

Effect of bud scale removal and AOA on bud break and ACC content of 'Muscat Bailey A' grapevines

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Abstract

A study was carried out to examine the effect of bud scale removal (BSR) and aminoxy acetic acid (AOA) on bud break and 1-aminocyclopropane-1-carboxylic acid (ACC) content of 'Muscat Bailey A' grapevines using single-eye cuttings. Samples were collected monthly from October to February. Single-eye cuttings were subjected to these treatments; BSR, BSR + AOA, control and AOA. The results show that in October and November, BSR and BSR + AOA were more effective on bud break without big difference between the two treatments. Whereas, control and AOA were found to be more effective from December up to February. In October, ACC content recorded a marked increase after one week and decreased afterwards under BSR and BSR + AOA. However, it showed a continuous increase under control and a reverse trend under AOA. In November, it increased after one week and decreased in the fourth week under all treatments. A continuous increase was recorded in December under all treatments. In January, there was no significant change under control with time and AOA treatment exhibited decline with time, while BSR and BSR + AOA treatments recorded small increment and then decreased. In February, it decreased under all treatments with time. The results indicate that bud break of grapevine seems to be associated with the promotion of ethylene biosynthesis caused by wounding stress.

Key words: Aminoxy acetic acid, AOA, 1-aminocyclopropane-1-carboxylic acid, bud break, bud scale removal, dormancy, ethylene biosynthesis, grape.

Introduction

In temperate zone deciduous fruit trees, the endo-dormancy period is overcome by exposure to low temperatures (Samish, 1954; Saure, 1985; Kawamata, *et al.*, 2002; Kuroda *et al.*, 2002). The amount of chilling required for bud break is specific for species and cultivars. Dormant grapevine buds have chilling requirements. However, these requirements for grape are generally thought to be less than those of most deciduous fruit species. Chilling is not an absolute requirement for bud break, because high temperatures (Tohbe *et al.*, 1998a), bud scale removal (Iwasaki and Weaver, 1977; Iwasaki, 1980; Mizutani *et al.*, 1995) which implies wounding stress, and anaerobic conditions (Erez *et al.*, 1980) can replace the chilling requirements. Ethylene production increases following various disturbances or stresses in plants. These disturbances can be induced by abiotic or biological agents (Abeles *et al.*, 1992). Environmental stresses that induce ethylene production include physical wounding and cutting, chilling, drought, and water flooding (Yang and Oetiker, 1998). 1-Aminocyclopropane-1-carboxylic acid (ACC), a precursor for ethylene synthesis, increased during the transition from dormancy to the active state in *Prunus avium* L. and *Prunus serrulata* Lindl. (Wang *et al.*, 1985).

Aminoxy acetic acid (AOA) has aminoxy groups that are effective inhibitors of ethylene production via inhibiting ACC synthase (Abeles *et al.*, 1992). Tohbe *et al.* (1998b) reported that aminoxy acetic acid was found to inhibit bud break. In the present study we examined the effect of bud scale removal and AOA on bud break and ACC content of grapevine using single-eye cuttings to know whether bud break of grapevine is

associated with the promotion of ethylene biosynthesis caused by wounding stress or not.

Materials and methods

Canes were collected monthly from mature 'Muscat Bailey A' grapevines (Bailey x Muscat Hamburg) grown at Ehime University Farm from 28 October, 2003 until 24 February, 2004. On each sampling date, single eye-cuttings were prepared from the collected canes 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.

These single eye-cuttings were subjected to the following treatments: 1) Control (buds without removing scales), 2) Aminoxy acetic acid (AOA), 3) bud scale removal (BSR), 4) BSR + AOA. Bud scale removal was done using forceps and the treatment of AOA was done using aqueous solution (10mM) of AOA by employing absorbent cotton. Each treatment was represented by 50 single-eye cutting.

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

ACC content was determined as follows: Buds (scaleless buds) were dissected from cuttings, weighed 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 4 mL distilled water and an aliquot of the solution was assayed for ACC content according to the method of Lizada and Yang (1979). ACC content was determined at the sampling

date (0 week), after 1 week and 4 weeks with an exception in January and February samples. It was determined at 0, 1 and 2 weeks because of rapid bud break in these two months.

Results and discussion

In October and November, BSR and BSR + AOA treatments recorded the highest percentage of bud break and bud break started earlier than those of control or AOA. From December until February the highest percentage was recorded under control

and AOA treatments without much differences between both of them (Fig. 1).

The time required to achieve 50% bud break was shorter under BSR and BSR + AOA than control or AOA treatments in October and November (Fig. 2). However, the reverse was true from December to February.

These results are in agreement with those of Iwasaki and Weaver (1977), Iwasaki (1980) and Mizutani *et al.* (1985). They reported that bud scale removal was much more effective in stimulating bud break of grape cuttings than leaving them intact. Spires (1972) found that bud scale removal in tung trees greatly reduced bud dormancy at an early collection period. However, this effect decreased with time and completely disappeared two months after the onset of treatments. Also, Iwasaki (1980) found that bud scale removal was more effective in bud break than control from August to November. Whereas, in December they recorded the same bud break percentage and it was higher under control thereafter until February. In this study the same tendency was observed as in Spires (1972) and Iwasaki (1980) results.

