Techniques Improved 'Ching Pi' Bitter Gourd (*Momordica charantia* L.) Seed Germination

Myint Myint Aye[1)] Yu Sung[2)] Woo-Nang Chang[3)]

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Summary

Bitter gourd seeds have small cotyledons enclosed in a hard, thick seed coat. A number of pre-sowing treatments can increase germination by overcoming the limitations imposed by the seed coat. Clipped and soaked in running water for 12 hrs could enhance bitter gourd seed germination at 30, 25 and 20℃. Seeds immersed in 50°C water for 60 min exhibited significantly higher germination than seeds immersed at other temperatures and for different times. The germination of seeds treated with H_2SO_4 was the highest after 30 sec of immersion. Germination was higher for clipped seeds immersed in 15% H_2O_2 for 25 min and for unclipped seeds imbibed with 1% H_2O_2 water. Priming seeds for one day with vermiculite No. 2 and NaOCl at a seeds: vermiculite # 2: 0.1% NaOCl ratio of 9:12:18, by weight produced the highest germination rate. The highest emergence rate was achieved with two different treatments of soaking clipped seeds in running water for 12 hr or immersing unclipped seeds in 50°C water for 1 hr. The pre-sowing treatment that increased germination were seeds immersed in 50°C water for 60 min or clipped and soaked in running water for 12 hrs.

1) Graduate student, Department of Horticulture, National Chung Hsing University.

2) Associate professor, Department of Horticulture, National Chung Hsing University, Corresponding author.

3) Professor, Department of Horticulture, National Chung Hsing University.

Introduction

The cultivated genera of Cucurbitaceae are widely distributed throughout the world. Many species are important field crops, and all are susceptible to frost (George, 1999). Bitter gourd is a member of the cucurbit family and native to the tropical regions of eastern India and southern China (Yang and Walters, 1992). Now it is commonly grown in South East Asia, India, South America and East Africa.

Germination of bitter gourd seeds require a minimum temperature of 18°C, temperature of 24 to 27°C is considered optimal (Morgan and Midmore, 2002). Bitter gourd seeds have small cotyledons and a hard, thick seed coat that protects the embryo but limits its germination. An impermeable or hard seed coat provides the protection a seed can have against fluctuations in humidity and temperature which could damage the embryo or encourage growth of microorganisms (Halloin, 1986). Hard seededness in soybeans greatly reduces field deterioration under simulated tropical conditions (Minor and Paschal, 1982).

A number of techniques for quickly making seeds physically permeable have been developed. These methods include mechanical scarification, chemical scarification, leaching, hot water, wet heat, dry storage, and low temperature (ESNERR, 2002). Bitter gourd seeds can be soaked in water for 24 hours, wrapped in damp paper toweling, then placed in a plastic bag and stored at 26-29°C for germination within a couple of days (Morgan and Midmore, 2002). Bitter gourd seeds immersed in warm water at 50°C for 30 min have been shown to improve germination (Wang *et al.*, 2003). Soaking the bitter gourd seeds in 50°C water for as long as 60 min softened the seed coat and increased the speed of germination by 20% (Lin and Sung, 2001).

The success of these methods varies with the species, variety, treatment intensity, and duration of treatment. Clipping the seeds or completely removing the triploid seed coat apparently relieved any mechanical restraint and/or barrier to gas exchange (Nerson *et al.*, 1985). Sulfuric acid (H_2SO_4) treatments are often used to break down especially thick, impermeable seed coats. Sulfuric acid treatment improved germination in leguminous species. Some leguminous species needed a longer exposure time (4-12) hr to reach high germination values, suggesting that they have thicker seed coats (Teketay, 1996).

Hydrogen peroxide also has disinfectant properties and can be used to disinfect seed to prevent mold growth on the seed and germination media (Copeland and McDonald, 1995). The stimulating effect of H_2O_2 on seed germination and seedling vigor has been observed in a number of species, including many conifers, legumes, tomatoes, and barley (Copeland and McDonald, 1995).

