladiolus corms 'Comet'.

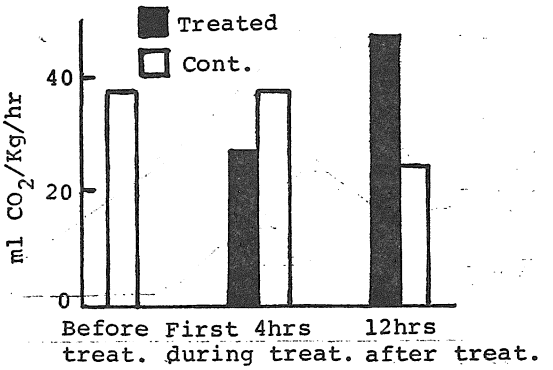

Fig. 2 Depression of respiration in gladiolus corms 'Traveler' during exposure to ethanol vapor, and subsequent increase of respiration after the treatment.

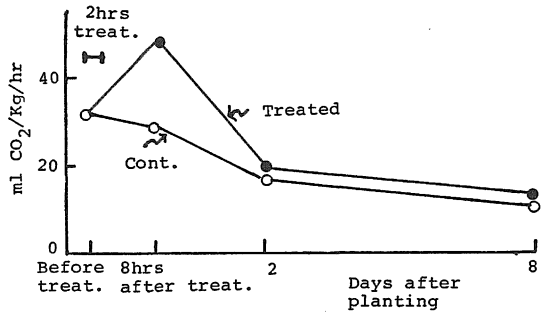

Fig. 3　Effect of calcium cyanamide treatment on respiration change in gladiolus corms 'Traveler'.

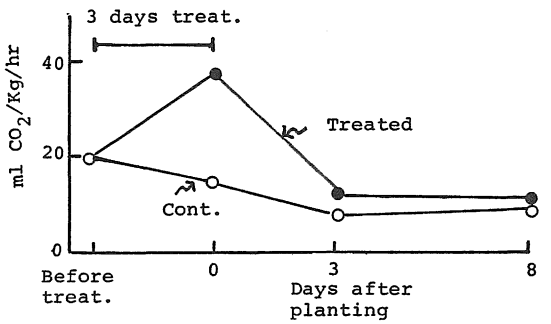

Fig. 4　Effect of ethylene gas treatment on respiration change in gladiolus corms 'Comet'.

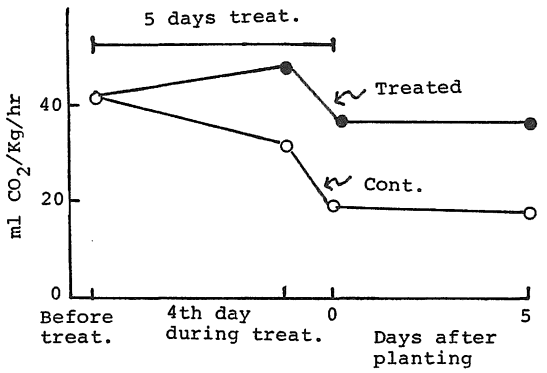

Fig. 5　Effect of nitrogen gas treatment on respiration change in gladiolus corms 'Traveler'.

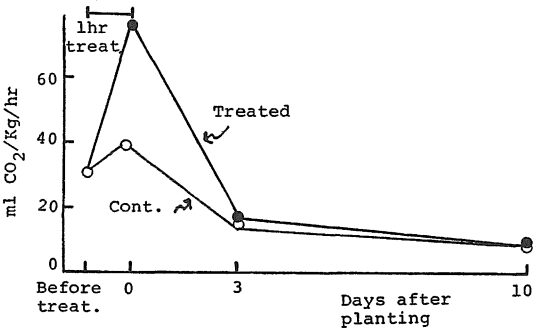

Fig. 6　Effect of hot water treatment on respiration change in gladiolus corms 'Traveler'.

