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Effect of Summer Pruning and Gibberellin Application on Reduction of Flower Bud Formation in "Saotome" Peach(*Prunus persica* Batsch.) Trees Grafted on *P. japonica* Rootstocks

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Summary

Effect of summer pruning and GA_3 application on reduction of flower bud formation was investigated by using a very early maturing peach cultivar "Saotome" trees grafted on *P. japonica*, which otherwise bear excessive flower buds. Severe pruning, in which the shoots, 41cm in average length, were cut back to 5cm from the base, reduced the final shoot length but promoted vegetative bud formation. Light pruning, in which the shoots, 35cm in average length, were cut back to 15cm, had little effect on the final shoot length but increased the number and percentage of vegetative buds. GA_3 application promoted shoot elongation and vegetative bud formation. The higher the GA_3 concentration, the greater the effectiveness. GA_3 application was superior to summer pruning in induction of vegetative buds. Thus, summer pruning and GA_3 application after fruit harvest are effective measures to enhance vegetative bud formation in "Saotome" peach trees grafted on *P. japonica*.

Introduction

"Saotome" peach is a very early maturing cultivar that was released in 1982 from the Fruit Tree Experiment Station of Japanese Ministry of Agriculture, Forestry and Fishery[9]. It arose from a seed of middle maturing cultivar "Hakuho" crossed with early maturing cultivar "Robin" in 1957. It flowers in early April and matures in middle June in the Matsuyama area. Fruit sizes are 80 to 120g.

In recent years much interest has been shown in dwarfing rootstocks for fruit trees because of the reduced cost and greater ease associated with spraying, pruning, thinning, and havesting of small trees. We observed that when "Saotome" was grafted on the dwarfing rootstock, *P. japonica*, fruit maturity became earlier and soluble solids content of fruit juice was higher than

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standard trees. But flower bud initiation was so promoted that almost all lateral buds tended to become flower buds. In an extreme case, only the terminal bud of a shoot is vegetative and all the other buds are reproductive. Excess flower bud formation results in no or little shoots in the middle and basal part of the shoot in the following year. Gibberellin is well known to inhibit flower bud initiation and cause rejuvenation in woody plants[1, 2, 7, 12]. As long as the tree remains vigorous, new shoots emerge after the current shoots are pruned during growing season. Such newly emerged shoots are expected to be physiologically young to bear vegetative buds. Therefore we investigated the effect of summer pruning and gibberellin application on reducing flower bud formation in "Saotome" peach trees grafted on the dwarfing rootstock.

Materials and Methods

Plants—We used 4-year-old "Saotome" peach trees grafted on *P. japonica* which were grown in an orchard of a farmer in Yoshida Town, Kitauwa-gun, Ehime Prefecture. After harvesting fruit in middle June, two trees for each treatment were selected and emlpoyed for the experiments.

Summer pruning—On July 3, 1984, ten current shoots, 41cm in average length, were selected and cut at 5cm from the base of the shoots as severe pruning, and other ten current shoots, 35cm in average length, were similarly selected and cut at 15cm from the base as light pruning. Severe and light pruning reduced the shoot length to about one-eighth and a half, respectively. As control, fifteen shoots were selected and tagged. Shoot length, number of nodes and number of flower and vegetative buds were measured and counted in the winter.

Gibberellin application—On July 4, 1984, seven current shoots, 27cm to 29cm in average length, were selected for each treatment and gibberellic acid(GA_3) solution at 0, 100, 250 and 500ppm was sprayed to the shoots. Shoot length, number of nodes and number of flower and vegetative buds were measured and counted in the winter.

Results

Effect of summer pruning

Table 1 shows the effect of summer pruning on shoot length, number of nodes and flower and vegetative bud formation. Light and severe pruning reduced the shoots to about a half and one-eighth their original length, and the length of newly emerged shoots after pruning was 13.4cm and 8.3cm, respectively. Thus the final shoot length was made shorter by severe pruning than light pruning. Light pruning showed completely recovered growth to the level of control. The final number of nodes in severe pruning plots was also reduced and this was associated with the reduced total number of buds(Figs. 1 and 2). However, the number and percentage of vegetative buds were increased by summer pruning(Fig. 2). The greatest number of vegetative buds was obtained in the light pruning plots(Fig. 2). The percentage of vegetative buds was 7.3%, 17.6% and 21.9% for control, light and severe pruning plots, respectively. This means that the heavier the summer pruning, the more effective in reducing flower bud formation.

