Korean J. Crop Sci. 46(4): 321~324(2001)

Effects of Storage Temperature and Humidity on Germinability and Longevity of Primed Tobacco Seeds

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ABSTRACT : Tobacco seeds (*Nicotiana tabacum* L. cv KF109) were primed in the polyethylene glycol 6000 (PEG) solution and then stored at 5 and 25°C under 40, 60 and 80% relative humidity (RH) conditions for six months. The effect of storage temperature and humidity on mean germination time (T_{50}), longevity and germination of the primed tobacco seeds were compared. Untreated seeds (control) stored at 5°C showed high germinability throughout the entire storage period and humidity, and a decline in germinability showed after 6 months at 60% RH and after 3 months at 80% RH when stored at 25°C. Primed seeds retained high germinability until 6 months at 60% RH and 3 months at 80% RH when stored at 5°C but showed a significant decline in germinability after 3 months at 40% RH, and 1 months at 60% and 80% RH, respectively when stored at 25°C. Primed seeds were completely lost viability when stored at 25°C under 60% RH for 6 months and under 80% RH for 3 months.

Keywords : tobacco, polyethylene glycol 6000, relative humidity, priming, mean germination time, germinability

Seed priming is a well known seed treatment technique in the low osmotic solutions to improve the rate, speed and uniformity of germination (Heydecker and Coolbear 1977). Optimum condition for tobacco seed priming was reported (Min and Seo, 1999; Min, Seo and Lee 1999). The optimum condition for tobacco seed priming was verified as -0.8MPa in osmotic potential with PEG 6000 solution at 25°C for 8 days.

Successful long-term storage for the primed seeds usually requires drying back to some moisture content. Handling of primed seeds in the dry state has practical advantages, but reports on the effects of long-term storage (at least two months) on seed germination have been conflicting. Primed tomato seeds stored at 4°C retained viability and germination rate after one year, but viability and vigor of the tomato seeds were markedly reduced within six months when stored at 30°C (Argerich, Bradford and Tarquis, 1989). Alvarado *et al.* (1988) reported similar results for primed tomato seeds. These authors concluded that primed tomato seeds must be vigorous with reduced self-life. In contrast, Geoghiou *et al.* (1987) noted that sweet pepper seeds that were primed then dried to their original moisture contents had greater germination rate and viability when stored at 25°C for up to three years. There is no information concerning the longevity of the priming effect in dry tobacco seeds or the consequences of the treatment for the seed viability during storage. Therefore, the objective of this experiment was to determine the relationships between the storage temperature and humidity on the longevity and viability of tobacco seeds after seed priming treatment.

MATERIALS AND METHODS

Tobacco seeds, cultivar 'KF109' were primed in polyethylene glycol 6000 (PEG) solution of equivalent osmotic potential (-0.8 MPa, 262 g/kg water) under fluorescent light at 25°C for 8 days (Min and Seo, 1999). Each batch of 2 g seed was primed on the blotters in plastic containers (11 × 11 × 4 cm). Inside the container, 9 cm petri plate put top down to support the blotters and two edges of the blotters were submerged and continuously moistened with 40 ml of the PEG solution from the bottom of the containers. The primed tobacco seeds were dried back to their original weight in forced air at 20°C just after priming treatment, and then placed the seeds on wire mesh trays in the plastic containers under controlled humidity conditions. The relative humidity (RH) inside the plastic containers was controlled by the mixing rate of the glycerol and water in the bottom of the containers adjusting 40, 60 and 80% RH according to Forney and Brandl (1992) method. The containers were tightly sealed with lids and parafilm and placed in the temperature controlled incubators of 5°C and 25°C. The primed and unprimed seeds were stored for 6 months and tested the germination on the each batch after one, three and six months storage. Germination test were conducted in 25°C by the AOSA rules (1993). Count of the number of germinated seeds were made at 24-hour intervals for 7 days. The mean time to germination(T_{50}) was calculated from the following equation:

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<Received August 10, 2001>

$T_{50} = \Sigma TiXi/\Sigma Xi$

where Xi is the number of newly germinated seeds at time Ti.

