

Effect of Low Temperature Treatment on the Bud, Bark and Growth of Kiwifruit tree

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저온처리에 의한 Kiwifruit나무의 내성에 관하여

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Abstracts

The buds of Hayward/Bruno tree were damaged from -7°C but serious damage was found on the buds treated at -15°C and 19°C . The bark tissue was more susceptible to low temperature than the bud.

The trees were survived and bursted their at all on the top of the graft union and new shoots were formed from the rootstock of the tree.

Yellowish area on the leaf surface was found, which is believed that as a result of low temperature.

From these, the kiwifruit trees must be grafted with cold tolerant rootstocks will be clarified in future.

Introduction

Low temperature in winter is one of limited environmental factors affecting possibility of the fruit tree cultivation in temperate and subtropical regions.

The plant naturally hardened in autumn and early winter and also rapidly dehardened in spring.

Low temperature in spring causes injury to the plant. Recently, one of important breeding programs is based on development of cold toler-

ant individuals. Many research workers emphasize to clarify mechanisms of cold injury and acclimation of the plant to cold temperature¹⁾.

This can be developed for hardier plant and possible new cultivation practices. Different sensitivity in plant tissues and among cultivars were reported.

Survival of the tissue is based on an ability from dehydration of the cell and supercooling of water in the cell¹⁾.

Kiwifruit tree can be damaged by low temperature throughout the year in many areas. The

shoot, flower bud and flower are susceptible to low temperature during growing seasons and led to earlier defoliation in autumn. These injuries are related to marketability of the fruit harvested. Dormant flower buds on detached shoots are tolerate temperature down to -10°C ³⁾.

Seasonal susceptibility to low temperature was reported in France by Blancher in 1985²⁾.

Female kiwifruit cultivars when went into dormancy earlier than male cultivars were less susceptible to frost temperature in United States⁴⁾. Gremminger et al.(1982) indicated that Abbot and Monty were hardier to low temperature than Hayward, Bruno and Matua⁷⁾. Cold hardiness appears vary widely among *Actinidia* species⁴⁾.

The authors attempted to determine the critical temperature at which freeze damage occurs for bud, bark, leaves expanded and survival of the plant in the pot.

Materials and methods

Two years old kiwifruit trees, Hayward/Bruno were planted in the pot during dormant period, mid-June 1992. After 15 days, the pots were treated at low temperature with the deep freezer.

Temperatures treated were -7 , -11 , -15 and -19°C at cycle of pre-cooling at 12°C for 6 hours, required temperature for 4 hours and returned to 12°C for 4 hours. In each temperature, 10 pots were used and control pots were placed at out-door conditions.

The experiment was conducted as follow.

1. Visual test

To clarify damage from low temperature the stem tips of kiwifruit tree containing a bud were cut.

Bud damage was assessed by horizontal slice through center of the bud with the razor blade and bark discoloration was scaled by browning

degree ; 0 (no damage), 1 (10% damage), 2 (20% damage), 3 (30% damage), 4 (40% damage) and 5 (almost completely killed). Bark tissue was cut by 1cm^2 and measured its discoloration degree.

2. Growing test

Kiwifruit trees treated with low temperatures were placed at 20°C greenhouse of plant growth unit.

Water supply was done at every two days intervals during growing seasons. Bud burst and injury from low temperatures were assessed after 10 days have passed at the greenhouse.

Results and discussion

Among *Actinidia* species, Hayward is a main cultivar in New Zealand.

Hayward is easy to be damaged by low temperature during growing seasons.

Kiwifruit tree is damaged by frost throughout the year in New Zealand climate conditions⁷⁾.

The authors attempted to clarify the symptoms of tree by low temperature treatment, and investigated injured symptoms on the flower bud, bark tissue, leaves expanded after treatment and percentage of tree survived.

By visual test of the tree tissues, bud was damaged by 10% at -7°C , approximately 80% at -11 and -15°C and all of the buds were killed completely at -19°C as shown in Table 1. and Photo 1.

Bark tissue was more susceptible to low temperature than the bud. Bark browning was appeared by 20% at -7°C and almost every bark tissues were changed to discoloration in brown at -11°C and -15°C . Bark tissue at -19°C was changed to dark brown, completely killed. Discoloration of the bark tissue was more conspicuous than the bud tissue by low temperature treatment. Pyke also reported that the whole plant was killed at -16°C and -18°C ⁷⁾. Ecological

Table 1. Visual and growing test of the Kiwifruit trees after low temperature treatment.

