

# The effect of seed moisture content and hot water treatment on carrot seed viability and *Alternaria radicina* control

C Merfield, J Hampton, M Hill, S Wratten

Bio-Protection and Ecology Division  
Lincoln University, Canterbury  
New Zealand

## Introduction

- Hot water treatment of seeds to control seedborne pathogens is an important tool for organic seed production. To be practical, the seed's thermal tolerance must be much greater than that of the pathogen.
- Techniques that can increase the seed's thermal tolerance and/or reduce the pathogen's thermal tolerance could improve hot water treatment.
- Seed moisture content (SMC) is known to affect seed's heat tolerance (TeKrony 1995).
- Reducing SMC may have the potential to increase seed tolerance to treatment.
- The effect of altered SMC on the tolerance of *A. radicina* to heat treatment is unknown.

## Method

- Experiment 1: Studied the effect of SMC (5, 10, 15 and 20%), temperature (45, 50, 55°C), and treatment duration (0, 10, 20, 30, 40, 50, 60 min) on the germination of carrot seed that was free of *A. radicina*, in a three factorial design.
- Experiment 2: Studied the effect of SMC (5, 10, 15 and 20%) and treatment duration (0, 10, 20, 30 min) on infestation levels of *A. radicina* in carrot seed, and seed germination, in a two factorial design. Carrot seed was artificially inoculated with *A. radicina* two months prior to harvest.
- SMC was altered by either adding water before treatment or by air drying at 30°C and then stabilising for 24 h at 5°C prior to treatment.
- Seeds were treated by loosely placing in stainless steel tea infusers then immersing in 11 l of water at the required temperature and duration and then immediately cooling them in 15°C water for 15 min.
- The germination tests and detection of *A. radicina* was conducted as per (ISTA 2004)

## Results

- In experiment 1 germination was significantly reduced ( $p < 0.001$ ) by increasing treatment duration and temperature, and there was a significant interaction between these two factors (Figure 1), in that at 45°C germination did not differ among treatment durations, but at 50°C was reduced after 50 minutes, and at 55°C after 20 minutes.
- Germination was reduced slightly by increasing SMC ( $p < 0.001$ ) from 68% at 5% SMC to 63% at 20% SMC.