Table 1 Effect of summer pruning on shoot growth and flower and vegetative bud formation in 4-year-old "Saotome" peach trees grafted on *P. japonica*.

Treatment[z]	At pruning		Final		No. of buds			Flower buds (%)
	Shoot length (cm)	No. of nodes	Shoot length (cm)	No. of nodes	Total	Flower	Vegetative	
Control	–	–	26.7±13.1	17.3± 6.4	20.2± 9.3	18.6± 8.7	1.4± 1.1	92.6± 4.0
Light (15cm)	35.2± 7.0[y]	20.7± 1.4 (9.9± 1.7)[x]	28.4± 9.4	17.0± 4.0	22.7± 5.4	18.5± 4.0	4.1± 2.1	82.4± 8.2
Severe (5 cm)	41.1± 7.8	22.2± 1.6 (5.1± 1.3)	13.3± 6.3	10.4± 4.1	7.7± 2.4	6.0± 2.0	1.9± 0.9	78.1±10.6

z : Fruit were harvested in middle June and shoots were pruned on June 3, 1984. Light and severe pruning represent that the shoots were cut at 15cm and 5cm from the base and reduced to about a half and one-eighth their original length, respectively.

x : Figures in the parentheses indicate the number of nodes that remained after pruning.

y : Mean±SD

Table 2 Effect of GA_3 application on shoot growth and flower and vegetative bud formation in 4-year-old "Saotome" peach trees grafted on *P. japonica*.

Treatmint[z]	At pruning		Increment[y] in		No. of buds			Flower buds (%)
	Shoot length (cm)	No. of nodes	Shoot length (cm)	No. of nodes	Total	Flower	Vegetative	
Control	28.5± 9.1[x]	20.1± 2.0	11.0± 6.2	5.6± 2.4	31.1±12.5	27.4± 9.7	3.7± 4.0	89.6± 7.6
100 ppm	29.3± 6.4	19.5± 1.6	18.0± 7.2	7.3± 2.0	37.2±11.2	22.2± 7.5	15.0± 6.6	60.0±11.9
250 ppm	26.9± 5.7	19.8± 1.6	32.9±12.9	10.6± 4.2	36.2±10.8	12.9± 4.7	23.4± 7.8	36.9± 9.5
500 ppm	27.2± 7.5	19.2± 2.2	45.3±20.6	13.2± 7.1	34.1±10.0	6.9± 3.5	27.5± 7.8	18.6± 8.7

z : Fruit were harvested in middle June and GA_3 solution was applied on June 4, 1984.

y : Increment in shoot length and node numbers after GA_3 application was measured.

x : Mean±SD

Effect of gibberellin application

Table 2 shows the effect of GA_3 application on shoot length, number of nodes and flower and vegetative bud formation. GA_3 increased shoot length and number of nodes; the higher

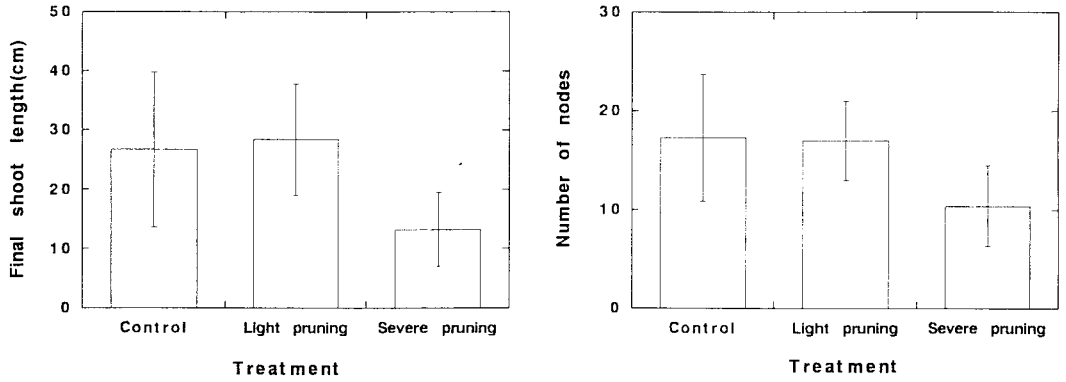

Fig. 1 Effect of summer pruning on the final shoot length and the number of nodes in "Saotome" peach trees grafted on *P. japonica*. Vertical bars indicate standard deviations.