(Hayward/Bruno)

Tests	content	Temperature treated	Temperature(°C)				
			Cont	-7	-11	-15	-19
Visual test		Bud (scale)	0	1	4	4	5
		Bark (scale)	0	2	5	5	5
Growing test		Trees survived(%)	100	100	100	20	0
		Shoot distorted(%)	0	0	60	50	0
		Rootstock survived(%)	100	100	100	70	30

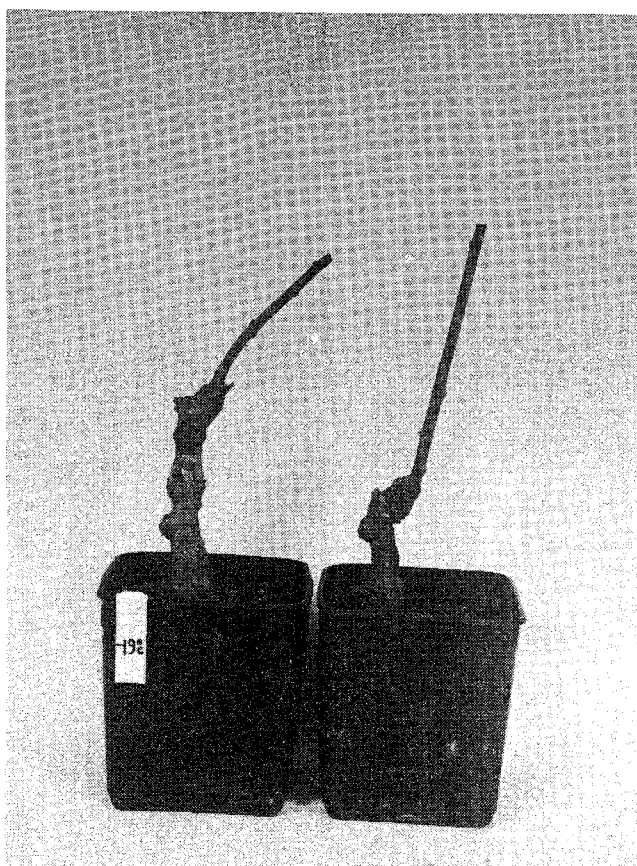


Photo. 1. The buds killed completely by low temperature.

and physical counter-measurement to protect the tree from low temperature is practical in New Zealand. In a certain year, Hayward tree was killed completely at -6.5°C ⁷⁾. This can be believed that reasonable management at the orchard before went into winter season can be

overcome the frost injury. Hewett and Young reported that the flower bud of kiwifruit tree was damaged at -1.5 and -2°C at blooming period and shoot growing period of the year⁵⁾.

Blanchet evidenced that kiwifruit tree was damaged at -3°C only for 30 min. exposure dur-

ing developing period²⁾.

Kiwifruit tree is easy to damaged at dormant and growing season²⁾.

By growing test of the kiwifruit tree treated with low temperature, the shoots were emerged normally at control, -7°C , -11°C by 100% survival as shown in photo 2.

Survival of the tree was lowered at -15°C by 20% and all of the trees were killed on the top of the graft union at -19°C . Days required for 100% bud burst was 15 days in the greenhouse

after low temperature treatment at control and -7°C , while approximately 30 days were needed for bud burst at -11°C and only 20% of bud burst can be seen at -15°C as Fig. 1.

Symptoms of shoot distortion was appeared and yellowish area on the surface of the leaves emerged as shown in photo. 3.

It is also believed that low temperature treatment to the tree affected on the shoot apex and leaf primordia before expansion of the bud.