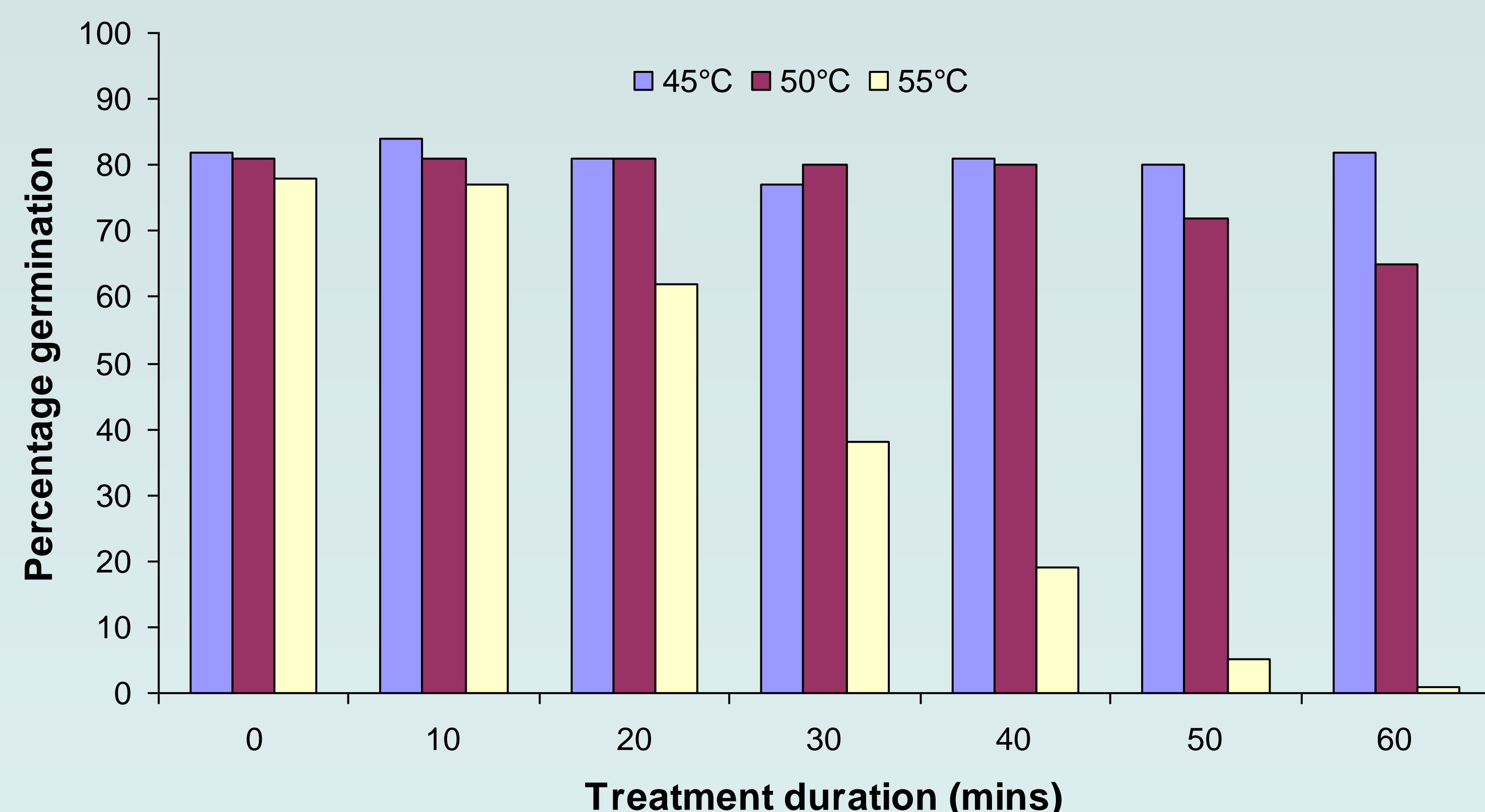


Figure 1. Effect of duration x temperature on germination (%) (LSD 4.3)



- In experiment 2, SMC (Figure 2) had a significant effect ( $p = 0.003$ ) and duration (Figure 3) had a highly significant effect ( $p > 0.001$ ) on infestation levels.