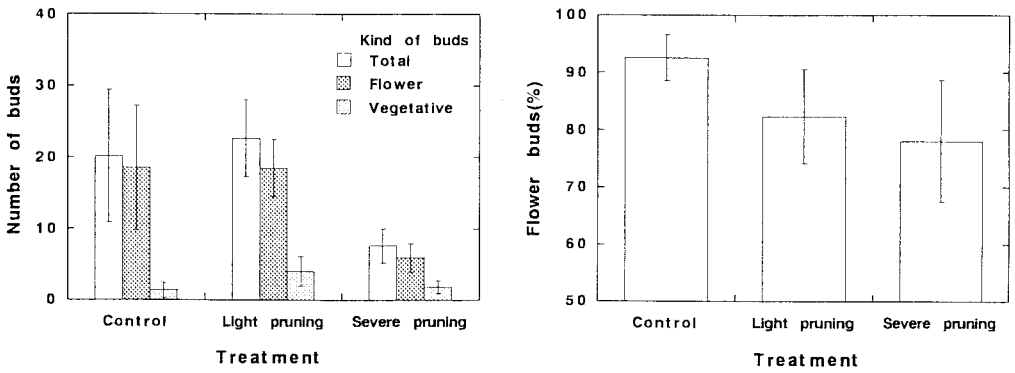

Fig. 2 Effect of summer pruning on the number of flower and vegetative buds and the percentage of flower buds in "Saotome" peach trees grafted on *P. japonica*. Vertical bars indicate standard deviations.

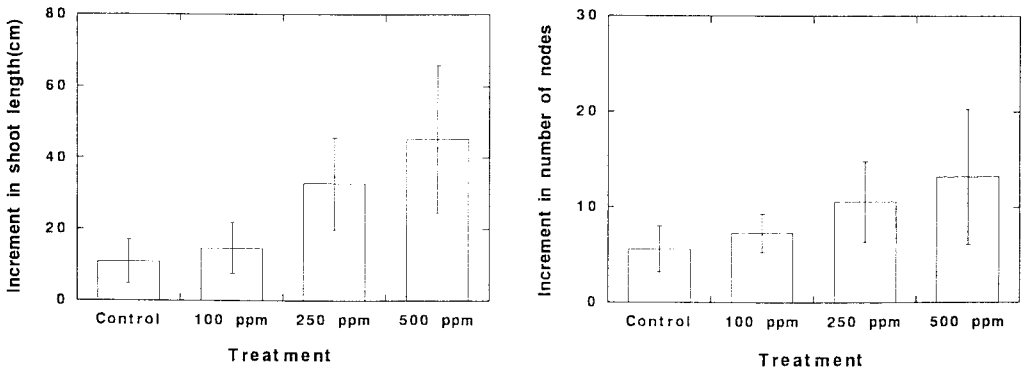

Fig. 3 Effect of GA_3 application on the increment in shoot length and number of nodes in "Saotome" peach trees grafted on *P. japonica*. Vertical bars indicate standard deviations.

concentration resulted in the longer shoots and the greater number of nodes(Figs. 3 and 5). The total number of buds was slightly increased by the application. The number and percentage of flower buds was gradually reduced with increasing GA_3 concentrations whereas the reverse was true for vegetative buds(Fig. 4). The percentage of vegetative buds was 10.4%, 40%, 63.1% and 81.4% for control, 100ppm, 250ppm and 500ppm respectively(Figs. 4 and 6).

