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Breaking Dormancy in Cucumber (*Cucumis sativas* L.) Seeds

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ABSTRACT

The new harvested cucumber seeds, local varieties often fail to germinate, because of dormancy. It take over 5-6 storage months until dormancy phenomenon disappear. The hot dry air treatment at 60°, 65°, 70°, 75° or 80°C for 1 to 7 days or 90°C for 1 to 24 hours could break that dormancy. Dry heat treatment at 70°C for 3 days obtained the best result. This treatment could up grade in germination from the initial 20 % and proved good growing characteristic in either vegetative or generative organs as near as untreated seeds.

Further more, soaking cucumber seeds in warm water at 45°, 50°, 50° and 60°C for 20-60 ninutes had been done for breaking seed dormancy. Soaking seeds at 60°C for 40 minutes show the best results among hot wet treatment, but it still was not better than hot dry air treatment at 70°C for 3 days.

INTRODUCTION

In many species of seeds, when shed from the parent plant, will not germinate. Such will germinate under natural conditions, if they are kept for a certain period of time. These seeds are said to require a period of after-ripening. After-ripening may be defined as a changes which occur in seeds during storage as a result of which germination is improved. This phenomenon can be definated in a state of dormancy (Mayer and Mayber, 1974). Cucumber seed is in the case. It required 6 month storage until seed germination improved to 90 %. From our experience local farmers reject freshy harvested seeds for planting. They will wait over next year until can use that seeds. Dormancy in cucumber seeds have serious effect on their production.

Oil palm seeds are dormant that intact kernels remained dormant for up six months. Rees (1961) found that heat treatment of oil palm seeds at 40°C for 60 days could break the dormancy and promoted rapid and percentage of germination. Thiraporn et al. 1987 reported that hot dry air treatment of yard long bean seeds at 45°C for one day activated B-anylase acitivity of cotyledon 4-7 day-seedling, This heat treatment also promoted rapid and percentage of new harvested yard long bean seeds. In preceeding paper (1990) we reported that hot dry air treatment at 70°C could raised up speed and percentage of seed germination in tomato and edible rape. The object of this paper is to study the methods of breaking dormancy in cucumber seeds using dry heat (drying in hot air oven) comparing with wet heat (soaking in warm water).

MATERIAL AND METHODS

A popular local of short type variety (8-10 cm. long and 4 cm. diameter) of cucumber fruits were collected from the farmers. The ripen stage fruits were cut opened and seeds processed by fermenting over night, they were then washed and dried for a few days till this moisture content was around 3-4%. These seeds were then used as materials for both the dry and wet heat experiments.

(1). Dry heat treatment in oven.

Four replications of 50 seeds each were used at 70°, 75° and 80°C heated for 1, 3, 7 and 10 days. Another treatment at 90°C heated 2, 4, 6, 8, 9, 10, 12 and 24 hours. The seeds were predried at 45°C for 1

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day prior to high temperature treatment.

(2). Wet heat soaking seeds in hot water.

Four replications of 50 seeds were also used for hot water treatment. Seeds were soaked in water at 40, 45, 50, 55, 60 and 65°C for 20, 40 and 60 minutes. After the above treatments, and 2 seed quality test were conducted according to 1985 ISTA (International Seed Testing Association) rules, for moisture and germination tests.

Imbibition or water uptake of seeds was measured in following manner. Seeds were placed in between rolled sheet of moist paper towel at 25°C. The increase in wet weight of imbibed seeds was taken as percentage increase over the original weight of dry seeds.

In addition field performance was also evaluated such as the measurement of vegetable growth in plant height and plant development, number of female flowering, percentage of fruit set and number of fruit set per plant.

RESULTS AND DISCUSSION

The optimum period of heat treatment was 70°C for 7 days after which there was increase in germination from the initial low of 20%. Heating at 70°C for 3 days gave the best result in term of percentage germination (Fig. 1 and Table 1)

Hot dry air treatment had no detrimental effect on growth of plants, generally the plant height is shorter than the control, with 70°C for 3 days the plants performed better than control and with 70°C for 7 days the plants performed equally well as control (Fig. 2 and Table 2). In term of number fruit set the trend was similar with heat treatment of 70°C giving the same percent fruit set of control but treatment with 70°C for 7 days had reduced.

