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Optimization the Germination Requirements for *Momordica charantia* Linn.

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Abstract
To optimize the germination requirement for *Momordica charantia* Linn. this experiment was undertaken. The investigations were conducted at Seed Testing Laboratory, Faculty of Agriculture, Chiang Mai University. There were total four experiments. First experiment was to find the best method of breaking dormancy. Soaking the seeds in boiling water for 4 seconds found to be the best method resulting 73.5 percent germination, the removal of seed components by removed half of the seed coat and half of the chlorenchyma membrane, resulted 75.5 percent of germination. The objective of the second experiment was to find out the optimum temperature for seed germination. Form the result, the optimum temperature for seed germination revealed as 30°C with 76 percentages at 40°C. The third experiment's objective was to find the optimum light requirement for seed germination. The result showed that light was not required for germination. The fourth experiment was to find the initial critical seed moisture level for germination. From the result, it was found that the critical moisture level for germination should be 36.2 percent and optimum seed moisture content for best germination should be 40 percent. However, the seed could not germinate when the moisture content was below 30 percent.

Introduction
Momordica charantia Linn. is a monoecious medicinal plant under the family Cucurbitaceae which commonly called krela, bitter gourd, bitter melon or balsam pear. Fruit extract of this plant can decrease the glucose level in blood vessel of diabetic patient (Welihinda, 1986). Kenya exports bitter gourd (fresh fruit) to Europe, and London. Prices of bitter gourd in Germany and in Netherlands are US$ 8 per kg (Huyskens, 1992). However, the seed of bitter gourd in thailand experiences some problems such as low and unedequate uniform germination (Anotai, 1984). Pinmanee et al. (1999) found percent the germination of bitter guard in Thailand by 40 percentage, which was quite low than the other Cucurbitaceae family's crops. The germination of ISTA recommends by 75 percent. Therefore, the objective of this investigation was to find out the optimum germination requirement for bitter gourd.

Materials and Methods

Seeds of bitter gourd were produced at the farm of Department of Agronomy under faculty of Agriculture, Chiang Mai University, Thailand and used for following trials. All the experiments were conducted following CRD with 4 replications.

Optimum time was soaking the seed in boil water for breaking dormancy: This experiment was followed by six different duration of soaking the seeds in boiled water were 0, 1, 2, 3, 4 and 5 second, followed by immediately soaking in water at 30℃. Fifty seeds of each treatment were placed between paper and incubated at 30℃, in 100 percent relative humidity. The data was taken at 4th and 8th day after incubation.

Optimum removal of seed component for breaking dormancy: This method was followed by six different treatments, viz. non remove of the seed coat, remove of half seed coat, remove of entire seed coat, remove of half seed coat and half chlorenchyma membrane, remove of all seed coat and all chlorenchyma membrane, and cutting of the bottom of the seed. Fifty seeds of each treatment were placed between paper and incubated at 30℃, at 100 percent relative humidity following darkness. The data was taken at 4th and 8th day after incubation.

Optimum temperature for seed germination: Seeds of each treatment were soaked in boiling water at 4 second and then to germination in 20, 25, 30, 35 and 40℃. Fifty seeds of each replication of each treatment were placed on between papers and incubated at 100 percent relative humidity in darkness. The data was taken at 4th and 8th day after incubation.

Optimum day length for seed germination : Seeds of each treatment were soaked the in boil water at 4 second followed by to germination in fluorescent light at 0, 6, 12, 18 and 24 hour per day. Fifty seeds of each treatment were placed on germination paper and incubated at 30℃ in 100 percent relative humidity. The data was taken at 4th and 8th day after incubation.

Optimum seed moisture for germination: The different treatments were 15, 20, 25, 30, 35 and 40 percent seed moisture. Fifty seeds of each treatment were placed in Petri dishes (petri dish close by Para film) and incubated at 30℃ in darkness. The data was taken at 4th day after incubation.

Results

Optimum time of soaking the seed in boil water for break dormancy: Soaking the seed in boiling water for 4 second found to be the best method which provided 73.5 percent germination. Although 3 seconds soaking gave similar amount of germination with 1 seconds soaking but their seedling growth rate was significantly lower. Moreover, there was no significant difference in die seeds. The non-soaking or control seed showed significantly less germination in 1 to 4 second soaking but at 5 seconds soaking the germination turn into similar position. (Table 1)

Optimum removal of seed component for breaking dormancy: The best germination was appeared at 4th and 8th day when the half seed coat and half chlorenchyma membrane was removed which was similar as removal of whole seed coat and all chlorenchyma membrane at 8th day. The removal of half seed coat and without removal of seed coat gave lower germination. However, the without removal of seed coat produced maximum died seed among all method. In all methods, the difference of seedling growth rate was not significant. (Table 2)

