Controlling seed-borne fungi by the use of heat and salt

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The general aim is to find an effective method of controlling seed-borne fungi while at the same time maintaining high levels of seed germination and vigour. Hot water has been used by many workers as a means of controlling seed-borne pathogens. However, a severe decrease in viability of the seed often accompanies this treatment. Experiments were carried out supplementing hot water with high concentrations of salt. Testing was carried out on Alternaria zinniae-infected zinnia seed.

Methods

One hundred ml solutions of calcium chloride dehydrate with varying concentrations were prepared in conical flasks (Table 1). To each flask 1 gm of zinnia seed (cv. Happy Talk) was added. Control flasks with no salt were also prepared. The flasks were placed in a hot water bath at 54?C for half hour with occasional shaking. After heating, the seeds were thoroughly washed and set to germinate on moist blotters in plastic trays with clear lids. Germination counts (the number of normal seedlings) were taken after 7 days and the seeds placed under UV light (Oliphant F40 BLB, 30 cm from seeds) to encourage the fungi to produce spores. Infection (visible spores) was read after a further 3 days.

A second experiment was carried out using a 1.5 molar solution of $CaC1_2 2H_2O$. The method was as above except that the temperature varied from 54-60?C and a cool-water soak control was included.

Table 1. Zinnia seeds heated at 54° ½ hr in $CaCl_2 2H_2O$.

Molarity	7 day germ %	Infection %
0	8	2
0.5	19	3
1.0	45	10
2.0	60	15
2.6	61	23
3.2	58	18

Table 2. Zinnia seeds heated ½ hr in 1.5 M $CaCl_2 2H_2O$.

Temp °C	$CaCl_2 2H_2O$	7 day germ %	Infection %
Control	+	58	23
	-	51	19
54	+	57	9
	-	5	3
56	+	54	4
	-	1	-
58	+	43	2
	-	0	-
60	+	30	0
	-	0	-

Results and Discussion

The results in Table 2 show that a temperature of 56-58?C plus 1.5 M $CaC1_2 2H_2O$ gives germination levels of around 50% and infection levels of less than 5%. This was the best treatment. At these temperatures without the addition of $CaC1_2 2H_2O$ germination was zero. Increasing the temperature greatly reduced the level of germination and decreasing the temperature led to an increase in infection.

It is possible that $CaC1_2 2H_2O$ acts as an osmotic agent preventing excess water entering the seed, which leads to leaching and decreased viability, while allowing heat to enter and kill the fungus.

Although the highest level of germination found is unacceptable for the sale of seed it is a vast improvement on a hot-water soak, even one at 54?C. If the method could be applied to, say, expensive or difficult to obtain seed it would give the grower a chance to produce a reasonable number of healthy plants rather than risk losing his entire crop. Modifications to the temperature and perhaps length of soaking used will be necessary depending on such factors as seed size and testa hardness.