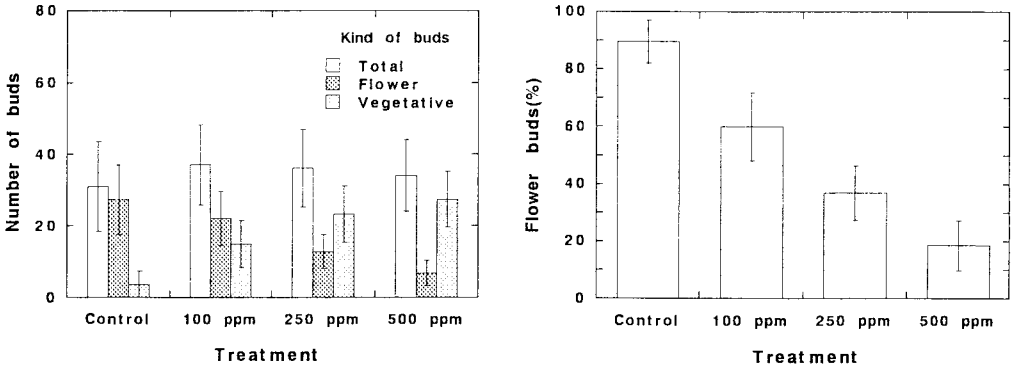

Fig. 4 Effect of GA_3 application on the number of flower and vegetative buds and the percentage of flower buds in "Saotome" peach trees grafted on *P. japonica*. Vertical bars indicate standard deviations.

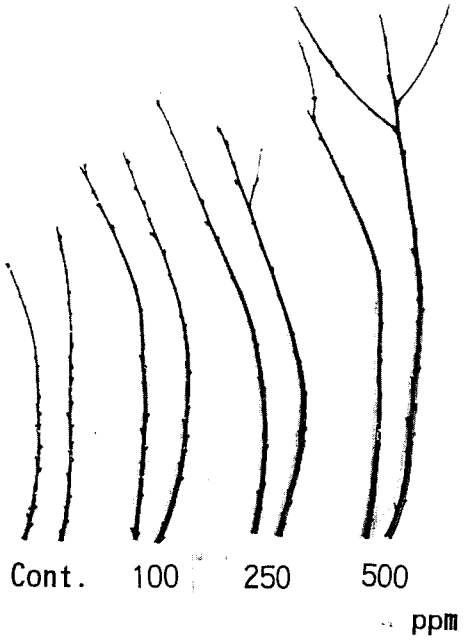

Fig. 5 Effect of GA_3 application on shoot elongation of "Saotome" peach trees grafted on *P. japonica*.

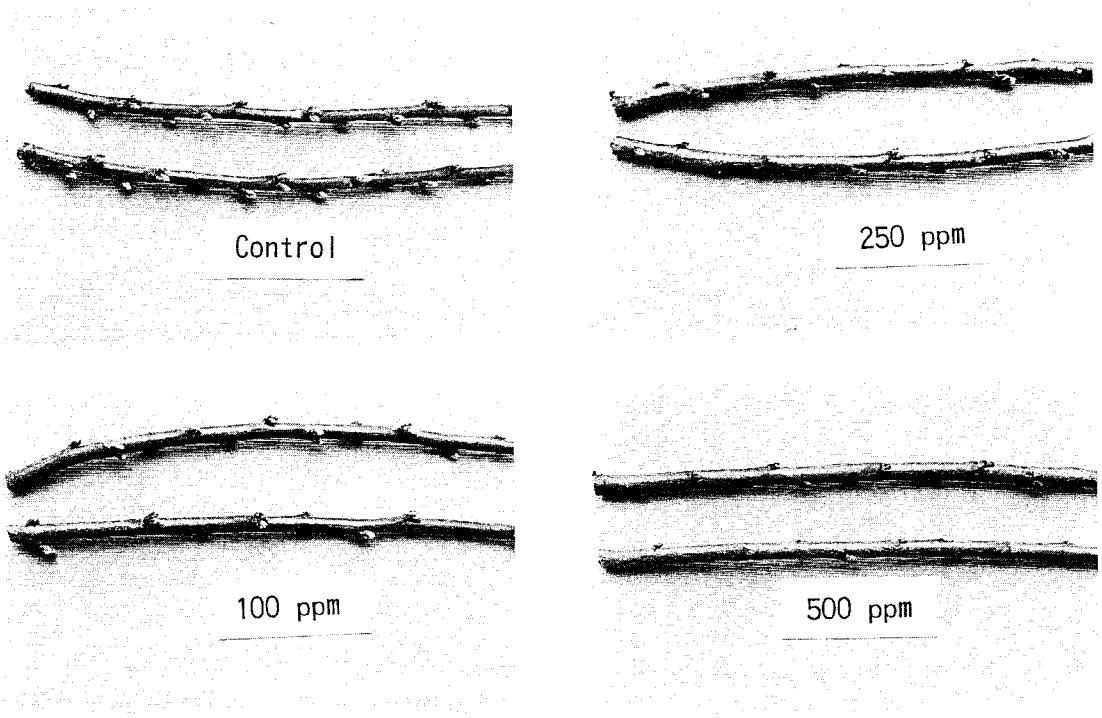

Fig. 6 Effect of GA_3 application on flower and vegetative bud formation in "Saotome" peach trees grafted on *P. japonica*. Round-oval-shaped and small-shield-shaped buds are flower and vegetative ones, respectively.