The purpose of priming is to reduce germination time, make germination occur over a shorter period, and improve the germination percentage, all to improve the final stand. Matriconditioning is the use of a solid carrier with low metric potential to control seed hydration. Substances such as vermiculite, peat moss, and Micor-Cel are ideal carriers. This method has been applied to a number crop seeds, including tomato, lima bean, and sweet corn, to enhance seed performance (Bradford, 1986; Khan *et al*., 1978).

The goal of this research was to study seed treatments that can effectively enhance germination of bitter gourd seed.

Materials and Methods

I. Seed material

Seeds of bitter gourd cultivar 'Ching Pi' was used in this study. 'Ching Pi' bitter gourd seeds were purchased from 'Fu Known' Seed Co., Ltd. It is open-pollinated (OP) variety.

The studies were carried out in the seed laboratory, Department of Horticulture, National Chung Hsing University from 2002 to 2004.

II. Seed treatment

1. Physical scarification

A. Seed clipping

Seeds were clipped with common nail clippers. The radicle part of seed coat had a crack.

B. Running water treatment

Thirty seeds were immersed in running water for 0.5 hr, 6 hr or 12 hr. Then the seeds were air-dried on paper towels at room temperature for 24 hr to near their original moisture level.

C. Warm water treatment

Thirty seeds were enclosed in nylon net bag and then immersed in warm water at 40 and 50℃ immersed duration were 30 min, 60 min, 90 min, however at 60℃ immersed duration only 30 min. Then, seeds were air-dried on paper towels at room temperature for 24 hr to near their original moisture level.

2. Chemical scarification

A. Sulfuric acid treatment

Thirty seeds were soaked in 120 ml concentrated sulfuric acid (98%) for 30, 45, 60 or 75 sec and stirred at 15 sec intervals. Then the seeds were put in a sieve, rinsed 1 to 2 min in running tap water and dried on paper towels at room temperature for 24 hr.

B. Hydrogen peroxide treatment

Thirty seeds were soaked in 120 ml H_2O_2 solution for 5min, 15 min, 25 min or 35 min. The solution was stirred at 2-3 min intervals. After treatment, seeds were dried at room temperature on paper towels for 24 hr. The other treatment was used 1% H_2O_2 as the adding water in the first time into the petri dish. Ten seeds were added 1.5 ml 1% H_2O_2.

3. Matriconditioning

To determine the effect of matrix conditioning on seed germination, 9 g bitter gourd seeds were mixed with 12 g vermiculite and 16, 18, 20 ml 0.1% NaOCl in a black plastic bottle. Seeds were mixed with No.2(1.0-2.0 mm)vermiculite.

Each plastic bottle was one replicate and there were 3 replicates of each treatment. The plastic bottles were placed on a spinning shaker, and spun at 4 rpm, 15^{o}C, for 24 hours. After spinning, seeds were collected and dried at room temperature for 24 hours.

III. Seed viability

1. Germination test

Prior to testing, seeds were surfaced sterilized in 0.25% Mie Da Le fungicide solution for 10 min and dried at room temperature for one day. There were three replicates of each treatment. Each replicate was comprised of 3 petri dishes, each containing 10 seeds on single layer filter paper(Advantec No. 1) with 1.5 ml distilled water (normal level), and was incubated in the dark at 20, 25 or 30℃. Seeds were considered germinated when the radical reached 2-3 mm in length. The number of germinated seeds was counted daily for 14 days. The final germination percentage (FGP), the mean days to germination (MDG) and the germination uniformity ($GT_{90\text{-}10}$; the number of days from 10% to 90% of final germination) are calculated using the following formulas:

$$FGP\ \% = (\Sigma GNi \times GN) \times 100$$

$$MDG = \Sigma(i \times GNi) / \Sigma GNi$$

Where: GNi = the number of seeds germinating on day i

GN = the number of seeds tested

i = 1, 2,……n; n = the last day of the test

2. Emergence test

Emergence tests were conducted in the greenhouse. For each replicate, 10 bitter gourd seeds were sown in 1 cm of medium (peat moss: vermiculite 1:1 (V/V) in a plastic flat (50cm x 30 cm). There were 3 replicates of each treatment. The medium was kept moist by daily irrigation. The number of emerged seeds(when the hypocotyl breaks through the soil)was counted daily. The final emergence percentage and the mean days to emergence (MDE) were calculated.

