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Effects of Different Temperatures and Sampling Dates on Bud Break and ACC Content of 'Muscat Bailey A' Grapevine Buds

A.R. El-Shereif, F. Mizutani, J.M. Onguso and A.B.M. Sharif Hossain
The Experimental Farm, Faculty of Agriculture,
Ehime University, Hattanji 498, Matsuyama City, Ehime 799-2424, Japan

Abstract: Effects of different temperatures on bud break and ACC content were examined by using canes of 'Muscat Bailey A' grapevines (Bailey x Muscat Hamburg) collected monthly from October to February. The canes were kept at 1 and 24°C for 1, 2 and 4 weeks. Bud break was evaluated at 24°C by using single-eye cuttings. Low temperature was more effective on bud break in October and November, while little differences were noted between 1 and 24°C in December. However, high temperature was more effective in January and February. ACC content was significantly greater under low temperature in October and November but the reverse was true after two weeks of temperature treatments from December to February. Thus, these data indicate that chilling requirement for bud break of grapevines seems to be associated with the promotion of ethylene biosynthesis caused by low temperature stress.

Key words: Grape, dormancy, single-eye cutting, 1-aminocyclopropane-1-carboxylic acid

INTRODUCTION

In temperate zone, deciduous fruit trees the endo-dormancy period is overcome by exposure to low temperatures[1-4]. Dormant grapevine buds have chilling requirements but these requirements are generally thought to be less than those of most deciduous fruit species. Dokoozalian *et al.*[5] found that bud break of dormant grape buds was most rapid for cuttings exposed to 800 chilling hours and least rapid for cuttings that received no chilling. Chilling is not an absolute requirement for bud break, because high temperatures[6], bud scale removal[7-9] and anaerobic conditions[10] can replace the chilling requirements. Such these rest-breaking treatments increase ethylene levels in plants[11]. 1-Aminocyclopropane-1-carboxylic acid (ACC), a precursor for ethylene synthesis, increased during the transition from dormancy to active state in *Prunus avium* L. and *Prunus serrulata* Lindl.[12], under high temperature stress in 'Delaware' grape cuttings[6] and by bud scales removal[9]. Exogenous ACC application promoted bud break of grapevines[9,13]. Therefore, we examined here if chilling requirement is associated with the promotion of ethylene biosynthesis.

MATERIALS AND METHODS

Canes were collected monthly from mature 'Muscat Bailey A' grapevines (Bailey x Muscat Hamburg) grown at Ehime University Farm from October 24, 2003 until February 13, 2004. On each sampling date 10 single-eye cuttings were prepared from the collected canes (used as control) and mounted through a sheet of styrene foam which was floated on water in a plastic container and placed in a growth chamber under continuous white fluorescent light at 24°C. The rest canes were divided into two groups then, wrapped in moist newspaper and placed in sealed plastic bags. One of these two groups was kept at 24°C and the other one was stored at 1°C. Single-eye cuttings were prepared from these two groups after 1, 2 and 4 weeks and placed through a sheet of styrene foam under the same conditions.

The percentage of bud break was calculated every week. Bud break was indicated by the presence of green tissues beneath the bud scales.

ACC contents was determined as follows: Buds were dissected from cuttings, weighted and extracted with 80% ethanol containing 0.05% (v/v) 2-mercaptoethanol. The extract was filtered and evaporated *in vacuo* to dryness. The residue was taken up in 2 mL distilled water and an aliquot of the solution was assayed for ACC content according to the method of Lizada and Yang[14].

RESULTS AND DISCUSSION

Figure 1 shows that in October low temperature treatments (1°C for 1, 2 and 4 weeks) recorded the highest percentage of bud break and bud break started earlier

Corresponding Author: El-Shereif Ali Ramadan, The Experimental Farm, Faculty of Agriculture,
Ehime University, Hattanji 498, Matsuyama City, Ehime 799-2424, Japan
Tel: +81 89 993 1636 Fax: +81 89 993 3173 E-mail: aelshereif@yahoo.com

