Arab Gulf Journal of Scientific Research, 24 (3): 183-187 (2006)

Original Paper Ref. No 2408

Influence of Interstock Grafting as a Dwarfing Component on Peach Trees Development and Fruit Quality

تأثير التطعيم المتداخل كمكّون مقزّم على تطور أشجار الدراق ونوعية الثمار

***Sharif Hossain*[1], *Fusao Mizutani*[2] *and Amru Nasrulhaq*[1]**

شريف حسين، فوساو ميزوتاني، وعمرو نصرالحق

[1] *Plant Physiology and Biotechnology Laboratory, Institute of Biological Science, Faculty of Science, University of Malaya, Kuala Lumpur 50603, Malaysia*
E-mail: sharif.um@gmail.com or sharifhort@yahoo.com

[2] *Bioresource Production Science Laboratory, Faculty of Agriculture, Ehime University, Matsuyama 799-2424, Japan*

Abstract: A field experiment was conducted to investigate the interstock grafting effect as a dwarfing component on peach tree development and fruit quality. The study was made at the Ehime University Experimental Farm located in south-eastern Japan during the period 2001-2005. The results of the field experiment indicated that pruned branches weight and flowers number were lower in interstock than in control trees. However, percent fruit set was a little higher in interstock treated than in control trees. Fruit yield and fruit weight were lower in interstock treated than control trees. Soluble solids content and maturity index were higher in interstock treated trees than control, with an increasing trend in the period from 2001 to 2005, while titratable acidity showed an opposite trend. The results of this study showed that the interstock grafting is a useful dwarfing component for controlling the size of peach trees and improvement of fruit quality.

Keywords: *dwarfing techniques, interstock grafting, peach trees, fruit quality.*

المستخلص: تم إجراء تجربة حقليه في محطة التجارب الزراعية لجامعة إيهيمي الواقعة في الجزء الجنوبي الشرقي من اليابان في الفترة من 2001-2005 لدراسة تأثير التطعيم المتداخل (interstock grafting) كوسيلة لتقزيم الاشجار على تطور إشجار الدراق وجودة الثمار. أظهرت نتائج التجربة الحقلية ان وزن الاغصان المقلمة وعدد الازهار في الإشجار المطعمة كان اقل من اشجار الشاهد (control) في التجربة، إلا أن نسبة الثمار في الأشجار المطعمة كانت اعلى قليلاً من تلك في أشجار الشاهد. ولقد ادى التطعيم المتداخل إلى انخفاض إنتاجية المحصول ومتوسط وزن الثمرة، إلا ان محتوى الثمار من المواد الصلبة الذائبة ومؤشر اكتمال النضج سجلا قيما اعلى، وبزيادة مستمرة في هذا الاتجاه خلال الفترة من 2001 إلى 2005، بينما اظهرت درجة الحموضة اتجاها معاكسا لذلك. بينت نتائج هذه الدراسة ان عملية تطعيم اشجار الدراق يمكن اعتبارها وسيلة تقزيم مفيدة للتحكم في حجم هذه النوع من الإشجار وتحسين جودة ثمارها.

كلمات مدخلية : *تقنيات تقزيم، التطعيم المتداخل، اشجار الدراق، جودة الثمار .*

Introduction

Dwarfing of fruit trees plays an important role in fruit growth, development and quality. Large vigorous fruit trees face a problem to fruit growers, because ladders have to be used during fruit thinning, bagging and harvesting. If trees are small-sized, then it is easy to pick fruits from the ground. Small, compact, dwarf or size-controlled fruit trees provide easier pruning, thinning, spraying and harvesting, and could lead to the production of high-grade fruit at lower production cost (Tukey 1964). Sunset (1990) reported that in the past, genetic dwarf fruit trees were often disappointing. If they produced any fruit at all, it didn't taste very good. Almonds, apples, apricots, cherries, nectarines, and peaches have genetic dwarf varieties. They are usually adapted to the same areas as their standard counterparts. Genetic dwarf nectarines and peaches, while adaptable to the same areas as standards, tend to have lower chilling requirements for most standard varieties. Though most still can not match the flavor of the best standard varieties, newly genetic dwarfs particularly peaches and nectarines made the fruit more tasty. Slingerland and Wilson (1998) reported that there are no commercially acceptable dwarfing rootstocks for plum, peach or apricot that are comparable to those presently available for apple and pear.