3. Data analysis.

PROC ANOVA (analysis of variance; SAS software, SAS Institute, Cary, NC, USA) was used to analyze variance ($\alpha = 0.05$). The means of treatments were compared using Fisher's tests. Germination data were transformed using arcsine.

Results

At 30°C, the germination of clipped seeds soaked for 12 hr (96.67%) was significantly greater than the germination of unclipped seeds soaked for 12 hr (86.67%) (Table 1). The MDG was not significantly different among treatments at 30℃. At 25℃, the germination of clipped seeds soaked for 12 hr (93.33%) was significantly greater than that of clipped, unsoaked seeds (76.67%). The germination of unclipped seeds soaked for 12 hr (86.67%) was significantly greater than that of unclipped, unsoaked seeds (66.67%).

The MDG of both clipped and unclipped seeds soaked for 12 hr was significantly less than the MDG of unsoaked seeds. At 20℃, the germination of clipped and unclipped seeds soaked for 6 or 12 hr was significantly greater than the germination of un soaked, clipped and unclipped, un soaked seeds. For both clipped and unclipped seeds, the MDG for seeds soaked for 6 hr was significantly greater than three of unsoaked seeds and seeds soaked for more or less time.

The highest germination of 'Ching Pi' seeds at 30, 25 and 20℃ were obtained from seeds soaked at 50°C for 60 min (Table 2). Seeds soaked at 40°C for 90 min and at 50°C for 30 min also had high germination rates. Higher soaking temperatures and longer times (50°C for 90 min, 60°C for 30 min) resulted in lower germination. The effect of soaking temperature and time on MDG was variable. At each germination temperature, MDG was the greatest for seeds soaked at 60°C for 30 min. Seeds soaked at 40°C for 90 min and them germinated at 30°C had the shortest MDG (2.1 days).

The germination of 'Ching Pi' seeds treated with H_2SO_4 was the highest in all temperatures with immersion for 30 sec (Table 3). However, in comparing to control the difference was significant only at 20°C. Immersion more than 30 sec, seeds germination decreased. At 30°C, seeds treated for 60 sec had significantly longer MDG, and the MDG of seeds treated for 75 sec was significantly shorter than control seeds. At 25℃, the MDG of all treated seeds were significantly lower than that of control.

'Ching Pi' seeds germinated at 30°C or 25°C, germination and MDG were the highest for unclipped seeds imbibed with 1% H_2O_2 water(Table 4). For both clipped and unclipped seeds, germination increased with soaking time, up to 25 min, but decreased when the soaking time was extended to 35 min. At 20°C, unclipped seeds immersed in 1% H_2O_2 solution

Table 1. Effect of seed coat clipping and soaking time on seed germination of 'Ching Pi' bitter gourd at three temperatures.

