

Research Article



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## 파풍망 종류에 따른 키위의 발아, 개화 및 과실 특성

곽용범<sup>1</sup>, 김홍림<sup>1</sup>, 이목희<sup>1</sup>, 이한철<sup>1</sup>, 곽연식<sup>2</sup>, 이용복<sup>2\*</sup>

<sup>1</sup>

<sup>2</sup>

### Budbreak, Floral Bud and Fruit Characteristics of Kiwifruit as Affected by Various Windbreaks

Yong-Bum Kwack<sup>1</sup>, Hong Lim Kim<sup>1</sup>, Mockhee Lee<sup>1</sup>, Han-Cheol Rhee<sup>1</sup>, Youn-Sig Kwak<sup>2</sup> and Yong Bok Lee<sup>2\*</sup>  
(<sup>1</sup>Namhae Branch, National Institute of Horticultural and Herbal Science, Rural Development Administration, Namhae 52430, Korea, <sup>2</sup>Institute of Agriculture & Life Science, Gyeongsang National University, Jinju 52828, Korea)

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#### ORCID

Yong Bok Lee

<http://orcid.org/0000-0002-7651-4556>

Yong-Bum Kwack

<http://orcid.org/0000-0003-2506-7693>

#### Abstract

**BACKGROUND:** Kiwifruit growers build their vineyards using many windbreaks to protect their kiwifruit vines from defoliation injury by strong winds such as typhoon. In this study, we have compared fruit quality, budbreak rate and floral bud as affected by windbreaks. And also we surveyed several microclimate indices of kiwifruit orchard depending on the covering materials of arch-type windbreaks.

**METHODS AND RESULTS:** Five different windbreak materials including polyethylene film (PE), blue- and white-colored nets were tested in pipe-framed arch-type kiwifruit vineyards as the covering materials. Photosynthetically active radiation (PAR), annual mean temperature (AMT) and chill unit (CU) as well as fruit quality were compared among the covering materials. In all treatments, annual PAR was more than  $400 \mu\text{mol m}^{-2} \text{s}^{-1}$ , in which kiwifruit leaf could reach its maximum photosynthesis, since the leaves were emerged. Annual mean temperature was greater in 0.1 mm-PE covering as much as  $1-2^\circ\text{C}$  than other windbreaks. In CU calculated by three different models, all windbreaks showed more

than 1400 CU that is fully fulfilled CU for kiwifruit rest completion. There were no difference in budbreak rate among the covering materials. Fruit weight was heavier in 0.1 mm-PE and white-net (4 mm) than other windbreaks.

**CONCLUSION:** Regardless of the windbreak materials, the PAR quantity was enough for kiwifruit photosynthesis. And CU for kiwifruit rest completion was fully achieved in all treatments. However, with respect to fruit weight, quantity of PAR, and AMT, etc., It is highly recommended for kiwifruit growers to choose 0.1 mm-PE and white-net (4 mm) as for their windbreaks materials.

**Key words:** Chill unit, Fruit quality, Kiwifruit, Microclimate, Windbreaks

#### 서론

1,300 ha가 ( , 2016).

1 3 ( , 2011)

가

\*Corresponding author: Yong Bok Lee

Phone: +82-55-772-1967; Fax: +82-55-772-1969;

E-mail: [yblee@gnu.ac.kr](mailto:yblee@gnu.ac.kr)

**Table 1. Physical features of cover materials of arch-type windbreaks used in this experiment**

Windbreaks	Average mesh size (mm)	Net porosity (%)
Blue net (2 mm)	1.36×2.39	49.3
Blue net (4 mm)	5.21×3.23	72.7
White net (2 mm)	1.73×2.29	65.6
White net (4 mm)	5.56×3.42	82.1

<sup>2</sup>Net porosity was calculated by mesh area and number per 100 cm<sup>2</sup>.

가 (Tanhora, 1988; Kwack *et al.*, 2012, 2013, 2015). (Choi *et al.*, 2002)

**과실희성 및 익년 발아, 개화 조사**

2012 2013 2014 2015  
가 (bud) (sprouted bud)

(PE)

(PR-32 α, Atago, Bellevue, USA) (TitroLine Easy, Schott, Germany)

**재료 및 방법**

**시험 품종 및 방풍시설**

31 (Hayward) 5 m, 4.3 m  
1.7 m 0.1 mm (PE)  
2010 12 (Open field)  
△△ 2 mm (Blue 2 mm) 4 mm (Blue 4 mm) 2 mm (White 2 mm) 4 mm (White 4 mm)  
(Table 1). (%) 100 cm<sup>2</sup> 5 m×6 m 6