Bud scale provide not only a protective covering for the bud, but also act as a buffer against resumption of growth, where it was found that inhibitive substances exist in the scales and its levels increased gradually, and then dropped until bud break (Iwasaki and Weaver, 1977). Therefore, the effect of bud scale

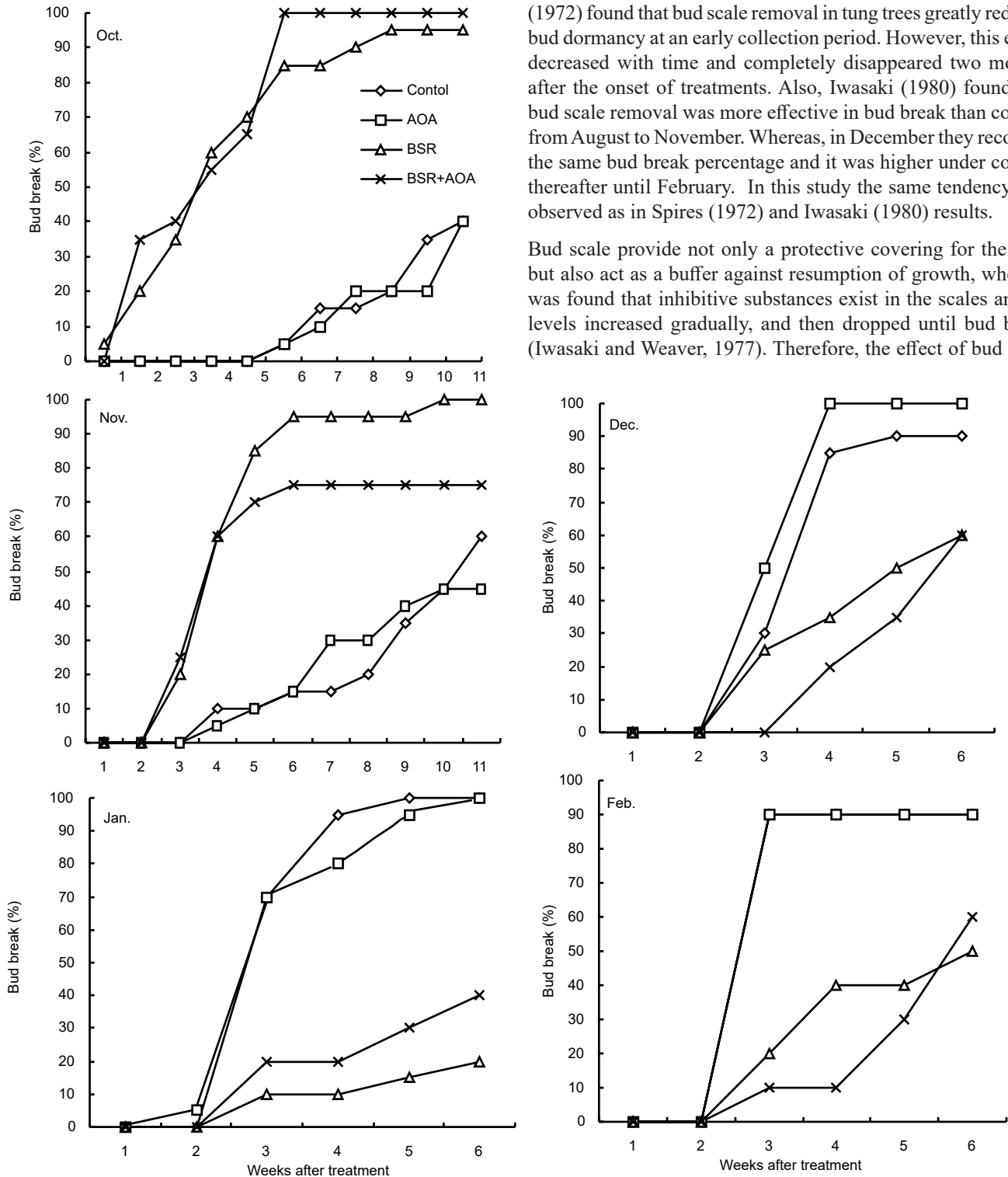


Fig. 1. Effect of bud scale removal (BSR) and AOA on bud break percentage of grapevine buds

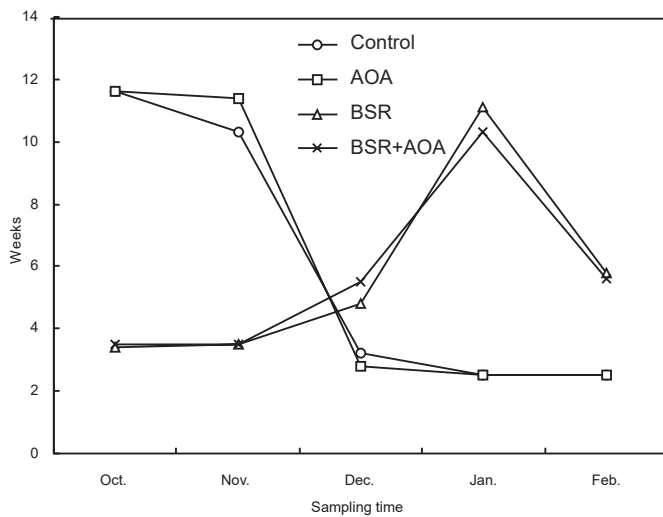


Fig. 2. The time required for 50% bud break of grapevine buds as affected by bud scale removal (BSR) and AOA treatments.

removal seemed to be mostly due to mechanical injury, greater ease of gas exchange and removal of inhibitory factors involved in the scales.