Germination Temperature(℃)	Clipping	Soaked (hr)	Germination (%)	MDG (day)
30℃	−	0	70.0 c[z]	2.9 a
	−	0.5	76.7 c	2.4 a
	−	6	80.0 bc	2.9 a
	−	12	86.7 bc	2.5 a
	+	0	80.0 bc	2.9 a
	+	0.5	83.3 bc	2.6 a
	+	6	90.0 ab	2.8 a
	+	12	96.7 a	2.7 a
25℃	−	0	66.7 c	3.5 ab
	−	0.5	76.7 bc	3.6 a
	−	6	80.0 bc	2.7 c
	−	12	86.7 ab	2.8 c
	+	0	76.7 bc	3.6 a
	+	0.5	83.3 b	2.9 abc
	+	6	86.7 ab	3.3 abc
	+	12	93.3 a	2.9 bc
20℃	−	0	56.7 d	4.6 b
	−	0.5	70.0 cd	4.2 cd
	−	6	80.0 abc	5.2 a
	−	12	83.3 abc	4.6 bc
	+	0	70.0 cd	4.5 bc
	+	0.5	76.7 bc	4.0 d
	+	6	86.7 ab	5.2 a
	+	12	90.0 a	4.1 cd

[z] Means followed by the same letter within each column are not significantly different by LSD ($p \leq 0.05$).

Table 2. Effect of immersion in warm water on 'Ching Pi' bitter gourd seed germination at three temperatures.

Germination Temperature(℃)	Warm water Temperature(℃)	Time (min)	Germination (%)	MDG (day)
30℃	Control	0	70.0 bc[z]	2.9 ab
	40℃	30	76.7 b	2.6 abc
		60	80.0 ab	2.7 abc
		90	83.3 ab	2.1 c
	50℃	30	83.3 ab	2.2 bc
		60	90.0 a	2.2 bc
		90	76.7 b	2.7 abc
	60℃	30	50.0 c	3.0 a
25℃	Control	0	66.7 d	3.5 ab
	40℃	30	73.3 cd	2.7 cd
		60	86.7 abc	3.3 abc
		90	86.7 abc	2.8 bcd
	50℃	30	90.0 ab	2.4 d
		60	93.3 a	2.3 d
		90	80.0 bcd	3.0 abcd
	60℃	30	63.3 d	3.7 a
20℃	Control	0	56.7 d	4.6 bc
	40℃	30	63.3 cd	4.5 bc
		60	76.7 abc	4.8 abc
		90	80.0 ab	4.7 bc
	50℃	30	80.0 ab	5.4 a
		60	86.7 a	5.0 ab
		90	83.3 ab	4.3 c
	60℃	30	70.0 bcd	4.9 ab

[z] Means followed by the same letter within each column are not significantly different by LSD ($p \leq 0.05$).

Table 3. Effect of immersion in sulfuric acid on 'Ching Pi' bitter gourd seed germination at three temperatures.

Germination Temperature(℃)	Time (sec)	Germination (%)	MDG (day)
30℃	Control	70.0 ab[z]	2.9 b
	30	76.7 a	2.5 bc
	45	66.7 ab	2.6 b
	60	56.7 b	3.5 a
	75	40.0 c	2.2 c
25℃	Control	66.7 ab	3.5 a
	30	76.7 a	2.7 b
	45	56.7 b	2.1 b
	60	40.0 c	2.3 b
	75	43.3 c	2.5 b
20℃	Control	56.7 b	4.6 a
	30	73.3 a	4.9 a
	45	60.0 b	5.2 a
	60	53.3 bc	4.6 a
	75	40.0 c	5.0 a

[z] Means followed by the same letter within each column are not significantly different by LSD ($p \leq 0.05$).

increasedat 30℃ and 25℃, with the time for seeds soaked in 15% H_2O_2 up to 25 min, but decreasedwhen soaking time was extended to 35 min. The effect of soaking time and solution on MDG was varied.

At germination of 'Ching Pi' seeds at all three temperature were the highest when they were primed at a ratio of 9:12:18, seeds: vermiculite No. 2: 0.1% NaOCl, by weight(Table 5). At 30°C, the MDG of seeds primed with 16 ml NaOCl was significantly shorter than the control seeds. When treated seed germination at 20℃, the treatment with soaking unclipped seeds in 50°C water for 60 min given the highest germination(90%) and the lowest MDG 4.1 days (Table 6). All treatments shortened MDG, in some cases reached significant difference. Clipped and soaking in running water or immersed in 50℃ for 60 min could be increased emergence

percentage to 66.7%. MDE of all treatments(except matriconditioning)were longer than control seeds.