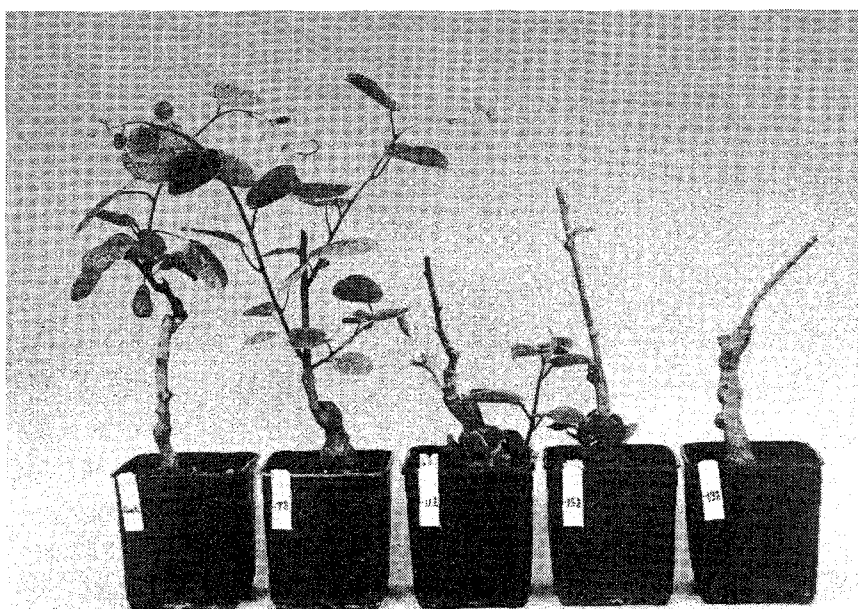


photo. 2. Kiwifruit trees survived even at -11°C

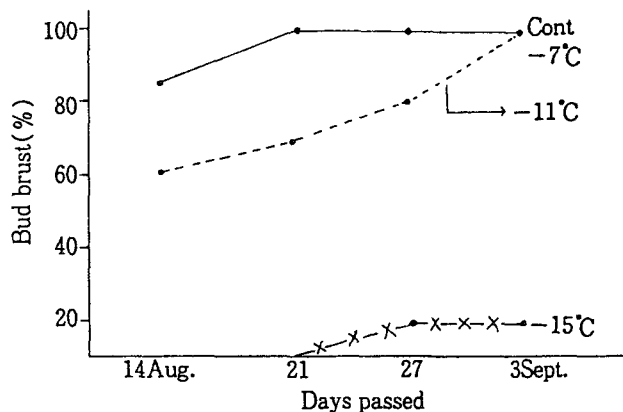


Fig. 1. Bud burst of kiwifruit tree, Hayward/Bruno by different low temperature treatment.

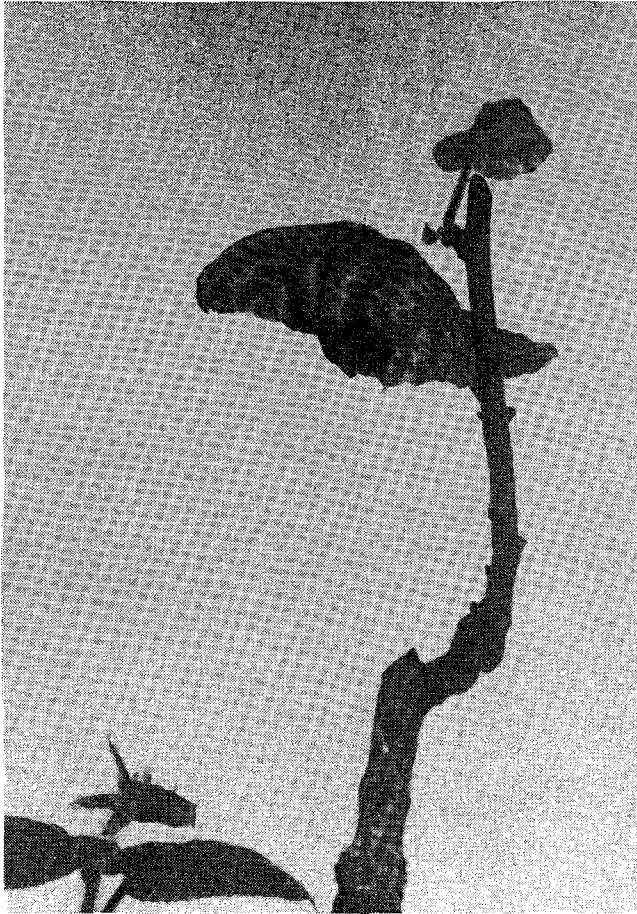


photo. 3. The shoot distortion and yellowish area on the leaf surface by low temperature.

On the contrary, new shoot was arisen at the rootstock of the tree without any shoot formation on the top scion part at -19°C as in photo. 4.

The shoot emergence at the rootstock was 70% at -15°C and 30% at -19°C respectively. From these results, the author believed that the rootstock, Bruno is hardier than top scion Hayward to low temperature.

For successful kiwifruit cultivation, it is required to select the most suitable area and cold resistant rootstock species in near future, the authors believed.

적 요

Hayward/Bruno 나무의 눈은 -7°C 에서 피해를 입었으나 -15°C 와 -19°C 의 저온에서는 심한 피해를 나타내었다.

표피조직은 눈보다 저온에 더 예민하였다. 그리고 저온에 처리후 화분에 재식된 Kiwifruit tree는 -7°C , -11°C 와 -15°C 의 처리에서는 생존하였고 눈의 싹이 터졌다. 그러나 -19°C 에서 처리한 나무는 접수에서는 전연 싹이 터지 않았고, 대목에서 새로운 가지가 발생되었다.

저온에 의한 Kiwifruit tree의 반응으로는 전개된 잎의 표면에 황색의 반점이 나타났고,



photo 4. The new shoot arisen at the rootstock of kiwifruit tree without any shoot on top scion.

또 새로 발생한 가지가 신장 생장이 되지 않았다. 그래서 앞으로 이러한 저온에 대한 피해를 막기 위하여 저온에 강한 대목의 선발이 필요하다고 믿는다.

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