Results of wet heat treatments show from 40° to 55°C there is no difference from the control, however at 60°C both at 40 and 60 minutes soaking increase germination from 20% to 80 and 55% respectively. Again this shows soaking cucumber seeds in hot water resulted in breaking their dormancy, with the optimum temperature of 60°C for 40 minutes (Fig. 4). The imbibition pattern is similar to dry heat treatment. However the sharp increase in water uptake after 20 hours is due to protrusion of radicle and rupture of testa allowing more water uptake (Fig. 5).

With the soaking of seeds in hot water although there is increase in germination but plant growth is

Table 1 Effect of seed heat treatment on seed moisture content and germination cucumber.

Treatment	Seed moisture content (%)				Seed germination (%)	
	wet weight basis		dry weight basis		first count	final count
	130°C		130°C			
	2 hours	24 hours	2 hours	24 hours		
dry new seeds	6.88	7.71	7.11	7.98	10	18
38°C - 4 days	4.70	5.84	4.94	6.20	8	27
45°C - 2 days	3.14	3.76	3.24	3.90	3	20
70°C 1/2 day	2.26	2.83	2.31	2.91	25	38
1 day	2.16	2.67	2.20	2.75	27	39
3 days	2.05	2.59	2.09	2.65	53	73
7 days	2.05	2.50	2.09	2.57	83	93
10 days	2.02	2.58	2.06	2.44	80	89
75°C 1/2 day	2.13	2.86	2.81	2.95	7	14
1 day	1.98	2.43	2.18	2.49	28	43
3 days	1.70	2.26	2.15	1.73	60	71
7 days	1.66	1.69	1.69	1.72	69	85
10 days	1.38	1.34	1.40	1.38	74	85
80°C 1/2 day	2.26	2.49	2.31	2.55	6	12
1 day	1.86	2.29	1.30	2.35	16	22
3 days	1.77	2.11	1.80	1.14	56	64
7 days	1.70	1.56	1.69	1.59	76	88
10 days	1.51	1.54	1.61	1.56	77	87

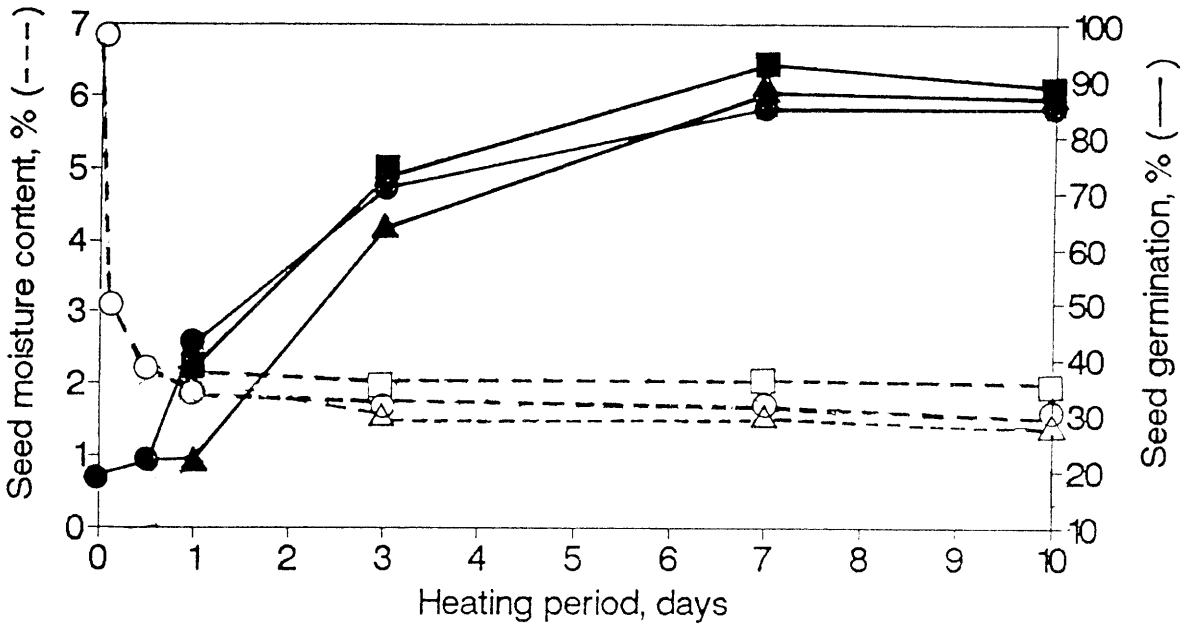

Figure 1 The relationship between seed moisture content and germination of cucumber seeds after heat treatment at 70°C (□, ■), 75°C (○, ●) and 80°C (△, ▲) for 1/2 day to 10 days.