Table 4. Effect of immersion in H_2O_2 solution on 'Ching Pi' bitter gourd seed germination at three temperatures.

Germination Temperature(℃)	Clipping	Treatment	Time (min)	Germination (%)	MDG (day)
30℃	−	Control	0	70.0 bc[z]	2.9 cd
	−	15%H_2O_2	5	66.7 c	3.3 a
	−	15%H_2O_2	15	70.0 bc	3.2 abc
	−	15%H_2O_2	25	80.0 abc	2.9 bc
	−	15%H_2O_2	35	73.3 bc	3.1 abc
	−	1% H_2O_2 Germination water		86.7 a	3.4 a
	+	Control	0	80.0 abc	2.9 bc
	+	15%H_2O_2	5	70.0 bc	3.3 ab
	+	15%H_2O_2	15	76.7 abc	2.5 de
	+	15%H_2O_2	25	83.3 ab	2.5 e
	+	15%H_2O_2	35	66.7 c	3.0 abc
	+	1% H_2O_2 Germination water		70.0 bc	3.2 abc
25℃	−	Control	0	66.7 de	3.5 a
	−	15%H_2O_2	5	63.3 e	3.4 a
	−	15%H_2O_2	15	70.0 cde	2.7 c
	−	15%H_2O_2	25	80.0 abc	2.9 bc
	−	15%H_2O_2	35	70.0 cde	3.2 ab
	−	1% H_2O_2 Germination water		86.7 a	3.4 a
	+	Control	0	76.7 abcd	3.6 a
	+	15%H_2O_2	5	63.0 e	2.5 c
	+	15%H_2O_2	15	73.3 bcde	3.3 a
	+	15%H_2O_2	25	83.3 ab	3.3 ab
	+	15%H_2O_2	35	70.0 cde	3.4 a
	+	1% H_2O_2 Germination water		70.0 cde	3.4 a

[z] Means followed by the same letter within each column are not significantly different by LSD ($p \leq 0.05$).

Table 4. Effect of immersion in H_2O_2 solution on 'Ching Pi' bitter gourd seed germination at three temperatures (Continued).

Germination Temperature(℃)	Clipping	Treatment	Time (min)	Germination (%)	MDG (day)
20℃	−	Control	0	56.7 ef	4.6 c
	−	15%H_2O_2	5	60.0 def	5.7 ab
	−	15%H_2O_2	15	63.3 cdef	5.1 bc
	−	15%H_2O_2	25	73.3 abc	5.9 a
	−	15% H_2O_2	35	53.3 f	5.5 ab
	−	1% H_2O_2 Germination water		80.0 a	5.0 bc
	+	Control	0	70.0 bcd	4.5 c
	+	15%H_2O_2	5	66.7 cde	5.1 bc
	+	15% H_2O_2	15	73.3 abc	4.7 c
	+	15% H_2O_2	25	76.7 ab	5.0 bc
	+	15% H_2O_2	35	60.0 def	4.7 c
	+	1% H_2O_2 Germination water		63.3 def	5.2 bc

[z] Means followed by the same letter within each column are not significantly different by LSD ($p \leq 0.05$).

Discussion

A variety of treatments can reduce the limitation on germination imposed by the seed coat (Teketay, 1996). In this study, we assessed the effectiveness of a variety of pre-sowing treatments to improve seed germination. The treatments included clipping the seed coat and soaking the seeds in running water, immersing the seeds in warm water, sulfuric acid, or hydrogen peroxide, and matrix conditioning.

