愛媛大学農学部農場報告
(Bull. Exp. Farm Coll. Agr., Ehime Univ.) 15 : 1 − 5 (1994)

Effect of KCN and SHAM on Bud Break and Rooting of Single-eye Cuttings of "Kyoho" Grape

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Summary

Using single-eye cuttings of dormant "Kyoho" grape vines, we examined the effect of inhibitors of cyanide-sensitive and cyanide-resistant pathways on bud break and rooting. When applied singly, KCN was more effective than SHAM for bud break, suggesting that cytochrome pathway is dominant in dormant grape buds. Further, combinations of the two compounds promoted bud break. Concomitant rooting with bud break was observed although only the buds were treated with the inhibitors. However, it is not clear at present whether the chemicals applied directly promoted rooting or the rooting was induced indirectly by some stimulus accompanied with the bud burst.

Introduction

Buds of most temperate fruit trees show a phenomenon of dormancy during fall through winter. Usually they resume growth next spring after they are exposed to chilling temperatures during winter. However, chilling is not an absolute requirement for bud break. High temperatures (Horiuchi, 1977), bud scale removal (Iwasaki and Weaver, 1977, Iwasaki, 1980, Mizutani et al., 1985), and chemical treatment (Kuroi et al., 1963, Horiuchi, 1977) are also effective in breaking dormancy of grape buds. Horiuchi (1977) reported that anaerobic conditions promoted bud break in grape vines. Dormant seeds germinate with the treatment of respiratory inhibitors (Yamaguchi, 1980). Erez et al. (1980) showed that low oxygen concentrations enhanced bud break of peach trees. It is well known that two respiratory pathways, cyanide-sensitive and resistant, operate in plant respiration (Solomos, 1977). Cyanide and salicyl hydroxamic acid (SHAM) have been used as inhibitors of cyanide-sensitive and cyanide-resistant pathways, respectively. Here we report the effect of KCN and SHAM on bud break and rooting by employing single-eye cuttings of "Kyoho" grape vines.

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Materials and Methods

Current dormant shoots of two-year-old "Kyoho" vines, grafted on Hybrid Franc and raised in pots 24-cm in diameter, were used for the experiment. Shoots were cut from the vines on December 3, 1980, and single-eye cuttings were prepared. By employing absorbent cotton, buds were treated with an aqueous solution of KCN at 0, 10, 100 and 1000 ppm in combination of SHAM (salicyl hydroxamic acid) at 0, 100 and 1000 ppm. The cuttings were stuck in vermiculite and placed under fluorescent light at 25℃. The percentage of bud break was evaluated regularly and the rooting percentage and root numbers per cutting were counted at the end of the experiment.

Results and Discussion

Fig. 1 shows time-course of the percentages of bud break after treatment. KCN was more effective than SHAM when they were applied singly. When 100 ppm SHAM was used, its combination with 10 ppm KCN was not effective, but the combination with 100 and 1000 ppm KCN promoted bud break. However, when a high concentration of SHAM (1000 ppm) was applied, even the combination with 10 ppm KCN showed the greater percentage of bud break than in the absence of KCN. SHAM is well known to inhibit cyanide-resistant respiratory pathway (Solomos, 1977). Therefore it seems that when the alternative pathway is blocked, the response of buds to KCN tends to increase, resulting in the enhanced bud break.

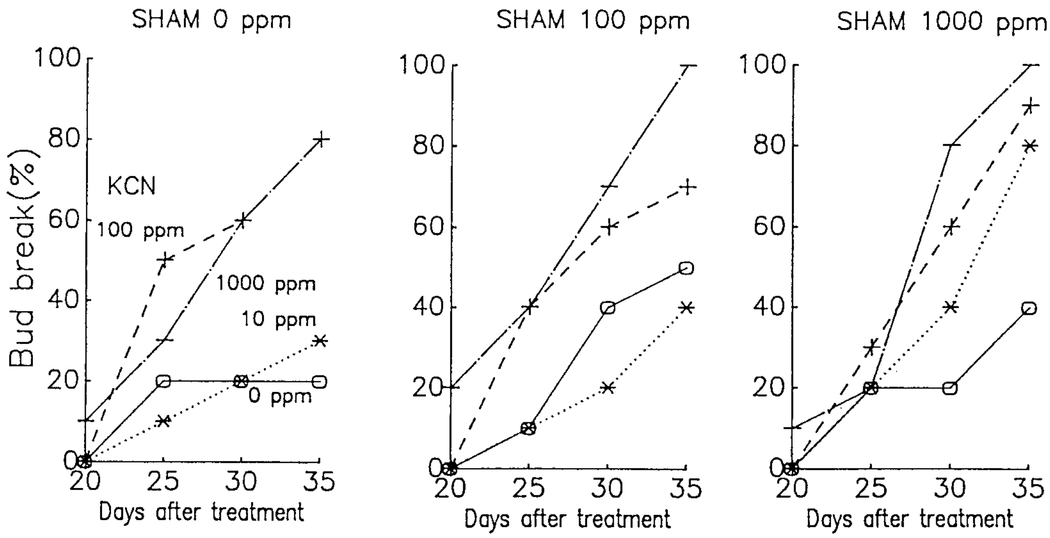

Fig. 1 Effect of KCN and SHAM on bud break of cuttings of dormant Kyoho grape vines.