The time used was the midpoint of the interval since the previous count.

RESULTS AND DISCUSSION

The final germination of control seeds was between 93% and 96%. When the seeds were stored at 5°C, there was no decrease in germination rate in the control unprimed until 6 months under the all RH conditions. In primed seeds, germination was unaffected by 6 months at 60% RH, but at 80% RH, the germination rate started to decrease after three months storage and significantly decreased to 79% after 6 months storage (Fig. 1, Table 1). Storage at 25°C, the germination rate in control began to decrease at 60% RH after 6 months storage and significantly decreased at 80% RH after 3 and 6 months storage to 81% and 5% respectively. In primed seeds, significant decrease in final germination rate showed even at 40% RH after 6 months storage to 72% and dramatically dropped at 60% RH after 3 and 6 months storage to 32% and 0% respectively. The primed seeds of more than three months storage in RH 80% at 25°C were com-

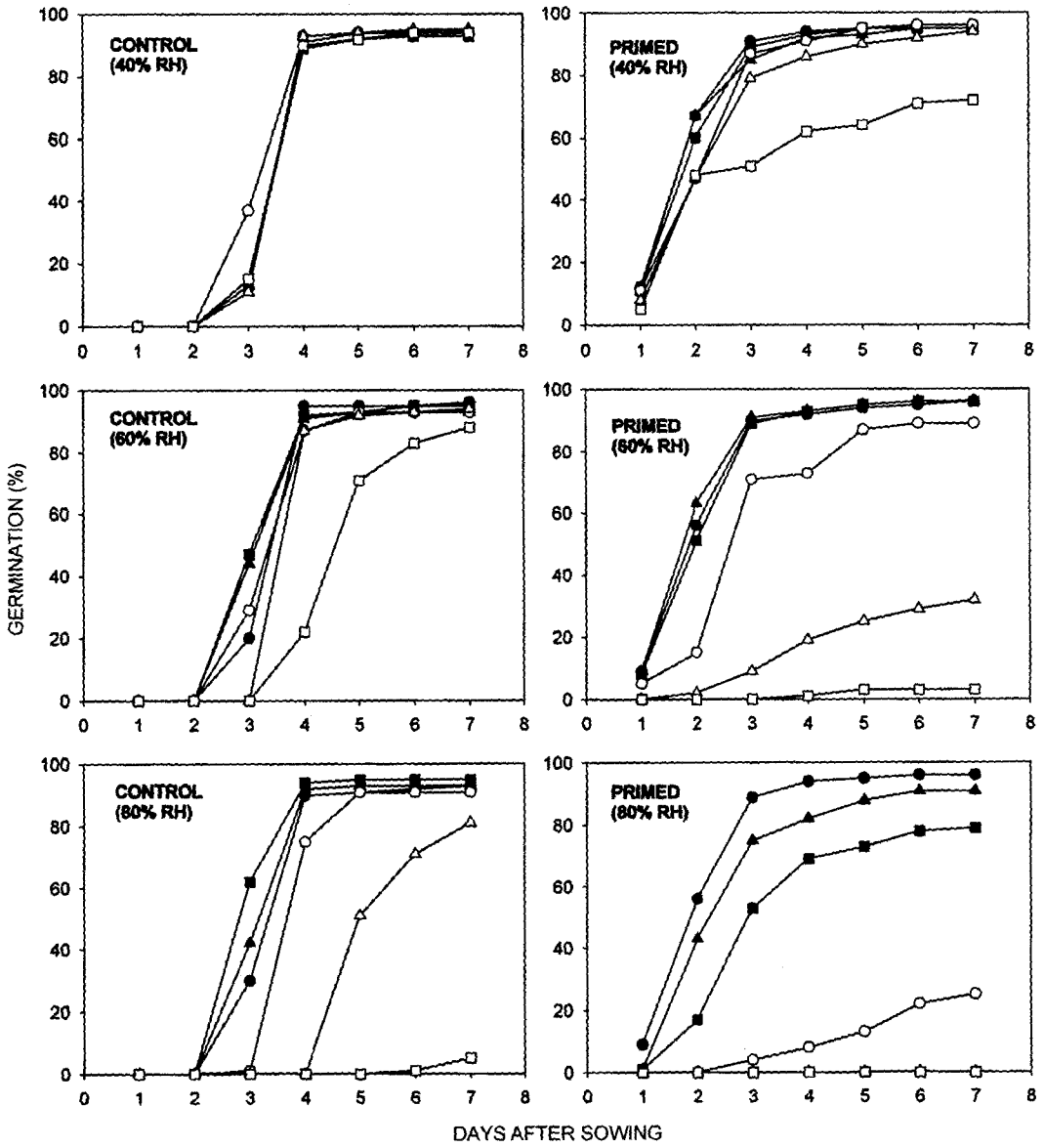

Fig. 1. Cumulative germination curves of control unprimed and primed tobacco seeds stored one, three and six months in 40, 60, 80% RH at 5°C and 25°C. The symbol ●, ▲and ■denote one, three and six months storage at 5°C respectively, and ○, △ and □ denote one, three and six months storage at 25°C respectively.

Table 1. Effects of storage temperature, time in storage and relative humidity on the percentage of final germination and T_{50} from primed and control (unprimed) tobacco seeds†.

Treatment	Storage temperature (°C)	Time in storage (month)	Final germination (%)			T_{50} (day)		
			RH (%)			RH (%)		
			40	60	80	40	60	80
Primed	5	1	95a‡	96a	96a	1.6a	1.8a	1.8b
		3	95a	96a	91a	1.6a	1.7a	2.0b
		6	95a	96a	79c	1.7a	1.9a	2.6a
	25	1	96a	89a	25a	2.0a	2.5c	4.9a
		3	94a	32b	0b	2.0a	3.7b	-
		6	72b	0c	0b	1.7a	4.3a	-
Control	5	1	94a	96	93a	3.5a	3.4a	3.3a
		3	95a	93	93a	3.4a	3.0a	3.1a
		6	93a	95	95a	3.4a	3.0a	2.7a
	25	1	94a	93a	91a	3.2a	3.3a	3.6c
		3	95a	94a	81b	3.4a	3.9a	4.8b
