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Effect of Late Summer Pruning and Cheesecloth Shades on Shoot Regeneration, Flower Bud Formation and Blooming Time of Peach Trees

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Summary

Effects of late summer pruning and cheesecloth shade on shoot regeneration, flower bud formation and blooming time of 'Hikawahakuho' peach trees grafted on wild form vigorous rootstocks were examined by using potted one-year-old trees. Summer pruning was performed on September 1 and the trees were placed under the black and white cheesecloth shade. The number of regenerated shoots was higher in summer-pruned (SP) alone trees than SP+black and white cheesecloth shaded trees. However, the growth of regenerated shoots and total shoot length were greatest in SP+black cheesecloth shaded trees. Chlorophyll content (SPAD value) was also greatest in regenerated leaves of SP+black cheesecloth shaded trees. The percent of flower buds was lower in SP trees than non-SP trees. Moreover, the greater the shading degree, the less the percentage of flower buds. No flower bud was produced in the regenerated shoots. Leaf drop was earlier in non-SP trees. Shading tended to delay flowering time the following spring.

Inrtoduction

The light is an important factor for plant growth and development. The quantity and quality of light have significant effects on tree growth and architecture that can be highly variable depending on the shade tolerance of the species [2]. Maqbool et al.[11] stated that mayapple shoots that developed under increasing levels of shade (30%, 55% and 80%) tended to produce larger shoots that persist for long durations than those under full sun. Photosynthetic capacity and light compensation points were lower for shade (30% of full sun light over a 30 days period) of forage grasses (*Brachiria humidicola*). Total leaf chlorophyll content was higher in shade treatment than full sunlight [5]. Conover and Poole [3] reported that plant height was higher in (63% shade of full sun light) shade than sunlight treatment over 10 weeks and trunk diameter was lower in shade trees (*Ficus species*). They also reported that the number of leaves dropped was higher in sun light treatment than shade treatment. In snapdragon, the increasing light intensity significantly shortened the flowering time and decreased leaf numbers [4,8]. The shaded plants (54% or 68%) produced larger leaves and taller stem in order to capture more light, probably because of a shade avoidance mechanism which resulted in decreasing the number of flower buds and delaying flowering time [1]. Munir et al.[16] described that the number of flower buds in Snapdragon decreased significantly with increase in shading percentage. They also reported that leaf numbers per plant below the inflorescences were also significantly affected by different shading materials and control plants produced less number of leaves (17) than the shaded plants (18-25). Plants without shading took minimum time to flower (95 days) while those receiving minimum of light (68% shade) throughout their development delayed flowering by 38 days. Plants that received high light intensity were dense and produced maximum branches per plant in control. Plant height was significantly increased as the light intensity decreased. Griffin et al. [7] stated that leaf chlorophyll content (SPAD value) of *Illicium* species was lower in full sun than shading treatment (plant covered by woven shade cloth). Shade grown plants often have relatively large antenna complexes for maximum light capture[10]. Medina et al.[13] reported that higher stomatal conductance and higher CO_2 assimilation rate were observed in shaded plants, so that integrated daily net CO_2 uptake was approximately 20% higher than in exposed plants.

Hossain et al. [9] reported that the initial growth of shoot and floral organs was enhanced in peach trees that had been summer-pruned compared with winter-pruned trees by using peach trees grafted on vigorous wild form peach rootstocks and trained as slender spindle bush type. They presumed that the shoots used for fruit bearing near the trunk in winter-pruned trees had been shaded during summer and autumn season due to mutual shading of branches. On the other hand, the shoots used for bearing in summer-pruned trees had been exposed to sun light after summer pruning. Therefore, in this work, we determined whether the shading of trees during autumn delays the subsequent initial growth of shoot and floral organs by using young potted peach trees.

Materials and Methods

Site

The experiment was carried out in an orchard in the Ehime University Farm located in southern Japan, 33° 57 N, 132° 47 E at an elevation of about 20 m above sea level. There is mild temperate climate characterized by hot humid summer and cold dry winter.