**통계분석**

2 SAS 9.2, Enterprise 4.3 (SAS Institute, Inc., Cary, N.C., USA) (*P*≤0.05)

**결 과**

**파풍망의 특성 및 과원 내 미세기상**

가 PE mesh 가 mesh 2 mm 4 mm 49.3% 2 mm 4 mm 72.7% 65.6% 82.1% mesh PAR Fig 1 PE가

**미세기상 조사**

400~700 nm (PAR) 가 WatchDog 2475 (Spectrum technology, USA) 30 cm 30 (chill unit, CU) Sunley (2006) 3가

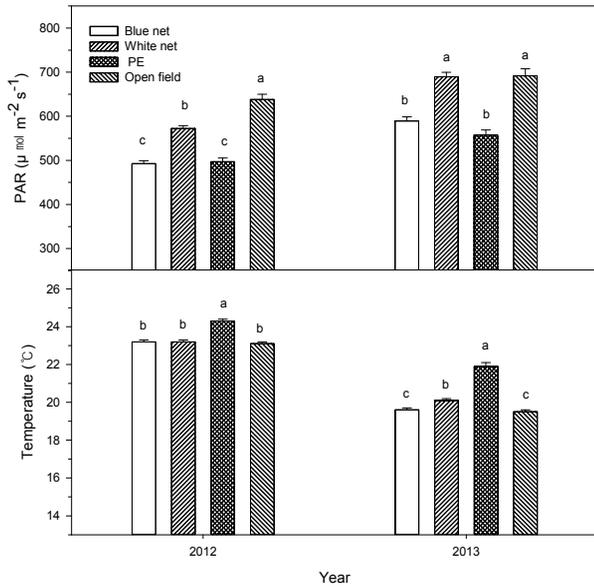


Fig. 1. PAR and mean temperature of kiwifruit orchard during seven months from April through October in 2012 and 2013 depending on covering materials of arch-type windbreaks. Bars labeled with same letter are not significantly different by the Duncan's multiple range test ( $p=0.05$ ). Vertical bars indicate standard errors of the means.

Table 2. Several microclimate indices under different covering materials of arch-type windbreaks during seven months from April through October

Year	Windbreaks	PAR (μMOL m <sup>-2</sup> s <sup>-1</sup> )	Temperature (°C)
2012	Open field	638.0	23.1
	PE	497.1	24.3
	Blue net (2 mm)	488.4	23.0
	Blue net (4 mm)	498.4	23.6
	White net (2 mm)	530.3	23.4
	White net (4 mm)	613.9	23.0
2013	Open field	691.7	19.5
	PE	557.2	21.9
	Blue net (2 mm)	563.7	19.4
	Blue net (4 mm)	617.0	20.0
	White net (2 mm)	677.9	20.2
	White net (4 mm)	701.0	19.9

<sup>z</sup>Mean separation within columns by the Duncan's multiple range test at  $p=0.05$ .

(Fig. 1). PAR

mesh 가  
PAR (Table 2). PAR 2 mm 4 mm 2012 488.4, 498.4 μmol m<sup>-2</sup> s<sup>-1</sup>, 2013 563.7, 617.0 μmol m<sup>-2</sup> s<sup>-1</sup>, 2 mm 4 mm 2012 530.3,

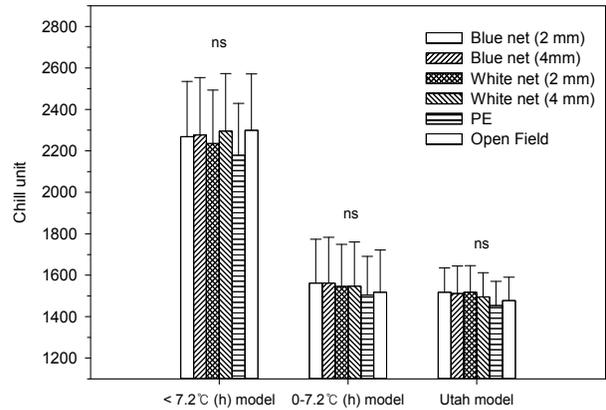


Fig. 2. Chilling unit of kiwifruit orchard calculated by three different models. It is sum of five months from November through March in the year 2012/2013 and 2013/2014 under different covering materials of arch-type windbreaks. Bars labeled with 'ns' are not significantly different by the Duncan's multiple range test ( $p=0.05$ ). Vertical bars indicate standard errors of the means.

Table 3. Fruit characteristics of 31-year-old 'Hayward' kiwifruit grown under different covering materials of arch-type windbreaks

Year	Windbreaks	Fruit weight (g)	Soluble solids content (Brix)	Titratable acidity (%)
2012	PE	92.5	13.5	0.8
	Blue net (2 mm)	90.8	13.5	0.8
	Blue net (4 mm)	88.2	13.9	0.9
	White net (2 mm)	97.9	12.7	0.8
	White net (4 mm)	93.8	13.3	0.7
2013	Open field	96.5	12.8	1.1
	PE	118.2	14.3	1.1
	Blue net (2 mm)	109.6	13.5	1.2
	Blue net (4 mm)	99.1	12.8	1.1
	White net (2 mm)	101.7	13.5	1.1
	White net (4 mm)	120.2	13.5	1.0

<sup>z</sup>Mean separation within columns by the Duncan's multiple range test at  $p=0.05$ .