Fig. 3 indicate that the effect of the treatments on ACC content was dependent on sampling date or the intensity of bud dormancy. ACC content recorded a marked increase in October after one week and decreased afterwards under BSR and BSR + AOA. However, it showed a continuous increase under control and a reverse trend under AOA. Whereas, in November it increased after one week and decreased in the fourth week under all treatments. A continuous increase was recorded in December under all treatments and there was no significant difference between control and BSR + AOA and between AOA and BSR especially after one week. In January, there was no significant change under control with time and AOA treatment exhibited decline with time, while BSR and BSR + AOA treatments recorded small increment after one week and then decreased to be lower than control in the second week. In February, the general trend was the decrease under all treatments with time.

The effect of bud scale removal on increasing ACC content is supported by Mizutani *et al.* (1995). They found that a sharp increase in the ACC content in the scale removed buds and the high ACC levels in treated buds were maintained until day 20 but the content decreased to the control level at day 30. Also they stated that bud scale removal implies wounding stress. Wounding, in general, is known to produce ethylene in plant tissues, whereas Iwasaki (1980) reported that it is difficult to assume that the termination of bud rest is hastened by ethylene released by bud scale removal. May be the bud break was enhanced because of HCN which is a co-product of the conversion of ACC to ethylene.

These results indicate that bud scale removal which implies wounding stress is more effective within the paradormancy and endodormancy stage and less effective thereafter. AOA inhibits ethylene biosynthesis effectively when it is combined with bud scale removal than with intact buds. Also, it indicate that bud break of grapevine seems to be associated with the promotion of ethylene biosynthesis caused by wounding stress.

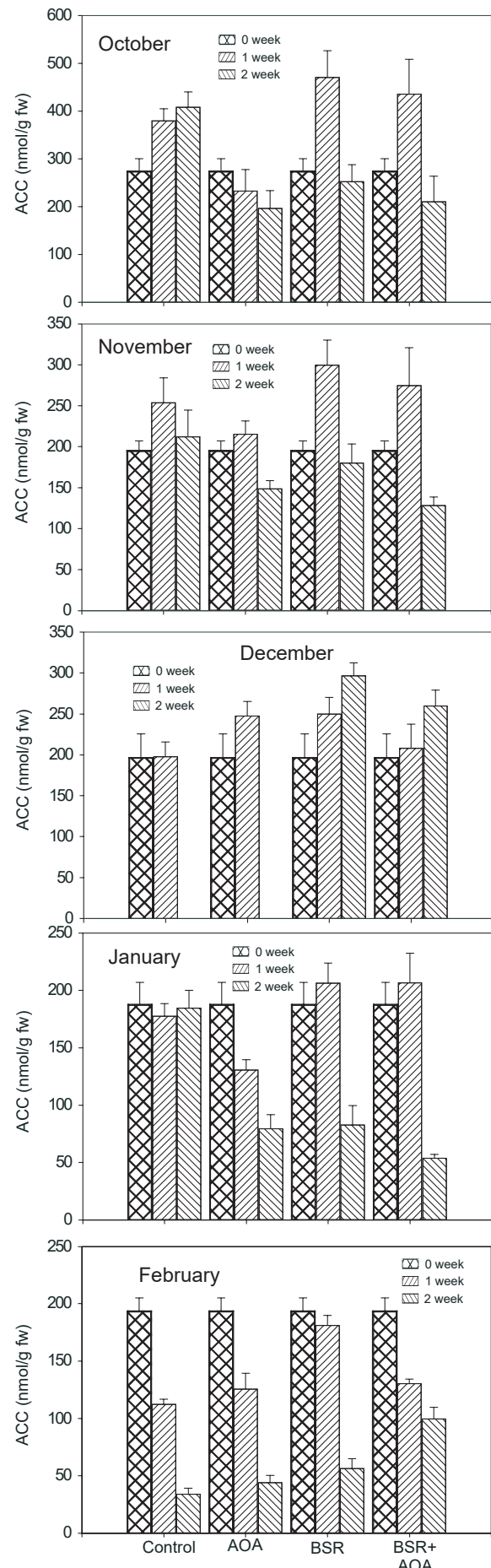


Fig. 3. Effect of bud scale removal (BSR) and AOA on ACC content of grapevine buds. Vertical bars indicate SE.

Acknowledgements

The authors are grateful to the Ministry of Education, Culture, Sports, Science and Technology, Japan for supporting this work through a scholarship.

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