Plant materials

One-year-old peach (*Prunus persica* var. ‘Hikawahakuho’) trees grafted on wild form vigorous rootstocks were used in this experiment. The trees were transplanted to the pot (ϕ 30cm) in mid March, 2003. Fertilizers (N, P_2O_5, K_2O =15%, 15%, 15%) were applied after transplantation at the rate of 30g per pot, respectively. Weeding, irrigation and pesticides were applied as required. There were total 18 trees used in the experiment. The treatments were control (no pruning and exposed to sunlight), white cheesecloth shade alone, black cheesecloth shade alone, summer pruning alone (exposed to sunlight), summer pruning+white cheesecloth shade, summer pruning+black cheesecloth shade. White and black cheesecloth were used as two sheets. Summer pruning was conducted on September l, 2003. As summer pruning, all the current shoots were cut back to 5cm length from the shoot base. Fertilizers (N, P_2O_5, K_2O =15%. 15%. 15%) were applied at the rate of 15g per pot on September 1, 2003. The pots were placed under or outside the shade until April

2004. The shade was made 75 cm above from the ground to protect sunlight. The number and length of regenerated shoots, leaf drop, flower bud formation and flower time were determined. Leaf chlorophyll in the middle portion of the shoot was measured with a Chlorophyll Meter (SPAD-502, Minolta Co. Japan). Three leaves per trees were measured, in which leaves of regenerated shoots and those of spring flushes were selected for SP-trees and non-SP trees, respectively.

Results and Discussion

The effect of summer pruning and shade treatments on the number of regenerated shoots is shown in Fig. 1. The generated shoot number was highest in SP alone trees. However, in SP alone trees, the average length of their regenerated shoots was only 5 mm (Fig. 4) and there was no leaf expansion (Fig. 3). The growth of generated shoots and the number of leaves were greatest in SP + black cheesecloth shade (Figs. 2, 3 and 4). This might be due to late summer pruning conducted in September. Marini[12] reported that only 2% of the shoots in summer pruning peach trees exhibited regrowth and the length of regrowth was 7.3 cm. Ferree et al.[6] reported that the amount of re-growth increased when the earlier pruning was done during the growing season. This phenomenon may be due to higher levels of cytokinin and other growth promoting hormones early in the season. The potential for re-growth is diminished as levels of promoters decline and inhibitors increase as the season advances. These plant hormone levels are also linked with flower bud formation. Hossain et al.[9] reported that early-mid July after fruit harvest might be the best time for summer pruning of peach trees to make small size. On the other hand, in SP+black and white cheesecloth shade treated trees, more leaves and longer stems were produced than non-shaded trees. In this regard, Ballare[1] reported that shaded plants produced larger leaves and longer stems in order to capture more light.

Leaf chlorophyll content was measured twice in September and November 2003 (Fig. 5). In September after one month of shading, there was little difference in SPAD value among treatments. However, in November shading tended to increase leaf chlorophyll content both in summer-pruned and non-pruned trees. Moreover, SP trees showed the greater chlorophyll content than non-SP trees (Fig. 5). Griffin et al.[7] found that leaf chlorophyll content (SPAD value) was lower in full sun than shading treatment. Mierowska et al.[14] also reported that in apple spur leaves total chlorophyll content was higher in summer pruned-trees than non-pruned trees during November-March. Leaf drop rate percentage was higher in non-SP trees than SP-trees (Fig. 6).

The percentage of flower buds was lower in SP-trees than non-SP trees and the greater shading tended to decrease the percentage of flower buds (Fig. 7). There was no flower bud in generated shoots of summer-pruned trees. The percentage of flower buds as a whole tree basis was lower in SP-trees than non-SP trees. Mizutani et al.[15] found the decrease in flower bud formation with the delay of summer pruning in apple trees. Munir et al.[16] described that the number of flowering buds decreased significantly with increase in shading percentage.

The greater shading tended to delay blooming (Fig. 8). By using spender spindle type trained

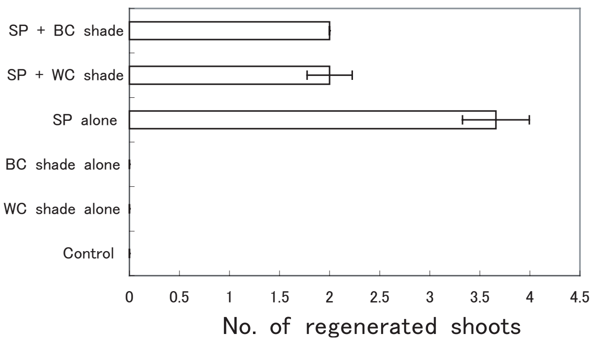

Fig. 1 Effect of late summer pruning and shade on the number of regenerated shoots. Bars represent SE (n=3). SP=summer pruning, WC=white cloth, BC=black cloth.