Discussion

Since fruit trees are perennial woody plants, it is very important to keep the balance between vegetative and reproductive growth for obtaining constant crop harvest every year. Vigorous vegetative growth tends to retard reproductive processes such as flower initiation, fruit set and fruit growth and development, whereas over crop-load leads to decline in tree vigor. The use of dwarfing rootstocks for peach has various advantages because they produce compact-sized trees bearing fruit with early maturing and high sugar content although some problems including graft incompatibility and bitterness of fruit have been reported[4, 5, 6, 8, 10, 11]. Peach trees grafted on dwarfing rootstocks also promote flower bud formation. "Saotome" peach is a very early maturing cultivar[9]. When we grafted this cultivar on *P. japonica*, we observed too excessive flower bud formation on the current shoots. In an extreme case, only the terminal bud is vegetative. When the sole vegetative bud is damaged by an insect, the shoot bears no new leaf the following year and eventually dies. Therefore "Saotome" trees on *P. japonica* tend to stretch their shoots outward while void spaces are being formed inside the crown. The tree shape that is commonly used for compact-sized fruit trees grafted on dwarfing rootstocks is slender spindle type. To maintain the tree slender, heading back of the shoots to near the trunk is necessary. But it is difficult to keep the shape unless there are vegetative buds in the vicinity of the trunk.

Practices or treatments that enhance vegetative growth are likely to inhibit flower bud formation. Among them are heavy pruning, excess nitrogen application and use of vigorous rootstocks. "Saotome" peach is a very early maturing cultivar and the fruit are harvested in middle June. Therefore there is an ample growing period to resume shoot growth even when the shoots are pruned after fruit harvest. In this experiment, severe pruning favored vegetative bud formation although the final shoot length was short.

It is well known that gibberellins inhibit flower bud formation and cause rejuvenation in woody plants[1, 2, 3, 7, 12]. The present results showed that GA_3 not only promoted shoot elongation but also inhibited flower bud formation, and hence it increased the percentage of vegetative buds. GA_3 application is more effective than summer pruning. Whereas the percentage of vegetative buds was only 21.9% for severe summer pruning, it was more than 40% for all gibberellin treatments.

Therefore, summer pruning or GA_3 application is effective to enhance vegetative bud formation in very early maturing cultivars grafted on dwarfing rootstocks which may otherwise bear excessive flower buds.

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夏季剪定とジベレリン散布がニワウメ台モモ“さおとめ”の花芽形成の抑制に及ぼす影響

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摘　要

モモの極早生品種“さおとめ”を矮性台木であるニワウメ台木に接ぎ木すると花芽が着き過ぎ、翌年、枝の基部から中央部にかけてはげ上がるので、夏季剪定とジベレリンの散布が花芽形成を抑制し、栄養芽(葉芽)を増加させるかどうかについて調査をした。平均長が41cmの当年枝を基部から5cmのところまで切り詰めると(強剪定)、最終的な枝の長さは対照区に比べて短くなったが、栄養芽の数はやや増加し、栄養芽率は高くなった。また、平均の長さが35cmの枝を基部から15cmのところまで切り詰めた場合(弱剪定)、最終的な枝の長さは対照区とほとんど変わらなかったが、栄養芽の数は増加し、栄養芽率も高くなった。ジベレリンの散布は枝の伸長生長を促し、栄養芽の数、率ともに高めた。また処理濃度が高いほど効果が大きかった。夏季剪定に比べてジベレリン散布の方が栄養芽形成に大きな効果がみられた。従って、花芽が異常に着き過ぎるニワウメ台“さおとめ”では栄養芽を確保するのに夏季剪定またはジベレリン散布が有効であることが分かった。