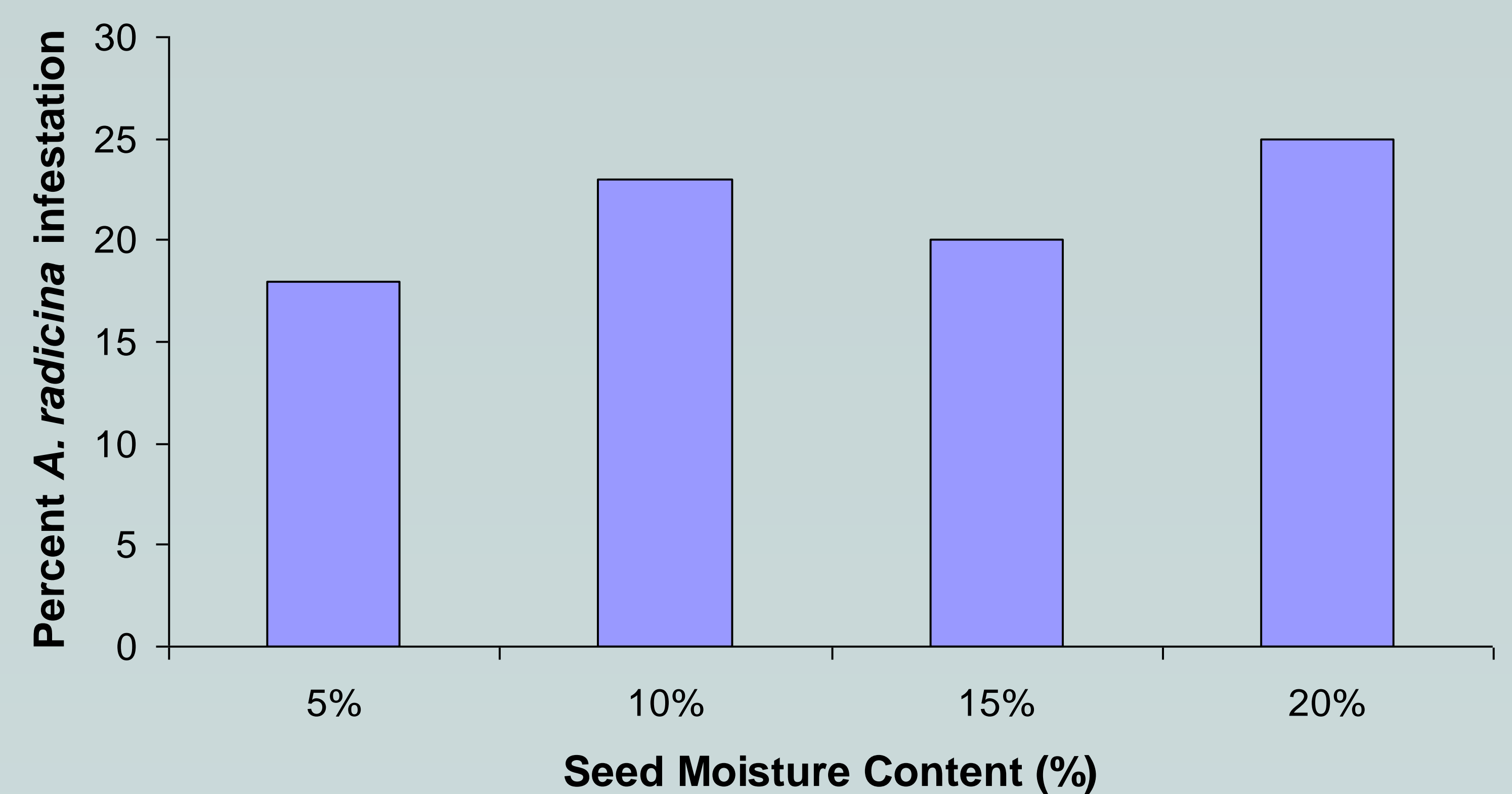


Figure 3. Effect of initial SMC on infestation of seeds by *A. radicina* (LSD 0.04)

