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Can pruning be utilized to minimize aberrant fruit formation in kiwifruit?

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Abstract: 'Hayward' (*Actinidia deliciosa* A. Chev C.F.Liang and A.R.Ferguson) is a kiwifruit cultivar preferred for its high yield and quality. However, its tendency to produce aberrant (flat or fasciated) fruits causes low marketability and therefore low income. This research was planned to determine if pruning can be used as a strategy to minimize aberrant fruit formation. It was conducted for two growing seasons on a commercial vineyard located at Kepez, Çanakkale, by applying three different levels of winter pruning (4, 8 and 16 buds per cane). At harvest, normal and aberrant fruits per vine were counted and yield and quality analyses were made. Results showed that pruning did not have an effect on minimizing the aberrant fruit formation and yield characteristics of the vines of 'Hayward' kiwifruit at a statistically important level.

Key words: Aberrant fruit, Fan, Fascinated, Hayward, Kiwifruit.

Budama kivide anormal meyve şekil oluşumunu en aza indirmek için kullanılabilir mi?

Özet: 'Hayward' (*Actinidia deliciosa* A. Chev C.F.Liang and A.R.Ferguson) yüksek verimi ve kalitesi için tercih edilen bir kivi çeşididir. Ancak, anormal şekilli (yassı veya yelpaze) meyve oluşturma eğilimi pazarlanabilir değerinin düşmesine ve dolayısıyla düşük gelire neden olmaktadır. Bu araştırma, anormal şekilli meyve oluşumunu en aza indirmek için budamanın bir strateji olarak kullanılıp kullanılamayacağını belirlemek amacıyla planlanmıştır. Kepez, Çanakkale yakınlarında bulunan bir ticari kivi bağında iki vegetasyon döneminde üç farklı düzeyde (4, 8, and 16 göz/dal) kış budamasının uygulanmasıyla yürütülmüştür. Hasatta normal ve anormal şekilli meyveler omca başına sayılmış olup, verim ve kalite analizleri yapılmıştır. Sonuçlar, budamanın 'Hayward' kivi çeşidinde anormal meyve oluşumu ve verim özellikleri üzerine istatistiksel olarak önemli düzeyde etkiye sahip olmadığını ortaya koymuştur.

Anahtar kelimeler: Anormal şekilli meyve, Hayward, Kivi, Yassı, Yelpaze.

Introduction

Fruit shape is one of the most important quality parameters for evaluation by consumer preference (Sadrnia et al. 2007). Consumers prefer fruits of equal weight and uniform shape (Waseem et al. 2002). Classification of fruit can increase uniformity in size and shape, reduce packaging and transportation costs and also may provide an optimum packaging configuration (Tabatabaeefar et al. 2000). Fruit shape is affected by inheritance in addition to environmental growing conditions (Sadrnia et al. 2007). Description of fruit shape is often necessary in horticultural research for a range of different purposes such as cultivar descriptions in applications for plant variety rights or cultivar registers (Beyer et al. 2002; Hasnain et al. 2003), consumer preference (Gerhard et al. 2001), heritability of fruit shape traits (Currie et al. 2000; White et al. 2000), and determination of misshapen fruit (Sadrnia et al. 2007).

The most important major problem limiting marketable quality in kiwifruit is the formation of aberrant (flat or fan shaped) fruits. Fan and flat fruits are not acceptable for export (Cooper and Marshall 1990). The most commercially significant cultivar, Hayward, is a member of the species, *Actinidia deliciosa* ((A. Chev.) C.F. Liang and A.R. Ferguson). The most commonly encountered problem with 'Hayward' is its tendency to form odd-shaped fruits, causing income loss to growers. Cooper and Marshall (1990) attributed these incidences to Hayward's genetic characteristics. They also speculated that such floral abnormalities might be due to low temperatures prior to budburst, or by competition for resources such as carbohydrates or hormones. Cause for aberrant flower development is not fully understood although it also occurs, to a greater or lesser degree, in many other fruit trees and vines (Brundell 1975 cited from May and Fulford). Engin et al. (2011) reported that flower buds to become aberrant fruits can be distinguished early in their development much before anthesis. Studies involving determination of effects of pruning on yield and quality of kiwifruit (Testolin et al. 1988; Inglese and Gullo 1992; Costa et al. 1995; Samancı

1997) generally focused on the marketable fruit. This research was designed to determine the effects of pruning on minimizing the formation of aberrant kiwifruits.