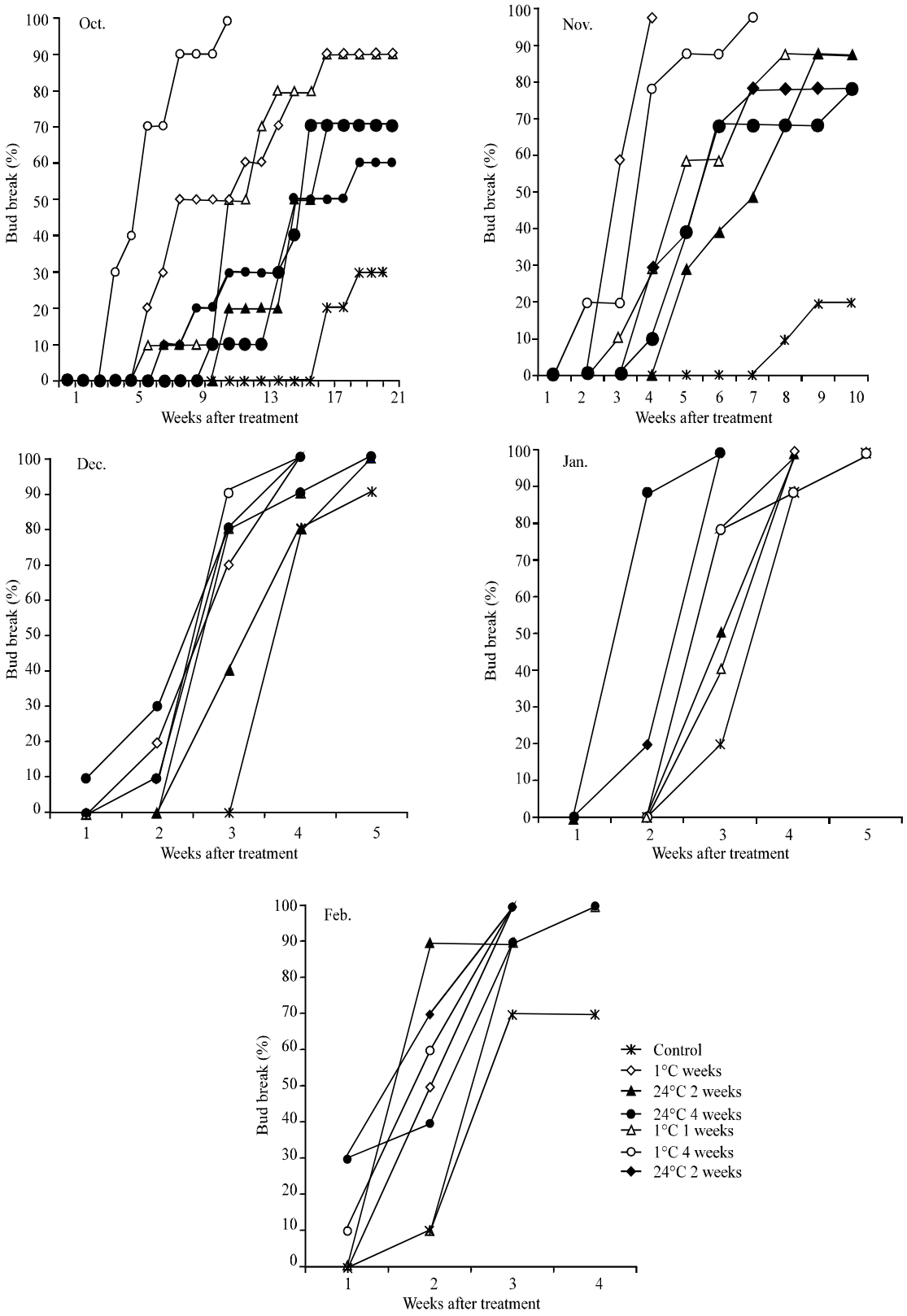

Fig. 1: Effect of temperature treatments on bud break of grapevine buds

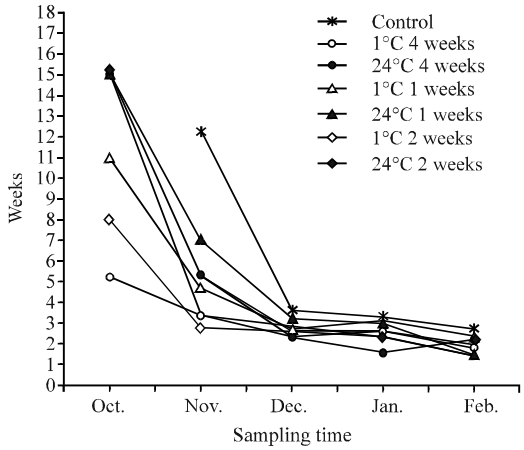

Fig. 2: The time required for 50% bud break of grapevine buds as affected by temperature treatments

than those of 24°C treatments. Among low temperature treatments, 1°C for 4 weeks caused bud break earlier than 1°C for 1 and 2 weeks. The control plot recorded the lowest percentage.

In November 1°C for 2 weeks recorded the highest early percentage followed by 1°C for 4 weeks. Although bud break took place earlier under 1°C for 4 weeks than that of 1°C for 2 weeks, but the increase under the last one was sharp. The control treatment recorded the lowest percentage. There were no considerable differences among treatments in December except the control which showed late response on bud break and lowest percentage. In January and February 24°C was more effective on bud break.