The percentages of bud break 4 and 5 weeks after treatment are shown in Fig. 2. This also indicates that KCN has the greater effect than SHAM when applied singly. When 10 ppm KCN was only applied, the effect was not so great. But the combination of 10 ppm KCN with 1000 ppm SHAM greatly enhanced bud break, the percentage of which was equivalent to that given with single 100 ppm KCN treatment (Fig. 2).

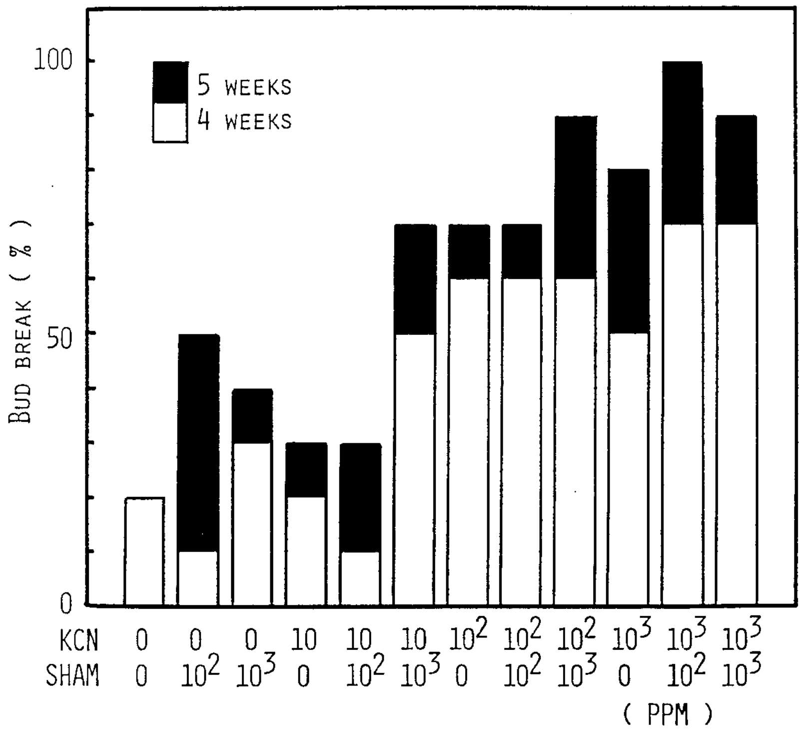

Fig. 2 Effect of KCN and SHAM on bud break of cuttings of dormant Kyoho grape vines. (Percentages of bud break were counted 4 and 5 weeks after treatment.)

The greater effect of KCN than SHAM indicates that the large part of respiratory pathway operating in the dormant grape buds is via cyanide-sensitive pathway. In this regard, Esashi et al. (1981) reported that in cocklebur seeds, KCN was stimulatory when the cytochrome path was dominant, whereas BHAM (benzohydroxamic acid) was promotive when the flux via the alternative path was superior because of the presence of KCN or NaN_3.

Rooting of the cuttings was also promoted by the treatment (Figs. 3 and 4). When applied singly, SHAM was effective only at 1000 ppm, but KCN enhanced rooting even at a low concentration of 10 ppm (Fig. 3). However, it seemed that 1000 ppm KCN was a supra-optimal concentration for rooting because both the rooting percentage and the root number per cutting were lower at 1000 ppm than at 100 ppm. A combined promotive effect was also apparent when 10 ppm KCN was applied with 100 ppm SHAM, since single application of SHAM had little promotive effect at this concentration. However, at 100 ppm KCN, the combinations with SHAM rather reduced the root number/cutting compared with single 100 ppm KCN application (Fig. 3). This indicates that the respiratory inhibitors adversely affect rooting at supra-optimal levels either applied singly or in combinations. Iwasaki and Weaver (1977) also reported that bud break and rooting of cuttings of dormant grape vines were concomitantly promoted with the spray of calcium cyanamide solution (250g/liter).