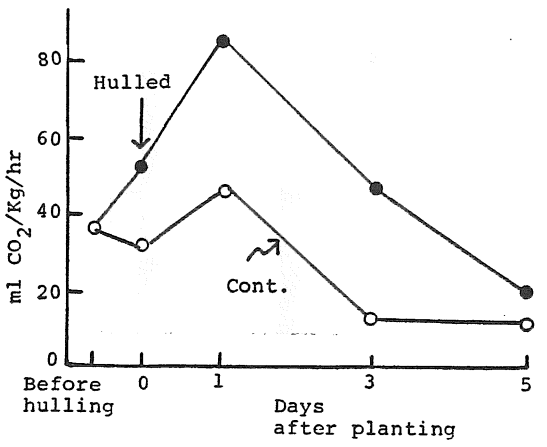

Fig. 7　Effect of hulling on respiration change in gladiolus corms 'Traveler'.

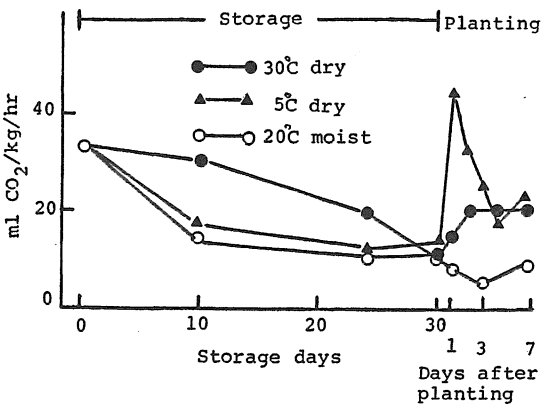

Fig. 8　Effect of different storage conditions on respiration change in gladiolus corms 'Traveler'.

Table 1 Effect of chemicals, hot water, hulling and storage on sprouting from dormant corms.

Gladiolus cultivar	Treatment	Days to 60% sprouting after planting
'Comet'	Ethanol	55
	Control	75
'Traveler'	Calcium cyanamide	145
	Control	167
'Comet'	Ethylene gas	91
	Control	104
'Traveler'	Nitrogen gas	150
	Control	163
'Traveler'	Hot water	148
	Control	164
'Traveler'	Hulling	116
	Control	125
'Traveler'	5°C dry storage	87
	30°C dry storage	104
	20°C moist storage	113

Discussion

Release of bulbs from dormancy has been studied as a function of balance among growth inhibitors and promotors.[6] Usually, the balance changes gradually in the process of release from dormancy. In this study, respiratory changes took place within 24 hours in all the corms after treatments. Some treatments such as hulling increased respiration rate immediately after treatment while ethanol increased it after temporary suppression during the treatment. Ethanol type of action mode was also noticed in KCN treatment (preliminary test). No matter in whichever mode they act, eventual respiration rise or change concomitant with it seems to relate with promotion of sprouting.

As for relation of chemical treatments with ethylene evolution, Heins[7] reported that ethanol inhibited ethylene evolution from flowers in carnation, and the similar result was noticed in gladiolus corms in my preliminary test. The other chemicals such as $CaCN_2$ and KCN did not stimulate ethylene evolution from dormant corms in freesia.[8] Therefore, enhancement of respiration rate in gladiolus corms also may be induced directly by the chemical treatments without intervention of ethylene evolution.

Although more detailed experiments must be conducted, there is a possibility that temporary rise in respiration rate after treatments signals the release from dormancy of gladiolus corms although hormonal balance still plays important roles.

Summary

Dormancy of summer- and spring-flowering gladiolus (*Gladiolus spp.* or *G.* X *Herald*, respectively) was broken by various chemicals, hot water, hull removal and storage. The treated corms showed an increase in respiration rate within 24 hours after treatments.

References

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摘　　要

夏咲きおよび春咲きグラジオラス（*Gladiolus spp.* および *G.* X *Herald*）の休眠は，種々の化学物質，温とう，除皮および貯蔵処理により破られた．処理された球茎は，24時間以内に呼吸量を増加させた．