The time required to achieve 50% bud break was shorter under low temperature treatments in October and

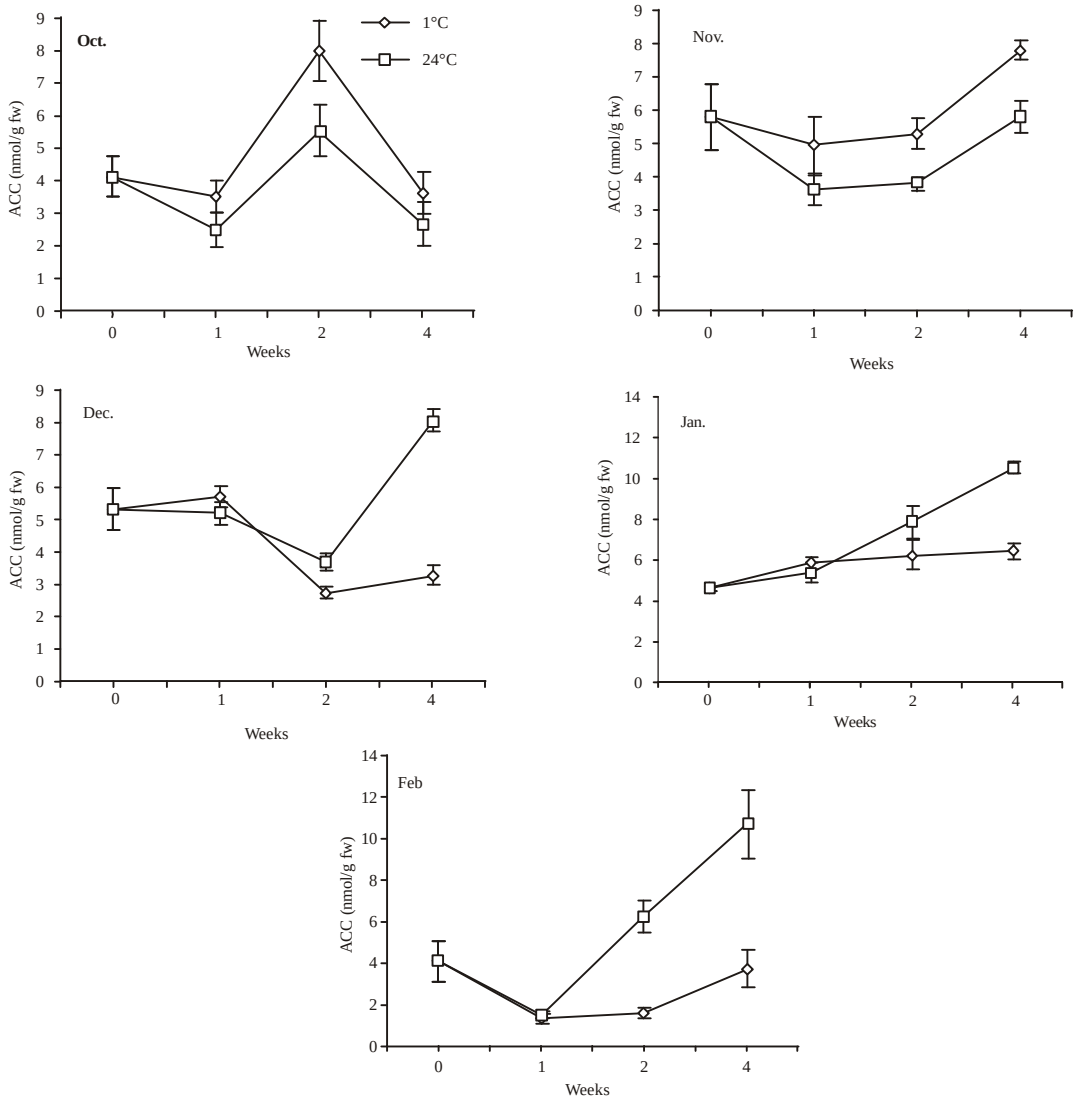

Fig. 3: ACC content of grapevine buds as affected by temperature treatments. Vertical bars represent SE (n = 4)

November (Fig. 2). After December there were little differences between 24 and 1°C.

Results show that low temperature had the pronounced effect on bud break in October and November and has no such effect thereafter. In January and February high temperature was more effective on bud break. Moreover, grape buds collected after December have experienced sufficient low temperature to complete chilling requirements.

ACC content was significantly higher at low temperature treatments than those of high temperature in October and November (Fig. 3). But the situation changed after December. ACC content was higher under 24°C treatments, especially under 2 and 4 weeks treatments.

It is probable that the increase in ACC content was caused by low temperature stress. Tohbe *et al.*[6] found that high temperature stress (soaking in 45°C water for 4 h) increased ACC content and ethylene production in 'Delaware' grape cuttings. Although ethylene itself has no effect on bud break[9] or may be not involved directly in breaking rest[15] it seems that bud break is enhanced by HCN, co-product of the conversion of ACC to ethylene. Concerning this, Mizutani *et al.*[16] reported that KCN promoted bud break of 'Kyoho' grapevine. Furthermore, Mizutani *et al.*[9] and Tohbe *et al.*[13] reported that exogenous ACC application promoted bud break of grape buds. Cyanide may stimulate the conversion of GSSG (oxidized glutathione) to GSH (reduced glutathione). Tohbe *et al.*[6] found that dormancy of grapevine buds was broken when that conversion occurred.

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