Scientia Horticulturae 177 (2014) 37–42

Contents lists available at ScienceDirect

Scientia Horticulturae

journal homepage: www.elsevier.com/locate/scihorti

Growth, fruit production, and disease occurrence of rain-sheltered Asian pear trees

Kyeong-Ho Lim[a,d], Mengmeng Gu[b], Jang-Hoon Song[a], Young-Sik Cho[a], Wol-Soo Kim[c], Byeong-Sam Kim[d], Seok-Kyu Jung[e], Hyun-Sug Choi[e,*]

[a] Pear Research Station, National Institute of Horticultural & Herbal Science, Naju, Jeollanam-do 520-821, Republic of Korea
[b] Department of Horticultural Sciences, Texas A&M AgriLife Extension, College Station, TX 77843, USA
[c] Department of Horticulture, Chonnam National University, Gwangju, Jeollanam-do 500-070, Republic of Korea
[d] Jeollanam-do Agricultural Research & Extension Services, Naju, Jeollanam-do 520-715, Republic of Korea
[e] Department of Floriculture, Catholic University of Daegu, Gyeongsan, Gyeongsangbuk-do 712-702, Republic of Korea

ARTICLE INFO

Article history:
Received 9 June 2014
Received in revised form 17 July 2014
Accepted 19 July 2014
Available online 14 August 2014

Keywords:
Canopy temperature
Frost
Fruit quality
Light
Niitaka

ABSTRACT

Tree performance, fruit production, and disease occurrence were compared for 'Niitaka' Asian pear (*Pyrus pyrifolia* Nakai) trees grown under open-field or rain-shelter system in two organic orchards. The study was conducted in two provinces, Naju (orchard A) with young pear trees in 2012 and 2013 and Namwon (orchard B) with mature pear trees in 2012. Pear trees under the rain shelter showed higher overall tree canopy growth, number of leaves, and fruit set in both orchards, with less frost damage to flower clusters due to preventing decreasing canopy temperature during flowering in orchard A. Trees grown under the rain-shelter system had higher fruit yield, average fruit weight, crop density, fruit soluble solid contents, titratable acidity, and fruit skin color L*, as well as reduced disease incidence of leaves or fruit, all of which would likely contribute to higher economic return compared to those from open-field systems.

© 2014 Elsevier B.V. All rights reserved.

1. Introduction

Organic fruit sales have increased approximately 20% annually in developed countries since the 1990s due to better perceived food safety, environmental friendliness, and better nutritional values (Lotter, 2003). Prices for organic fruit are 20–100% higher than those of conventional fruit in South Korea, where the government recommends that farmers cultivate organic fruit, minimizing or excluding the use of agro-chemicals (Kim, 2010). However, organic fruit comprised only 1% of total fruit production in 2012, mostly due to either little experience or scientific information for growing organic fruits. In addition, the warm and humid monsoon climatic condition during the growing season in South Korea present great challenging to organic fruit production (Choi et al., 2012). The summer season typically witnesses high amounts of rainfall (50% of annual precipitation) and often several typhoons, causing severe occurrence of scab (*Venturia nashicola* Tanaka et Yamamoto) and rust (*Gymnosporangium asiaticum* Miyabe et Yamad) on leaves or fruit.

Asian pear is one of the most popular fruit species in South Korea and is sold mainly for fresh consumption. 'Niitaka' Asian pear (*Pyrus pyriforia* Nakai) fruit comprises approximately 82% of total pear production (KREI, 2008). However, 'Niitaka' pear trees are very sensitive to scab (Shin et al., 2004), and the symptom occurs on the leaves and fruit in spring and summer. Symptom develops as black charcoal-like fungi covering the leaf petioles and fruit stalks (Cho et al., 1985). The occurrence of scab increases remarkably between flower initiation and full bloom. Typically, agro-chemicals are sprayed to control scab in conventional orchards. In organic orchards, on the other hand, the best scab control includes early fruit bagging, elimination of infected leaves and fruits, and application of Bordeaux mixture, which does not completely suppress pest pressures (Choi et al., 2011).

Rain shelters have been used mostly for vegetable production, in particular for peppers, or for grapevines to create a more favorable microclimate during a growing season, increase carbohydrate contents of bark, and reduce foliage wetness, frost damage, and disease occurrence (Ahn et al., 2012; Meng et al., 2013; Park et al., 2006). Rain-shelter systems have been used with success in several organic Asian pear orchards to lower disease incidence.

The objective of this study was to investigate the effects of rain-shelter system on the performance, fruit production, and disease

* Corresponding author. Tel.: +82 53 850 3279; fax: +82 53 850 3279.
E-mail addresses: hchoiuark@gmail.com, dhkdwk7524@daum.net (H.-S. Choi).

http://dx.doi.org/10.1016/j.scienta.2014.07.030
0304-4238/© 2014 Elsevier B.V. All rights reserved.

Table 1
Soil pH, OM (organic matter), and concentration of P_2O_5, K_2O, CaO, and MgO at the depth of 0–30 cm in the open-field (control) and rain-sheltered systems in pear orchards A (Naju) and B (Namwon) in mid-July.