Ⅰ Soaking in running water and clipping

The optimum temperature for bitter gourd seed germination was 25 and 30℃, while germination was the fastest at 30℃(Table 1). Soaking bitter gourd seeds in running water for 0.5, 6 or 12hr increased germination at 20, 25 and 30°C. Clipping could enhance seed germination. The germination of clipped seeds soaked for 12 hr was significantly greater than that of unclipped and unsoaked seeds(Table 1). Clipping increased the germination of triploid 'Genesis' watermelon seeds, especially at 30°C or 20°C.(Duval and NeSmith, 2000). Clipping

the seed coat reduces mechanical restraint and/or barriers to gas exchange and water absorbtion.

For many seeds, the mechanical restriction exerted by the seed coat inhibits germination. Hard seed coats typically have low permeability to water and gases (Nerson, 1985). Puppala and Fowler (2002) proposed that soaking facilitates germination by leaching germination inhibitors out of the seed. A number of phenolic acids exhibit inhibitory effects on seed germination and plant growth (Klejdus and Kuban, 2000). Soaking decreases the amount of phenolic compounds in the seed coat.

Table 5. Effect of matriconditionning [y] on 'Ching Pi' bitter gourd seed germination at three temperatures.

Germination Temperature	0.1%NaOCl (ml)	Germination (%)	MDG (day)
30℃	Control	70.0 b[z]	2.9 ab
	16, vermiculite No.2	73.3 ab	2.3 c
	18, vermiculite No.2	83.3 a	2.5 bc
	20, vermiculite No.2	66.7 b	3.1 a
25℃	Control	66.7 b	3.5 a
	16, vermiculite No.2	66.7 b	3.4 a
	18, vermiculite No.2	80.0 a	2.9 a
	20, vermiculite No.2	60.0 b	3.3 a
20℃	Control	56.7 b	4.6 ab
	16, vermiculite No.2	63.3 b	4.7 a
	18, vermiculite No.2	76.7 a	4.9 a
	20, vermiculite No.2	53.3 b	4.2 b

[z] Means followed by the same letter within each column are not significantly different by LSD ($p \leq 0.05$).

[y] 9g seed and 12 g vermiculite No.2 mixed with 0.1%NaOCl for 24 hrs

Ⅱ.Warm water treatment

Bitter gourd seeds were immersed in 40, 50, or 60°C water for different lengths of time. At 40°C, seed germination increased as immersion time increased. At 50°C, seeds immersed for 60 min had the highest germination. Immersion in 60°C water for 30min injured bitter gourd seeds.

The length of time for seeds can be immersed in hot water before they are killed decreases as temperature increases.

Table 6. Germination and emergence[x] of 'Ching Pi' bitter gourd seed following different seed treatments.

Treatment	Clipping	Time	Germination (%)	MDG (day)	Emergence (%)	MDE (day)
Control	−	0	56.7 d[z]	4.6 b	43.3 bc	7.7 bc
	+	0	70.0 cd	4.5 bc	50.0 abc	5.9 c
Running water	−	12 hr	83.3 abc	4.6 bc	53.3 abc	8.5 ab
	+	12 hr	90.0 a	4.1 c	66.7 a	8.7 ab
50℃ Warm water	−	60 min	86.7 ab	5.0 b	66.7 a	8.1 ab
98% H_2SO_4	−	30 sec	73.3 bcd	4.9 b	43.3 bc	9.8 a
15% H_2O_2	−	25 min	73.3 bcd	5.9 a	30.0 c	7.8 abc
	+	25 min	76.7 bc	5.0 b	60.0 ab	7.8 bc
9:12:18 [y]	−	24 hr	76.7 bc	4.9 b	56.7 ab	7.3 bc

[z] Means followed by the same letter within each column are not significantly different by LSD ($p \leq 0.05$).

[y] 9g seed and 12 g vermiculite No.2 mixed with 0.1%NaOCl for 24 hrs

[x] Germination temperature at 20℃; Emergence temperature at 23℃ (daily average).