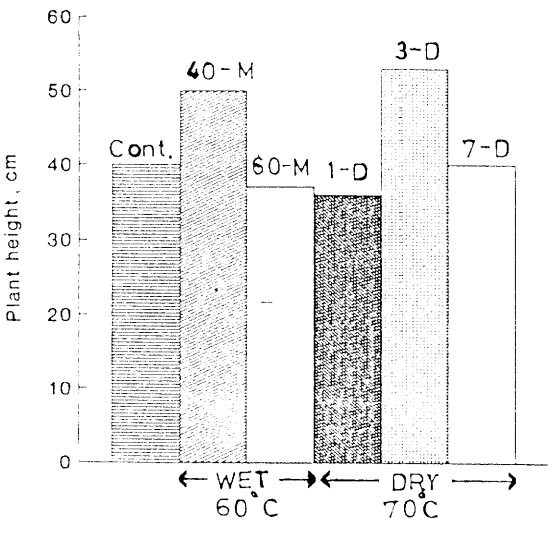

Figure 2 Effect of treating seeds with hot water at 60°C for 40 minites and 60 minutes (M) and with hot dry air treatment at 70°C for 1 day, 3 day and 7 days (D) on plant height of cucumber.

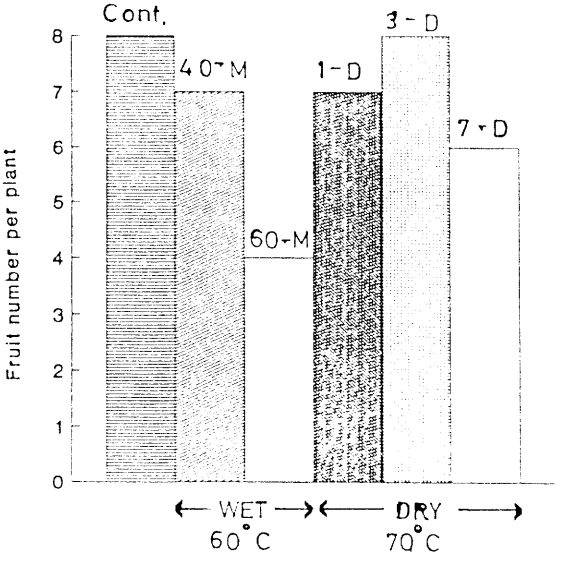

Figure 3 Effect of treating seeds with hot water at 60°C for 40 minutes and 60 minuter (M) and with hot dry air treatment at 70°C for 1 day, 3 day and 7 days (D) on fruit number per plant.

affected as in Fig. 2 if the duration is above 40 minutes, is at 60-minute soaking, in which the plant height is reduced, but at 40-minute soaking there is an increase in plant height. In term of seed development, soaking seeds at 60°C for 60 minutes has detrimental effect on fruit set, being significantly reduced (Fig. 3).

It is also observed at the highest temperature of 90°C increase in duration of heating from 2 hours to 24 hours resulted in increased germination (Table 3), however there are also detrimental effects involved such as slower rate of germination and as observed with leguminous seeds there are damages to cotyledonary tissues which is a from of mechcanical damage which will affect subequently growth and develop-

Table 2 **Effect of dry hot air treatment and hot water soaking of cucumber seeds on their germination, plant growth and fruit number per plant.**

Items investigated	Control (non-heated)	Dry hot air treatment at 70°C			Hot water soaking at 60°C	
		1 day	3 days	7 days	40 min	60 min
Seed germination,%	18	39	73	93	80	87
Plant height, cm	40	36	53	40	50	37
Fruit number per plant	8	7	8	6	7	4

Table 3 **Effect of seed heat treatment on seed moisture content and germination of cucumber.**

Treatment		Seed moisture content (%)				Seed germination (%)	
		wet weight basis		dry weight basis		first count	final count
		130°C		130°C			
		2 hours	24 hours	2 hours	24 hours		
90°C	1 hour	3.05	4.03	3.14	5.76	8	35
	2 hours	2.77	3.51	3.00	3.63	3	21
	4 hours	2.27	3.13	2.32	3.18	7	29
	6 hours	2.21	2.92	2.26	3.01	8	27
	8 hours	2.18	2.72	2.23	2.80	12	34
	10 hours	2.15	2.65	2.20	2.73	18	50
	12 hours	1.96	2.62	2.00	2.69	8	49
	24 hours	1.78	2.42	1.56	2.49	30	72