Material and method

This study was carried out in a commercial block of 7-year old the kiwifruit (*Actinidia deliciosa* ((A. Chev.) C. F. Liang and A. R. Ferguson) cv. 'Hayward', located near Univ. of Çanakkale Onsekiz Mart, Northwestern Turkey in 2008 and 2009. The vines were managed by standard vineyard practices and trained on T-bars. Loads of 80, 115 and 185 thousands buds/ha, obtained with 4-, 8-, and 16-node long canes were compared, during two bearing years. At the harvest time, marketable and non-marketable (flat and fan) fruits were counted and yield and quality analyses were performed. No flower or fruit thinning was performed. Summer pruning was not applied. Each pruning treatment was performed on four vines. Data obtained from two consecutive years were pooled before they were subjected to ANOVA with Minitab statistical software (Microsoft ver. 13.1) and Duncan's multiple range test was adopted to test mean separation.

Results

Statistical analyses showed that pruning did not have any effects on the formation of fan or flat shaped fruits and the yield characteristics of the vines (Table 1). As the longer canes were left on the vine, fruit number showed an increase in the both normal and aberrant fruits. Yield per vine corresponded to this increase but fruit weight stayed at similar range, except for the ones on the vine with 4-node canes. These changes however were not at a statistically important level. Percentages of the aberrant fruits in total yield and number per vine were lowest in the shortest bearing canes. On the other hand, medium size canes had higher percentages of aberrant fruits compared with the longer canes.
Statistically significant differences were observed in the soluble solids and titratable acidity (citric acid equivalent) of the normal fruits and the pH and titratable acidity of the aberrant fruits (Table 1). As more buds were retained on the canes, pH and acidity of the aberrant fruits were increased. The response of the normal fruits to the pruning differed in that soluble solids were higher in the fruits from the short and medium-long canes while fruits on the short and long canes contained higher acidity.

Table 1. Yield and quality characteristics of the normal and aberrant fruits of 'Hayward' kiwifruit vines pruned at different levels.

Yield characteristics								
	Yield per vine (kg)			Fruit per vine (n)			Fruit weight (g)	
Pruning level	Normal	Aberrant	% in total	Normal	Aberrant	% in total	Normal	Aberrant
4-bud cane	4.11	0.32	7.23	51.90	3.75	6.70	81.09	55.76
8-bud cane	15.43	3.46	18.30	178.0	34.88	16.40	81.18	166.92
16-bud cane	24.05	4.67	16.30	284.40	50.50	15.10	80.96	163.42

Quality characteristics						
	Soluble solids (Brix°)		pH		TA (citric acid eq.) g/100 ml	
Pruning level	Normal	Aberrant	Normal	Aberrant	Normal	Aberrant
4-bud cane	7.50aA*	3.64bB	2.97	1.47	2.04aA	0.93bC
8-bud cane	7.25aA	9.50aA	2.93	4.04	1.89bA	2.86aB
16-bud cane	6.48bB	10.78aA	2.97	4.76	2.03aA	3.40aA

*small letters in rows show the differences between the fruit shapes and the capital letters in columns show the differences among the pruning levels.

Discussion

Pruning had no major influence on fruit shape differences of kiwifruit vines. Although studies on effect of pruning on yield and quality of kiwifruit can be found in literature, its relation with or effect on producing aberrant fruit in kiwifruit is limited. Cooper and Marshall (1990) stated that production of aberrant fruit might be due to the genetic characteristics of 'Hayward' and could be triggered by low temperatures before the bud break, or by competition for carbohydrates or hormones. Thorp (1994) commented on that there can be a considerable variation from site to site. Kiwifruit may have up to 13% flat (Watson and Gould 1994) and 25% fan (Cooper 1986) shaped fruits. Gökbayrak et al. (2007) found that the percentage of aberrant fruit formation was between 3-29% in some kiwifruit vineyards of Lapseki, Çanakkale-Turkey. Although selective hand thinning and sorting can be used to remove these fruit, the cost increase may be considerable.

Findings in this study showed that pruning did not affect the number of aberrant fruit or the overall yield produced on the vines of 'Hayward' kiwifruit. This can be attributed to the allocation of photosynthates produced on the shoots retained after the pruning. The number of fasciated fruit produced varies between shoots, canes, vines or years and generally more fans are borne on vines or shoots of high vigor (Thorp 1994). In the present study, with no statistical importance, longer canes contained more aberrant fruits. Volz et al. (1991) stated that larger canes tended to produce a higher proportion of misshapen fruits than smaller ones. Gökbayrak et al. (2009) calculated the ratios for abnormal buds to the total buds were 9.5% in 3 buds per cane, 11% in 6 buds per cane, and 13% in 12 buds per cane. Lai et al. (1990) also reported that long laterals and early blooming flowers produce larger ovaries and fruits. In this study, tendency of the larger canes to produce aberrant fruits were only observed in values, but they were not statistically different from the less developed canes.

Conclusion

Aberrant fruit formation is a problem in kiwifruit production. Although pruning was not found to be factor in regulating this phenomenon, taking into account that canes of high vigor tend to develop more of these fruits, pruning can be employed to keep cane development under better control so that formation of non-marketable fruits can be limited to maximize income.

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