Optimum temperature for seed germination: Temperature 30 ℃ provided best germination percentage and less mortality of seed. When temperature was increase, the percent was decreased percent germination and increased the died seed percent. When

temperature was decreased, less germination was noticed and death of seed was not different from 30℃ temperatures. (Table 3)

Optimum day length for seed germination: At 4th day, the percent of seed germination was less when the seed cultured in light duration at 24 hour per day which was not significantly different with 12 hour light per day. However, at 8th day in all treatments, there were not any significant difference was found in percent germination, dead seed production and seedling growth rate. (Table 4)

Optimum seed moisture for germination: Seed moisture at 40 percentage was 54.5 percent germination, when decrease seed moisture was reduced percent germination. The seed was not germination at less than 25 percent seed moisture. (Table 5)

Table 1 Effect of various times soaking seed in boiling water on germination percentage, die seed percentage and seedling growth rate (SGR) of *M. charantia.*

Treatment	Germination (%) at 4th day	Germination (%) at 8th day	Die (%)	SGR (mg./seedling)
Non-Soak	26.0 d	54.5 d	18.00	32.62 abc
Soak 1 sec.	47.5 bc	66.5 bc	9.50	33.00 ab
Soak 2 sec.	40.5 c	73.5 ab	9.00	31.57 bc
Soak 3 sec.	62.5 a	77.5 a	8.50	31.00 c
Soak 4 sec.	55.5 ab	73.5 ab	7.00	34.22 a
Soak 5 sec.	21.5 d	57.5 cd	16.50	34.20 a
SE				
LSD (5%)	9.23	9.56	NA	1.74
CV %				

NA = not applicable

Table 2 Effect of various remove seed covering part on germination percentage, die seed percentage and seedling growths rate (SGR) of M. charantia.

Treatment	Germination (%) at 4th day	Germination (%) at 8th day	Die (%)	SGR (mg./seedling)
-	25.5 c	40.5 c	31.00 a	29.75
	19.0 c	69.0 b	6.00 c	28.02
	59.0 b	90.0 a	9.50 bc	28.35
	31.0 c	48.0 c	17.00 b	30.22
	75.5 a	83.5 a	11.00 bc	29.75
	54.0 b	70.0 b	10.50 bc	32.60
SE				
LSD (5%)	12.96	11.83	10.49	NA
CV %				

SC = seed coat

CM = chlorenchyma membrane

NA = not applicable

Table 3 Effect of various temperatures on germination percentage, die seed percentage and seedling growths rate (SGR) of *M. charantia.*

Treatment	Germination (%) at		Die (%)	SGR (mg./seedling)
	4th day	8th day		
Temperature 20 °C	0.0 c	0.0 c	9.00 c	-
Temperature 25°C	31.0 b	46.5 b	9.00 c	32.52
Temperature 30°C	59.0 a	76.0 a	11.00 c	31.90
Temperature 35°C	37.5 b	54.5 b	23.50 b	31.10
Temperature 40°C	0.0 c	5.5 c	42.50 a	32.18
SE				
LSD (5%)	8.76	8.25	11.02	NA
CV %				

NA = not applicable

Table 4 Effect of day length on germination percentage, die seed percentage and seedling growths rate (SGR) of *M. charantia.*

Treatment	Germination (%) at		Die (%)	SGR (mg./seedling)
	4th day	8th day		
Light 0 hr./day	79.5 a	78.0	13.50	29.92
Light 6 hr./day	77.5 a	87.5	9.00	29.70
Light 12 hr./day	61.0 ab	78.5	17.00	31.48
Light 18 hr./day	79.0 a	88.0	11.50	29.15
Light 24 hr./day	55.0 b	89.5	5.50	31.15
SE				
LSD (5%)	19.36	NA	NA	NA
CV %				

NA = not applicable

Table 5 Effect of various seed moisture on germination percentage of *M. charantia.*

Treatment	germination (%) at 4th day
Seed moisture content 15%	0.0 c
Seed moisture content 20%	0.0 c
Seed moisture content 25%	0.0 c
Seed moisture content 30%	23.0 b
Seed moisture content 35%	36.5 ab
Seed moisture content 40%	54.5 a
SE	13.02
LSD (5%)	19.34
CV %	

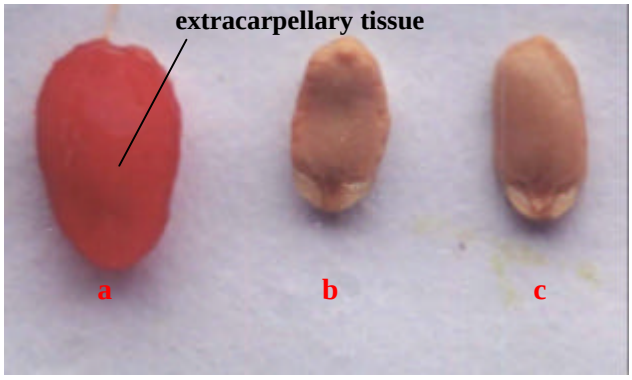

Figure 1 The fresh seed of bitter gourd a) Extracarpellary tissue cover the seed b) Front side of the seed c) Back side of the seed.