		6	93a	86b	5c	3.6a	4.5b	6.4a

†Data are means of four replicates of 100 seeds each.
‡Values within a column followed by the same letter are not significantly different ($p<0.05$).

pletely dead (Fig. 1, Table 1). T_{50}s were not affected when the seeds stored at 5°C until 6 months at any RH in contol and until 6 months storage below 60% RH in primed seeds, but in 25°C storage, the advantage of rapid germination in primed seeds over control began to reduce from 3 months storage over 60% RH.

As the results, primed tobacco seeds were greatly affected adversely by the high storage temperature and humidity. The detrimental effect of high temperature on the control and primed tobacco seeds was evident when stored at 25°C over 40% RH condition, particularly severely affected in the primed seeds. However, when the primed seeds stored at 5°C, the final germination percentage was retained until three months storage at high humidity condition of 80% RH. The results indicated that the longevity of primed tobacco seeds responded very sensitively to high temperature than humidity.

These results did not agree with the reports that priming treatments extended seed longevity and maintain seed quality under adverse storage conditions (Priestly, 1986) and other report that viability and germination rate were enhanced by priming both before and after storage (Thanos, Georghiou and passam, 1989). Berry and Drennan (1971) concluded that, in a series of hydration/dehydration treatments of tomato seeds, desiccation had little harmful effect if carried out prior to the initiation of cell division and enlargement. Min, Seo and Lee (1999) observed that embryo growth occurred in the primed tobacco seeds, and from this fact, when the seeds stored at 25°C, the primed seeds might then accelerate the deterioration process. Therefore, storing the primed seeds at low temperature and humidity, particularly at low temperature, could be highly required to maintain priming effects prolonged.

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