Orchard system	pH (1:5)	OM (%)	P_2O_5 (mg kg^{-1})	K_2O	CaO	MgO
				(cmol kg^{-1})		
Orchard A in 2012						
Open-field	6.6 ± 0.46	3.0 ± 1.0	239 ± 94	0.9 ± 0.21	9.9 ± 0.95	3.6 ± 0.35
Rain-shelter	6.8 ± 0.01	2.4 ± 0.2	213 ± 43	1.3 ± 0.15	10.6 ± 0.08	3.9 ± 0.20
Orchard A in 2013						
Open-field	7.1 ± 0.01	3.7 ± 0.03	198 ± 3	1.7 ± 0.01	7.8 ± 0.04	3.3 ± 0.01
Rain-shelter	6.7 ± 0.01	4.3 ± 0.01	194 ± 4	1.8 ± 0.01	6.6 ± 0.03	4.0 ± 0.03
Orchard B in 2012						
Open-field	6.8 ± 0.01	3.7 ± 0.08	736 ± 1	1.2 ± 0.01	8.4 ± 0.11	3.7 ± 0.02
Rain-shelter	6.8 ± 0.01	2.3 ± 0.05	662 ± 3	2.9 ± 0.02	8.9 ± 0.04	3.7 ± 0.01
Desired level[a]	6.0–6.5	2.5–3.0	200–300	0.30–0.60	5.0–6.0	1.5–2.0

[a] The levels were adopted from RDA (2011).

Table 2
Trunk cross-sectional area (TCA) increase (%), canopy growth length (%), and number of leaves/fruit set in the open-field and rain-sheltered Asian pear trees in orchards A (Naju) and B (Namwon).

Orchard system	TCA increase (%)[b]	Canopy width increase (%)		No. of leaves per fruit	No. of fruit set per tree
		Within row	Between row		
Orchard A in 2012					
Open-field	16.7	59.9	9.2	1.5	6.5
Rain-shelter	16.9	37.2	10.2	4.9	9.3
Significance	NS[a]	**	NS	***	*
Orchard A in 2013					
Open-field	11.7	28.7	7.2	3.8	16.3
Rain-shelter	12.6	48.9	15.0	4.5	21.2
Significance	NS	**	**	***	*
Orchard B in 2012					
Open-field	2.3	7.4	4.6	–	67.8
Rain-shelter	2.6	11.4	11.0	–	202.6
Significance	NS	NS	*	–	***

Canopy length increase (%), canopy length increase from April to November.
[a] NS.
[b] TCA increase (%), tree trunk cross-sectional area increase from March to November.
* Nonsignificant or significantly different at $P = 0.05$.
** Nonsignificant or significantly different at $P = 0.01$.
*** Nonsignificant or significantly different at $P = 0.001$.

occurrence of 'Niitaka' pear trees grown in two organic orchards in the warm and humid climate of South Korea.

2. Materials and methods

2.1. Plant material and site information

The study was conducted in two organic orchards, Naju (latitude: 35° N; longitude; 126° E) and Namwon (latitude: 35° N; longitude; 127° E), South Korea. In Naju (orchard A), the trial was conducted, in both 2012 and 2013, and in Namwon (orchard B), the trial was conducted only in 2012 as serious disease occurred in 2013 and fruit yield was low in the open-field system. Five-year-old 'Niitaka' pear trees were used for orchard A, with 5.0 m × 1.5 m planting density in both open-field and rain-shelter systems. In orchard B, 20-year-old 'Niitaka' pear trees were used with 6.0 m × 5.5 m planting density for both systems. All trees were trained to 3.0 m tall Y-shape with a 2-wire trellis system. Orchard A was loamy soil on the top and clay loam soil in the deeper layers, and orchard B was mainly sandy loam soils.

Total precipitation was 1285 mm and 932 mm from May to October in the orchard A in 2012 and 2013, respectively, and 1200 mm in orchard B in 2012 (KMA, 2012–2013). Average temperature was 20.8 °C and 23.0 °C from May to October in orchard A in 2012 and 2013, respectively, and 21.5 °C for orchard B in 2012 (KMA, 2012–2013). The duration of wet fruit and leaf surfaces (more than 0.1 mm precipitation per day) was 61 days in orchard A and 67 days in orchard B in 2012, with 52 days in orchard A in 2013 (KMA, 2012–2013).

Certified organic materials used to prevent diseases and insects, including lime sulphur, clay sulphur, oil emulsion, plant extract from leaves, seeds, flowers, and fruits, and lactobacillus in both orchards, which were widely used in East Asia. Two times of applications containing lime sulphur, clay sulphur, and oil emulsion were used to control disease in the open-field and rain-shelter systems during the winter in both orchards in 2012 and 2013. Average of four times of applications of the certified organic materials was annually used to control disease and insects in the rain shelter in orchard A during the growing season, with twelve times of applications used in the open field. Annual application of cattle manure compost (0.9% (w/w) N, 1.2% (w/w) P, and 1.1% (w/w) K) was made at both orchards in April, based on soil nutrient recommendations (RDA, 2011). The annual average compost application was approximately 20,000 kg per ha.

Download English Version:

https://daneshyari.com/en/article/4566687

Download Persian Version:

https://daneshyari.com/article/4566687

Daneshyari.com