Peach trees grafted on *Prunus tomentosa* and *Prunus japonica* rootstocks could be dwarfed but showed grafting incompatibilities after a certain period (Andrews and Serrano, 1992). The primary factor limiting the use of size controlling rootstocks in stone fruit production is the lack of suitable rootstocks with a wide range of compatibility among cultivars (De Jong, *et al.*, 2001). Therefore, dwarfing techniques, other than dwarfing rootstocks, need to be developed to control peach tree growth.

Tree size can be reduced by using interstock. Perez-Garcia *et al.* (1993) reported up to 42% decrease in plant height using different interstock/rootstock combinations on Manila mango compared to Manila seedling trees. Karp (1996) found greater yield in interstock treated apple trees than in controls. However, Sandoval (1987) indicated that interstocks of apple trees caused tree size reduction, as well as earlier initial fruit production, but also a lower yield per tree. In this study, a field experiment was undertaken during the period 2001-2005, to study the effects of interstock grafting as a dwarfing component on peach trees development and fruit quality.

Materials and Methods

Site: The experiment was carried out in an orchard in the Ehime University Farm located in south-eastern Japan.

Plant material: One-year-old peach trees were planted at a spacing of 1.2 x 2.0 meters (m) in April 1998. The trees were grown and nurtured properly until they became three years old (May 2001). Afterwards these three-year-old peach (*Prunus persica* Batsch cv. 'Akatsuki') trees were used to collect data in the experiment started in May 2001.

Treatment setting: The treatment was made at planting (1998). There were two treatments: control and interstock of ten trees used in the experiment, where five trees were used for control and the other five for interstock treatment. The trees were grafted on 25 cm interstock (var. 'Tsukuba No. 2') and then this interstock was grafted again on vigorous stock (var. 'Tsukuba No. 4'), as shown in Fig. 1.

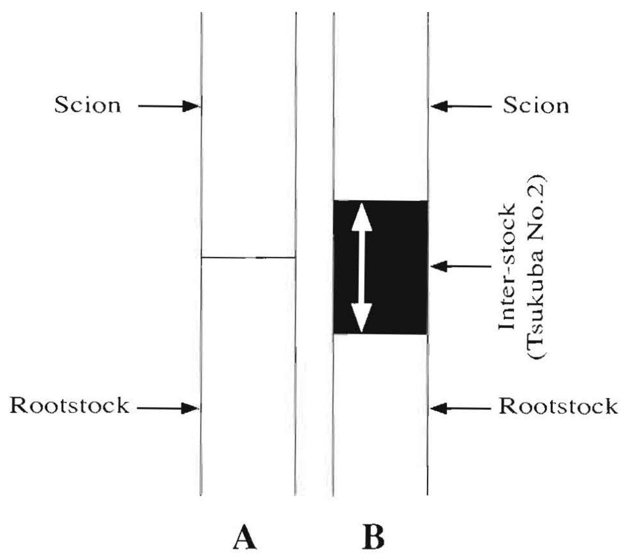

Fig. 1. The grafting treatments applied on peach trees. A: Control (no interstock), B: Treatment (with interstock).

Cultural operations: Fertilizers were applied in the first year after plantation, for N, P and K at rates of 10%, 10% and 10%, respectively, with 10 grams per tree. Weeding was made at a 15 days interval manually. Irrigation was applied per week. Pesticide was used as needed to control disease and pest.

Data collection: Pruned branch weight was collected after winter pruning in February in the period 2001-2005. Percentage of flower bud and fruit set were measured in January and May in 2005, respectively.

Fruit bagging, harvesting and measurement: Fruits were bagged in early May, 2001, 2004 and 2005 and harvested in mid July 2001, 2004 and 2005. Fruit yield and degree of maturity were recorded immediately after harvest. Ten fruits per tree were randomly selected and used to determine soluble solids content (SSC) and titratable acidity (TA) immediately after harvest.

Maturity degree measurement: Fruits were kept in different baskets after harvest by following each replicate. A score of 1 was given for green fruit, and a score of 5 was given for ripen fruits. By following these categories, the maturity index/degree was measured for each replicate and the mean for each treatment was calculated.

Juice collection: Fruit juice was collected manually immediately after harvest using hand threaser and cheesecloth and preserved in the freezer to determine SSC and TA.