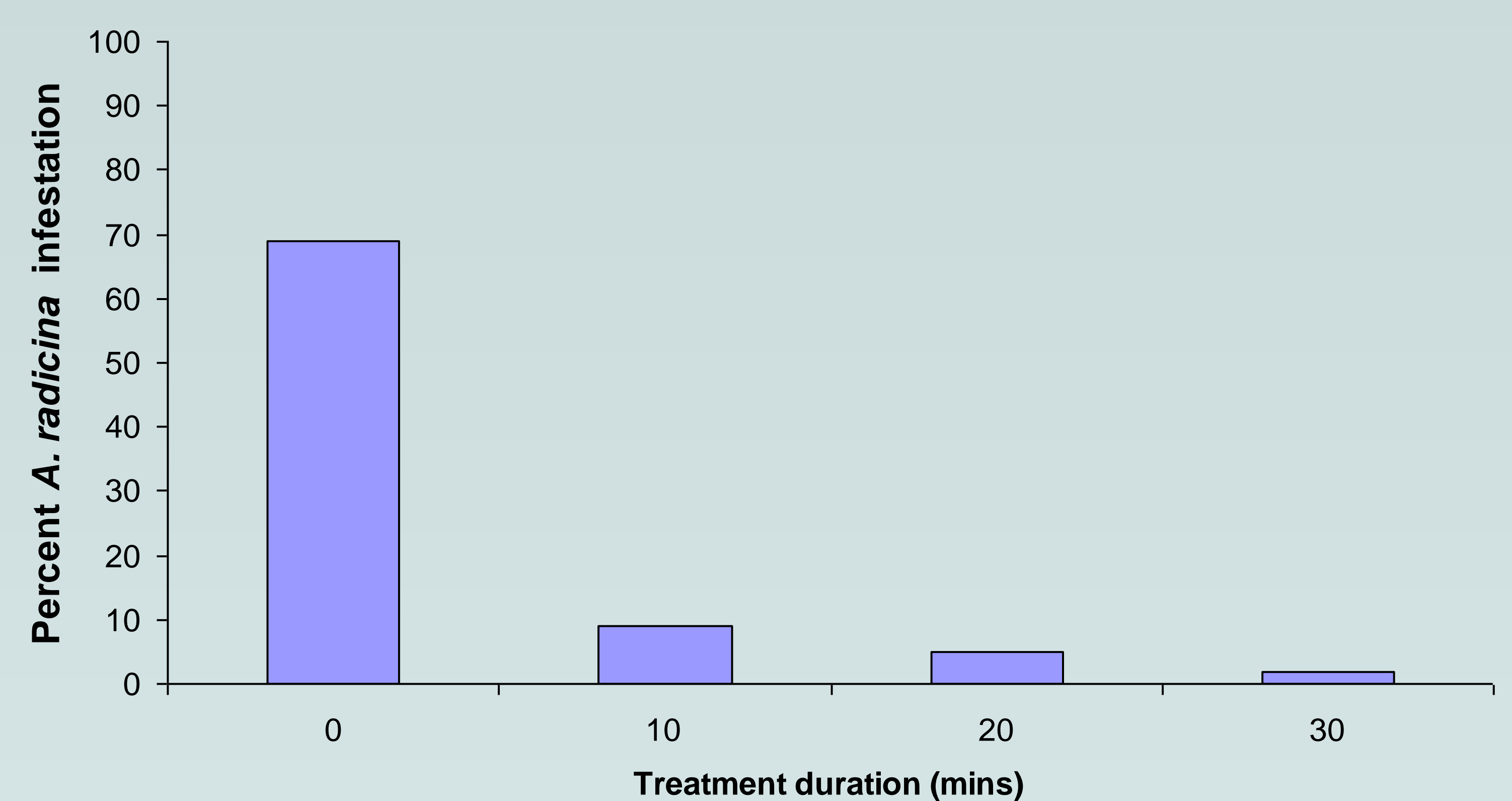


Figure 4. Effect of treatment duration (mins) on infestation of seeds by *A. radicina* (LSD 0.04)

- The effect on percentage germination was not significant for either SMC or duration.

## Conclusions

- The safe hot water treatment duration and temperature established for carrot seed is much greater than that required to cause a large reduction in viable *A. radicina*, showing that it is a practical and effective means of reducing the infestation levels of carrot seed lots.
- The effect of altering SMC prior to treatment was less pronounced, but there was a small improvement in germination of treated seed and a decrease in the infestation level as SMC was reduced.
- It may be commercially and practically valuable to decrease SMC to 5% prior to hot water treatment to reduce the loss of seed viability while also reducing viable fungal infestation levels.
- Even if this is not the case, care should be taken to ensure that SMC is not raised above ambient levels prior to treatment, as this will reduce the effectiveness of the treatment.
- Further work using seed that has infestation levels more likely to be found in commercial practice would be valuable to confirm the observed effects of altering SMC and also to test the method on other seed borne carrot pathogens such as *Alternaria dauci* and *Cercospora carotae*.

## References

ISTA (2004). International Rules for Seed Testing. Bassersdorf, Switzerland, International Seed Testing Association.

TeKrony, D. M. (1995). Accelerated ageing. International Seed Testing Association: Vigour Test Committee: Seed Vigour Testing Seminar, Copenhagen, Denmark, International Seed Testing Association.

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