The dormancy of hard seeds could be broken by immersion in warm water for a short period of time (Cantliffe *et al.*, 1980). The seed germination increased in some species in 50°C water. Immersion in hot/warm water made permeable the impermeable seeds of *Abutilon theophrasti* (Horowitz and Taylorson, 1984), *Acacia albida* (Teketay, 1996), *Cassia nictitans* (Martin and Cuahwa, 1975). Our findings on the effect of warm water treatment on the germination and viability of bitter gourd seeds agreed with the results of above mentioned studies.

Ⅲ.Sulphuric acid treatment

H_2SO_4 treatment did not significantly increase the germination of 'Ching Pi' seeds (Table 6). Seeds can be damaged by overheating in the acid or by acid penetrating the seed(Cantliffe *et al.*, 1980). Acid scarification for 3 hr partially destroyed the counter palisade cell of the hilum in *Lupinus angustifolia* seeds. Acid treatment of *Rhus ovata* fruits for 3hr destroyed areas round

the micropyle and hilum (Baskin and Baskin, 1998).

Ⅳ.Hydrogen peroxide (H_2O_2) treatment

There were two methods of immersing in H_2O_2 to improve bitter gourd seed germination. Using 1% H_2O_2 then adding water during germination was better than that of seed immersed in 15% H_2O_2. Hydrogen peroxide stimulates respiration, which accelerates the breakdown of food reserves and provides a greater supply of energy. It also has disinfectant properties and can be used to prevent mold growth on seeds and germination media.(Copeland and McDonald, 1995).

Ⅴ.Matriconditioning

At all three germination temperatures, matriconditioning improved the germination of 'Ching Pi' bitter gourd seeds(Tables 5). The amount of 18 ml 0.1% NaOCl and vermiculite No.2 as the condition for matrix priming increased the germination percent. The mean days to germination (MDG) was not shortened by matriconditioning because of increasing in overall germination. Matriconditioning did increase germination speed and synchrony of 'Special Six' and 'Moon Shine' bitter gourd seeds when they are germinated at a sub-optimal temperature of 20℃(Chen and Sung, 2001).

Seed priming facilitates imbibition and initiates germination, but it does not help the radicle to penetrate the seed coat(Perkins-Veazie and Cantliffe, 1984). It shortens the time from sowing to seedling emergence(Khan *et al.*, 1992) and may soften the seed coat and subsequently improve bitter gourd seed germination (Lin and Sung 2001).

Ⅵ.Recommended treatments

From our study to confirm the most effective treatments for improving the germination of bitter gourd seeds were seeds immersed in 50°C water for 60min or clipped and soaking in running water for 12 hrs.

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促進苦瓜種子發芽之技術

何 麗 敏[1)]　宋 妤[2)]　張 武 男[3)]

關鍵字：苦瓜、種子、發芽率、種子前處理

摘要：苦瓜種子子葉小，種皮厚，厚及硬之種皮限制其發芽。本試驗利用種子前處理之方法促進種子發芽，提升苦瓜種子之品質。以 '青皮'品種之苦瓜種子為試驗材料。掐開於胚根處之部分種皮並以流水浸種 12 小時，於 30、25、20℃可得到最佳的發芽率。種子以 50℃溫水浸種 1 小時較 40 或 60℃及不同時間處理者有顯著較佳之發芽率。種子以濃硫酸浸漬處理 30 秒發芽率最高，但浸漬時間超過 30 秒發芽率則下降。將掐開種子以 15%雙氧水浸種 25 分及未掐開種子以 1%雙氧水為種子第一次之發芽水處理有較高之發芽率。利用種子、蛭石 2 號及 0.1% NaOCl 之混合，比例為 9：12：18(重量百分比)，滲調 1 天，種子發芽速度最快。以掐開種皮流水浸種 12 小時或不掐開種皮以 50℃溫湯浸種 1 小時，可提高種子萌芽率。

1) 國立中興大學園藝學系碩士班研究生。
2) 國立中學大學園藝學系副教授。通訊作者。
3) 國立中興大學園藝系教授。