Figure 2 The dry seed of bitter gourd.

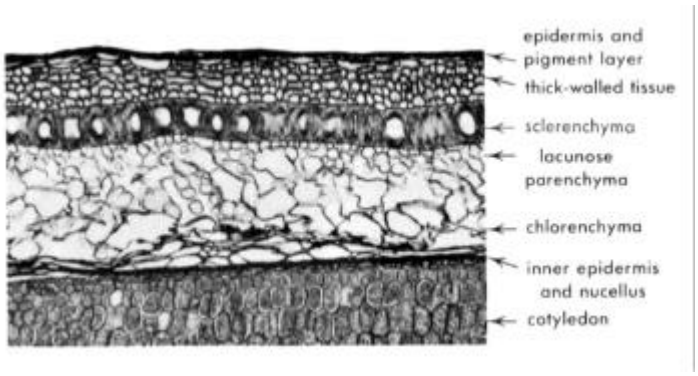

Figure 3 The profile of seed coat and some part of embryo of plant in family Cucurbitaceae (Esau, 1959).

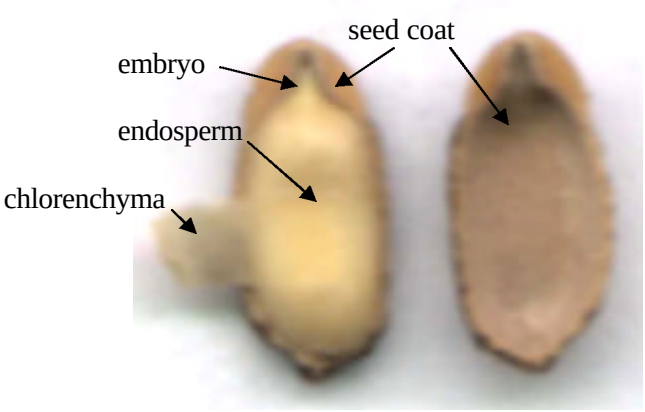

Figure 4 The bitter gourd seed after open half seed coat and some part of chlorenchyma membrane.

Conclusion and Discussion

Seed dormancy of bitter gourd seed can be broken by soaking the seed in boiling water. The optimum time of seed soaking was found to be 4 seconds when the best germination percentage and seedling growth rate was revealed at 4th and 8th day. This result supports the finding of XiaoJie et al. (1999) broke dormancy of Rhus glabra and R. typhina by soaking the seed in the boiling water. They mentioned that the cause of dormancy was due to character of endocarp, which was permeable membrane. The time of seed soaking in boiling water for 5 seconds was long time for breaking dormancy; it caused the damage of embryo.

The finding of this experiment also shows that the bitter guards seed dormancy can be broken with removal of seed coat and chlorenchyma membrane. The removal of seed coat and chlorenchyma membrane decreased the percent of died seed. The removal of half or full seed coat is possible, but optimum removal was found to be removal of half seed coat and half chlorenchyma membrane. The removal of whole coat caused damage of embryo.

The characteristic of seed coat and chlorenchyma membrane is thickness, and chlorenchyma membrane is alive membrane, which contains cellulose, pectic etc., but it was not lignin (Esau, 1959). That caused the block of root growth, which agreed the finding of Rehman et al. (1999) incase of Acacia salicina seed and regarding Medeiros et al. (1999) Acacia longifolia seed. They broke seed dormancy by soaking in the hot water for long time. However the chlorenchyma membrane may be permeable to block oxygen or some growth regulator in corn, wheat, barley, soybean, sunflower and watermelon etc. (Kigel and Galili, 1995).

The optimum temperature for germination was 30°C, followed by 25°C and 35°C. At temperature 20°C and 40°C, low percent germination was found with 0 and 5.5 percent. The low or high temperatures than 30°C decreased percent germination but in low temperature the seed was still alive. However, in high temperature the seed died. Huyskens *et al.* (1992) observed that the optimum temperature for bitter guard seed germination was between 25°C to 35°C which supports the present findings.

Day length did not influence the germination percentage, percent died seed and seedling growth rate.

The seed could not germinate in less than 30 percent seed moisture and the best percent germination was found at 40 percent seed moisture. The optimum seed moisture may be higher than 40 percent, but the high moisture can cause the death of seed.

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