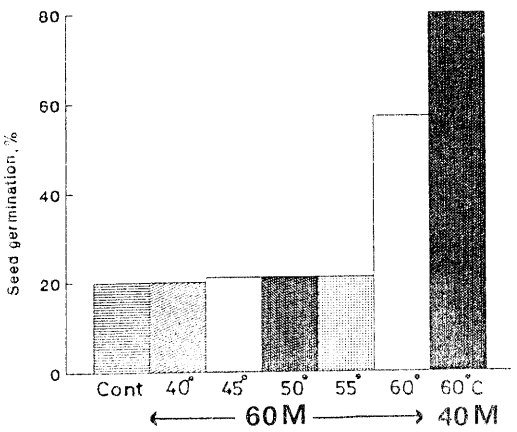

Figure 4 **Effect of soaking seed in hot water at 40°C, 45°C, 50°C, 55 and 60°C for 60 minutes and at 60°C for 40 minutes on seed germination of cucumber.**

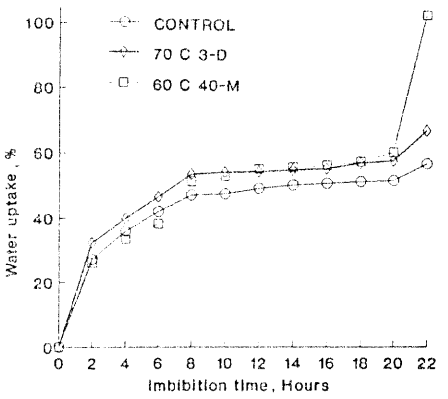

Figure 5 **Effect of heat treatment of seeds of changes of water uptake in cucumber seeds.**

ment of heated seeds.

From the above results, the heat treatments of both the dry heat and wet heat (soaking seeds in hot water) can break seed dormancy in the cucumber. After the treatment the percentage germination was much higher than the control which is normally around 20%. This method of breaking dormancy is simple to be practised by farmers, the optimum period of heating around 3 days of hot dry air at 70°C and soaking for 40 minutes at 60°C.

According to Bewley and Black (1982) seeds are dormant due to either embryo covering or embryo dormancy. Usually, embryo covering dormancy can be broken by various means such as removed of mechanical barier by scarification or by use of chemical treatment. The actuel machanisms involved in this method is not due to increase permeability, although we observe increase of water uptake is in the same trend as the control except it is at a higher rate (Fig. 5).

The mechanism of embryo dormancy is rather complex one. It's mobilization of food reserve is not initiated, eventhough substrates are aviable for enzymes (Bradbeer and Colman, 1967). Arias et al., 1976 explained to a reason of seeds fail to germinate associate with lacking of gibberellic acid (GA) to activate activity of enzymes. Instead of breaking dormancy by high temperature as our techniques, he suggested to incubated the seeds in low temperature (5°C) to activate seed to produce GA. Incubation seeds at low temperature or application GA directly to the seeds, both methods were suggested by Arias et al. 1976 in order to promote seed germination.

There appears to be a relationship between moisture content and germination when seeds are heated at 70, 75 and 80°C. As compared to the control at all the 3 temperatures there is big initial drop in moisture content from 5% down to 1.8 % in the first 24 hours after which from 1 to 10 days heating moisture remained fairly constant above that of the control while germination increase from 1 to 3 days of heating after which there is slight increase and later levels of around 80 or 90% (Fig. 1). Williams et al. (1973) studied on abscisic acid (ABA), seed germination inhibitor in embryo. He reported that effect of ABA on seed germination was enfluence by changing of seed moisture content. Khan, 1982 suggested that if seed dormancy controlled by an interaction between germination promoters (indole acetic acid, gibberellic acid) and inhibitors (abscisic acid), then dormancy release may involve increase promotive activity or diminished inhibitory activity, or both. Nevertheless, mechanism of seed dormancy in cucumber is needed for further study.

The drying of seeds down to below 2% is after referred to as ultra low moisture content and if there is no significant effect on germination, then it is possible to use this techniques of drying with the view of the possibility of storing seeds at a higher temperature instead of the recommeded -80°C which is costly and hard to maintain. In particular for this local variety, the dryheat treatment seems to be appropiate for use to break dormancy in cucumber seeds. There is a possibility that this ultra dry seeds can be stored more economically and efficiently at higher temperatures instead of super coolingre command.

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