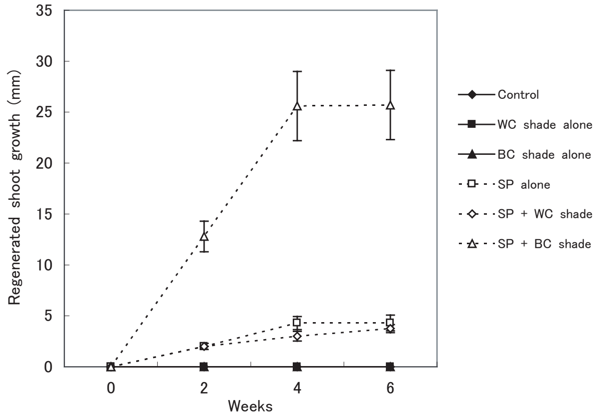

Fig. 2 Effect of late summer pruning and shade on regenerated shoot growth of peach trees. Vertical bars represent SE (n=3). SP=summer pruning, WC=white cloth, BC=black cloth.

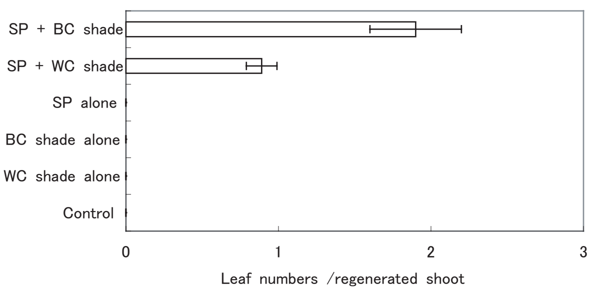

Fig. 3 Effect of late summer pruning and shade on leaf initiation in regenerated shoot of peach trees. SP=summer pruning, WC=white cloth, BC=black cloth. Bars indicate SE (n=3).

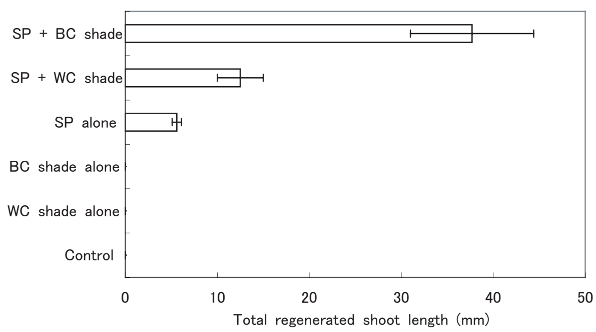

Fig. 4 Effect of late summer pruning and shade on total regenerated shoot length of peach trees. SP=summer pruning, WC=white cloth, BC=black cloth. Bars indicate SE (n=3).

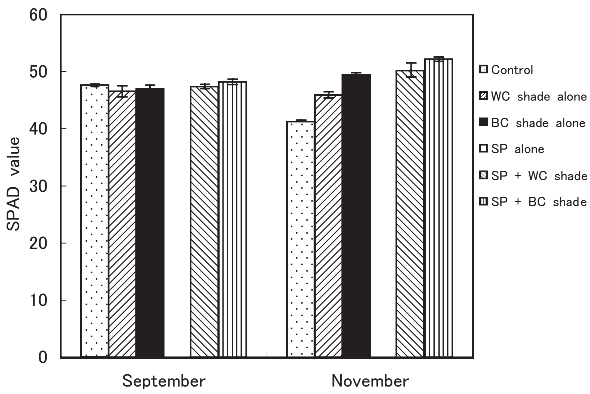

Fig. 5 Effect of late summer pruning and shade on leaf chlorophyll of peach trees. In SP alone, there was no leaf expansion. SP=summer pruning, WC=white cloth, BC=black cloth. Bars indicate SE (n=3).