Soluble solids content determination (SSC): Soluble solids content was measured with a refractometer (Atago PR-1). One drop of juice was taken on the refractometer and reading was recorded.

Titratable acidity determination (TA): TA was determined by titration with 0.1N NaOH using phenolphthalein as an indicator. Titration was made using juice until color was developed and recorded the reading.

Design and Statistical analysis: Treatments were set following completely randomized design repeated in different trees. Standard error was calculated to test the mean deviation.

Results and Discussion

Trees were trained as slender spindle bush types and pruned branches were weighed after every pruning (Figure 2). Branch weight was lower in interstock treated trees and higher in control trees during the years 2001-2005. Percent flower bud was higher in interstock treated than in control trees, while percent fruit set was lower in interstock treated trees than in control (Figure 3). Positive correlation was found between shoot growth (measured by branch weight) and trunk circumference (Figure 4). Fruit yield and fruit weight were lower in interstock treated than in control trees (Table 1). There was no treatment effect on fruit number, yield and mean fruit weight in 2001, 2004 and 2005. However, soluble solids content and degree of maturity were higher and acid content was lower in interstock treated than in control trees (Table 2).

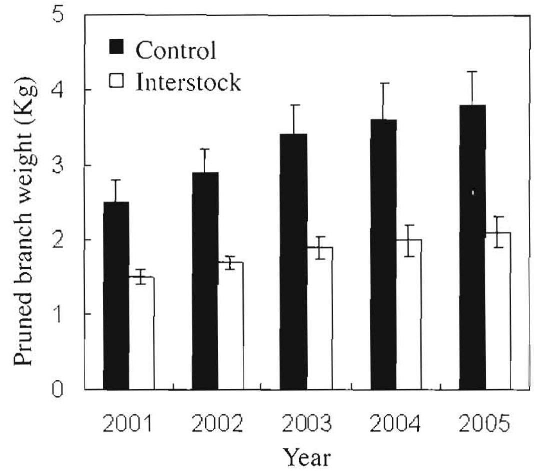

Fig. 2. Effect of interstock on pruned branch weight of peach trees. Vertical bars represent SE (n=5)

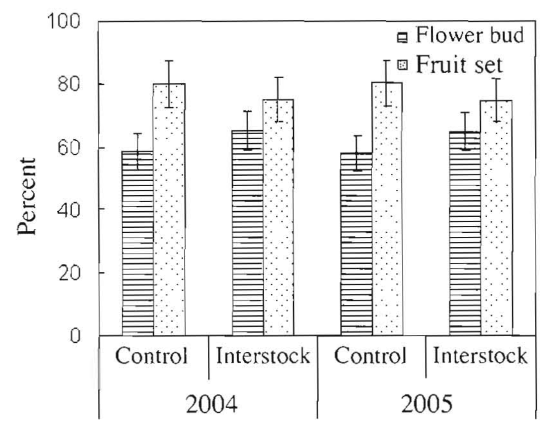

Fig. 3. Effect of interstock on percentages of flower bud formation and fruit set of peach trees. Vertical bars indicate SE (n=5)

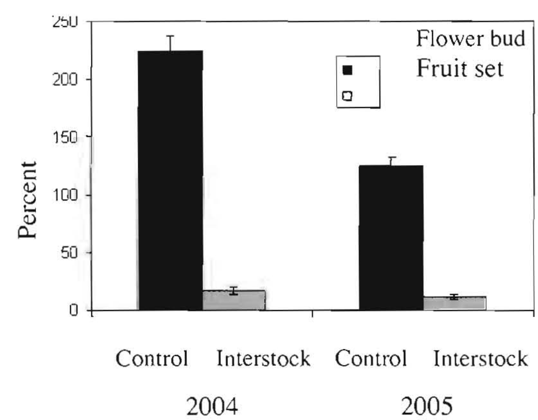

Fig. 4. Effect of interstock on shoot length (SL) and trunk circumference (TC) of peach trees. Vertical bars indicate SE (n=5)

Table 1. Effect of interstock on fruit yield and size of peach in different years (Mean±SE; n =5).