It is interesting that although only buds were treated with the respiratory inhibitors, rooting was promoted as well as bud break. It is not clear at present whether the chemicals directly affect rooting or the rooting was induced by some transmissible stimulus from the bursting bud.

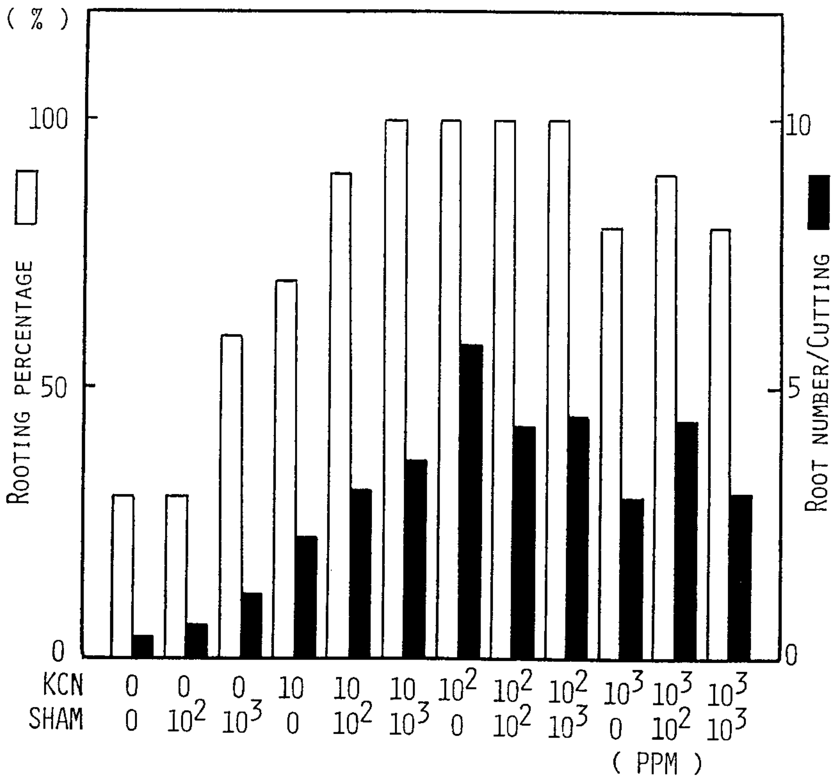

Fig. 3 Effect of KCN and SHAM on rooting of cuttings of dormant Kyoho grape vines. (Only buds were treated with the respiratory inhibitors. Rooting was evaluated 5 weeks after treatment.)

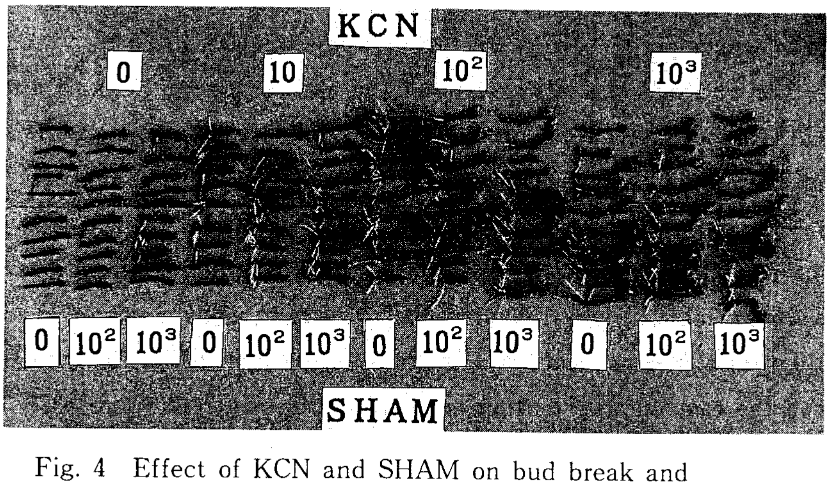

Fig. 4 Effect of KCN and SHAM on bud break and rooting of cuttings of dormant Kyoho grape vines. (The photograph was taken 5 weeks after treatment.)

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摘　　要

休暇中の巨峰の一年生枝の一芽挿しを用いてシアン感受性とシアン耐性呼吸の阻害剤が休暇打破と発根に及ぼす効果を調査した。単独で処理をした場合、SHAM (salicyl hydroxamic acid) よりもKCN の方が休暇打破効果が大きかった。このことはブドウの休眠芽ではシアン感受性呼吸経路が支配的であることを示唆している。両阻害剤を組み合わせると休暇打破が促進された。芽にのみ処理をしたにもかかわらず萌芽が促進された区では発根も促進された。阻害剤が直接作用したことによるのか、萌芽に伴う何かの刺激によって発根が促されたのか現在のところ不明である。