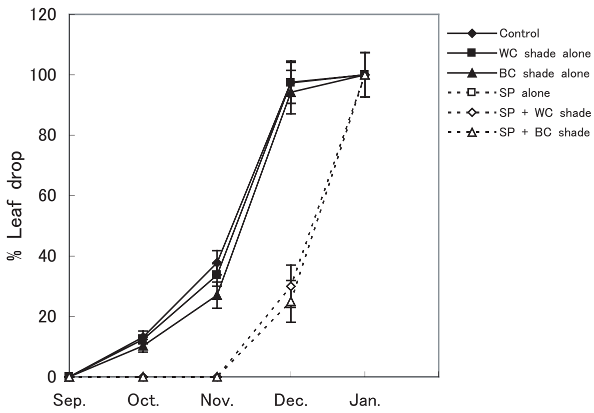

Fig. 6 Effect of late summer pruning and shade on leaf drop in peach trees from late September to late January. Vertical bars represent SE (n=3). SP=summer pruning, WC=white cloth, BC=black cloth. SP alone had no expanded leaves.

peach trees grafted on vigorous wild form peach rootstocks, Hossain et al.[9] reported that three or four days earlier bud break and flowering were observed in summer-pruned trees compared with winter-pruned trees. In their work they presumed that in summer pruned trees, shoots which are supposed to be used for bearing the following season are exposed to sunlight by summer pruning, whereas in winter pruned trees those which are supposed to be used for bearing are shaded due to mutual shading of branches during summer and autumn. The present results confirmed such presumption. In snapdragon, the decreasing light intensity significantly delayed the blooming time [4, 8].

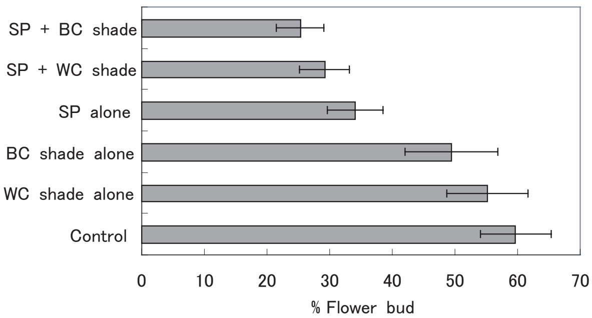

Fig. 7 Effect of late summer prunng and shade on flower bud formation of peach trees. SP=summer pruning, WC=white cloth, BC=black cloth. Bars indicate SE (n=3).

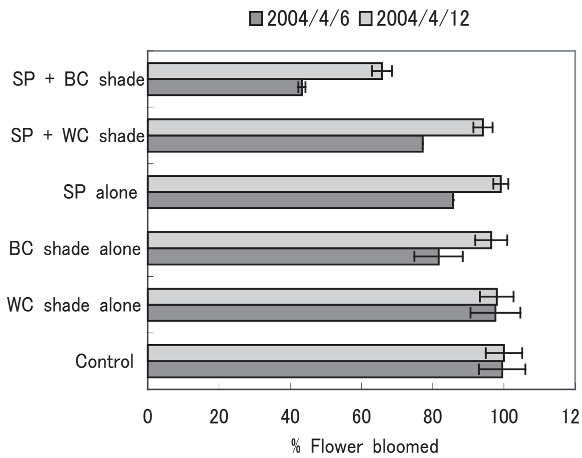

Fig. 8 Effect of late summer pruning and shade on bloomimg of peach trees. Data were taken twice on April 6 and April 12, 2004. Bars indicate SE (n=3).

Acknowledgments

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遅い夏季剪定と寒冷紗による遮光がモモの枝の再生、花芽分化、開花時期に及ぼす効果

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摘　　要

野生モモ台木に接ぎ木したポット植えの1年生‘日川白鳳’を用いて、遅い時期の夏季剪定と寒冷紗による遮光が、枝の再生、花芽分化、翌年の開花に及ぼす効果を調査した。９月１日に夏季剪定を行い、遮光区は樹を白と黒の寒冷紗の下においた。枝の再生は遮光をしない夏季剪定のみの区で、最も多かったが、再生した枝の生長は夏季剪定＋黒色寒冷紗区で最大であった。葉のクロロフィル含量（ＳＰＡＤ値）も夏季剪定＋黒色寒冷紗区で最も大きかった。花芽形成率は夏季剪定をしない区に比べて、夏季剪定をした区で低かった。また、遮光程度が大きくなるにつれて、花芽形成は抑制される傾向が見られた。再生した枝には花芽形成は見られなかった。落葉速度は夏季剪定をしない区で早かった。遮光は翌年の開花時期を遅らせる傾向があった。