613.9 μmol m<sup>-2</sup> s<sup>-1</sup>, 2013 677.9, 701.0 μmol m<sup>-2</sup> s<sup>-1</sup> mesh (PAR)

가 가 가  
(chill unit, CU)  
37가 (Sunley *et al.*, 2006)  
mesh

(Fig. 2).

파풍망에 따른 과실특성 가

**Table 4. Characteristics of budbreak and flowering of 31-year-old 'Hayward' kiwifruit grown under different covering materials of arch-type windbreaks**

Year	Windbreaks	Budbreak (%)	Floral bud (%)	Flower (No/floral shoot)
2013	Open field	67.5 a <sup>z</sup>	40.7 c	2.2 c
	PE	66.0 a	84.0 a	3.6 a
	Blue net (2 mm)	65.4 a	61.9 b	3.0 b
	Blue net (4 mm)	65.8 a	65.3 b	3.2 a
	White net (2 mm)	66.9 a	71.4 b	3.2 a
	White net (4 mm)	68.3 a	71.8 b	3.3 a
2014	Open field	66.7 a	89.1 a	4.1 a
	PE	66.2 a	85.8 a	3.6 b
	Blue net (2 mm)	60.6 a	80.6 a	3.4 b
	Blue net (4 mm)	65.3 a	75.6 a	3.3 b
	White net (2 mm)	71.6 a	79.6 a	3.2 b
	White net (4 mm)	66.3 a	84.4 a	3.1 b

<sup>z</sup>Mean separation within columns by the Duncan's multiple range test at  $p=0.05$ .

(g FW), (Brix), (%)  
 (Table 3).  
 가, PAR 가  
 4 mm 1~2°C  
 0.1 mm PE 가 2013 가  
 2012 4 mm 13.9 Brix, 2013 0.1 mm  
 PE 14.3 Brix 가  
 mm 4

**파풍망에 따른 익년 발아 및 개화**

. 2013 2014  
 (bud) 가 (Table 4).  
 가 가  
 (floral bud) 2014  
 가 . 2013  
 40.7% 가 PE 84.0%  
 가 . 2013 2014  
 mesh  
 2013 가  
 가가

**고 찰**

(Norton, 1988),  
 (Judd and McAneney, 1984; Jarvis, 1985)

(Briassoulis *et al.*, 2007). mesh  
 (Gravina *et al.*, 2011), 2 mm  
 , 4 mm mesh  
 9.4~16.3%  
 가  
 , 5 10~11  $\mu\text{mol}$   
 $\text{CO}_2 \text{ m}^{-2} \text{ s}^{-1}$  (Piller and Meekings, 1997),  
 (PAR) 375  $\mu\text{mol m}^{-2} \text{ s}^{-1}$   
 가 (Buwalda *et al.*, 1991).  
 mesh 가 PAR가 가  
 mesh PAR가  
 PAR  
 400  $\mu\text{mol m}^{-2} \text{ s}^{-1}$   
 (Fig. 1; Table 2).  
 PE 가  
 1~2°C (Fig. 1; Table 2). Norton  
 (1988)  
 Williams (1970) 1°C  
 가  
 2013 PE (Table 3)  
 4 mm PE 가  
 PAR  
 (Table 2)  
 (Sunley *et al.*, 2006).  
 (Weinberger, 1950, 1954; Oukabli *et al.*, 2003). 가  
 (Sunley *et al.*, 2006).  
 950~1000  
 (4°C ) (Brundell, 1976; Lionakis and Schwabe, 1984). Caldwell(1989)  
 950 가  
 1150  
 2012~2014  
 11 3 5 1 3  
 가 (Sunley *et al.*, 2006)  
 (Fig. 2). PE

1400 CU 가  
 (Fig. 2).  
 가 (Table 4), 2013  
 가 2012  
 (Kwack *et al.*, 2013, 2014, 2015)  
 PE  
 1~2°C (Table 2)  
 0.1 mm PE (PAR)  
 (2 mm, 4 mm)  
 가  
 가  
 가 PE 가  
 가 PAR  
 , PE 4 mm  
**요 약**  
 5 4.3 m  
 (PAR)  
 4~10 400  $\mu\text{mol m}^{-2} \text{s}^{-1}$   
 PAR PE  
 1~2°C 가 (CU)  
 1400 CU  
 가 PE 4 mm  
 가 PAR  
 PE  
 4 mm 가

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**Notes**

The author declare no conflict of interest.

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