Year	Treatment	Fruit no./tree	Fruit yield (kg/tree)	Fruit weight (g)	Fruit diameter (mm)	Fruit length (mm)
2001	Control	11.5±2.0	1.5±0.21	130.8±5.4	---	---
	Interstock	10.6±2.1	1.2±0.20	113.5±4.5	---	---
2004	Control	15.3± 2.4	2.7±0.34	176.2±5.0	65.4±0.8	60.1±0.6
	Interstock	15.9± 2.5	2.6±0.24	163.3±4.1	65.9±0.9	60.2±-0.5
2005	Control	26.6± 4.0	4.5±0.33	169.1±6.0	66.5±0.7	59.6±0.5
	Interstock	21.5± 3.6	3.6±0.20	168.5±5.2	67.4±0.8	60.4±0.4

Table 2. Effect of interstock on fruit quality (SSC, TA and maturity) of peach in different years (Mean±SE; n = 5).

Year	Treatment	Maturity degree*	Souble solids content (%)	Titratable acidity (%)
2001	Control	2.5 ± 0.26	---	---
	Interstock	3.3 ± 0.29	---	---
2004	Control	2.7 ± 0.33	10.1 ± 0.25	0.51 ± 0.06
	Interstock	3.5 ± 0.31	11.6 ± 0.23	0.36 ± 0.04
2005	Control	3.0 ± 0.30	12.9 ± 0.23	0.37 ± 0.03
	Interstock	3.8 ± 0.28	13.7 ± 0.24	0.26 ± 0.03

* For maturity degree, ripen fruit was counted as score 5 and green fruit as score 1.

The results show that interstocks can be effective in dwarfing peach trees. Branch weight was lower in interstock treated trees, probably due to the suppression of mineral and photosynthate movement between shoots and roots the interstock. In addition, the interstock used in this experiment has been observed to have dwarf characteristics, though it is not effective as a dwarfing rootstock. Hossain *et al.* (2005) found that shoot growth was lower in interstock treated than in control trees. Sandoval (1987) stated that several cultivars in mango (*Mangifera indica* L.) cv. Manila tested as interstocks showed tree size reduction as well as earlier initial fruit production but also a lower yield per tree. Chaudhri (1976) reported that tree size was dwarfed when interstocks were used and Tojnko *et al.* (2004) reported that growth in trees with interstocks was suppressed by about 20% in comparison with trees without interstocks. Our results show that it is possible to suppress shoot growth by use of interstocks in peach trees and improve fruit quality.

References

Andrews, PK and **Serrano, CM** (1992) Graft incompatibility. *Hort Rev.* **15:** 183-232.

Chaudhri, A (1976) (*Mangifera indica*) mango. *In*: **Garner, RJ (ed)**, *The propagation of tropical fruit trees*. FAO-CAB. England. pp. 403-474.

De Jong, TM, Weibel, A, Tsuji, W, Dolye, JF, Johnson, RS and **Ramming, D** (2001) Evaluation of size controlling rootstocks for California peach production. *Acta Hort.* **557:** 103-110.

Hossain, ABMS, Mizutani, F, Onguso, JM and **El-Shereif, AR** (2005) Effect of interstock and spiral bark ringing on the growth and yield of peach. *Bulgarian Journal of Agricultural Sciences* **11:** 316-320.

Karp, K (1996) Influence of interstock on apple trees. *Acta Hort.* **422:** 258-262.

Perez-Garcia, E, Avila-Resendiz, C, Matheis-Toledano, L and **Mosqueda-Vazquez, R** (1993) Vegetative growth analysis of Mango 'Manila' trees grafted onto several interstock/rootstock combinations. *Acta Hort.* **341:** 256-263.

Sandoval, EA (1987) Efecto de portainnjertos e interinjertos de porte bajo sobre en mango (*Mangifera indica* L.) cv. Manila. Tesis de Maestria, Colegio de Postgraduados. p. 83.

Tojnko, S, Cmelik, Z and **Zadravec, P** (2004) Influence of interstock on growth and cropping of Red Elstar. *Acta Hort.* **658:** 303-306.

Tukey, HB (1964) *Tree Structure, Physiology and Dwarfing*, Dwarf Fruit Trees. Cornell University Press, UK. pp 562.

Slingerland, K and **Wilson, K** (1998) Fruit Tree in the Home Garden. Ministry of Agriculture, Food and Rural Affairs, http://www.omafra.gov.on.ca. Ontario, Canada. p1

Sunset (1990). The new dwarf fruit trees includes related article on choosing a genetic dwarf fruit tree. Sunset publishing group, http://www.encyclopedia.com. p1

Ref. 2408
Rec. 20/ 11/ 2006
In-revised Form 02/ 03/ 2007