



# Developing an “artificial exosperm” for promoting and synchronizing seed germination at limiting low temperature and moisture conditions in carrots.



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## Introduction

Stand establishment is critical for optimizing yield and quality in carrots, especially when they are grown under low soil temperatures and rainfed conditions. Providing an “artificial exosperm” with appropriate germination promoters, stress conditioners and growth invigorators to the seed growing medium may facilitate uniform germination and emergence. Germination patterns and velocity of germination of two carrot cultivars, Oranza and Sugarsnax, were studied. We hope to identify a suitable gel type to develop an “artificial exosperm” to provide a complete protective delivery system for carrot stand establishment for Nova Scotia farmers.

## Objectives

- > To identify appropriate gel and optimal concentration that facilitate germination both at contrasting temperatures (5°C and 20°C) and moisture regimes (20%FC and 40%FC).
- > To assess germination patterns and monitor velocity of germination of two carrot cvs. Oranza and Sugarsnax at contrasting temperature regimes (5°C and 20°C) using different kinds of gels mixed at various ratios.

## Materials and Methods

Gels such as laponite RD, laponite RDS and agar were used. Gels were evaluated by mixing carrot seeds (cvs. Oranza and Sugarsnax) at various ratios (such as, 100:0.1%, 100:0.2% etc) to achieve seed to gel ratios. Seeds were counted and submerged in gels in petridishes (100 mm x 15 mm). One hundred seeds were used for each treatment in each replication. Each treatment was replicated two times at contrasting temperatures (5°C and 20°C). Mean germination percentage and velocity of germination were calculated (Czabator 1962).



Fig. 1: Gel preparation



Fig. 2: Dispensing gel



Fig. 3: Seeds in gel



Fig. 4: Incubation

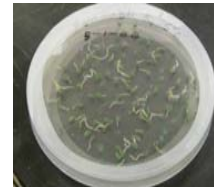


Fig. 5: Germinating seeds

## Statistical Analysis

The GLM procedure with repeated measures analysis (SAS Institute, Inc. Cary NC) was used for ANOVA to test statistical significance. Means were separated using Fisher’s protected LSD ( $P \leq 0.05$ ) where F-tests were determined to be significant.

## Results and Discussion

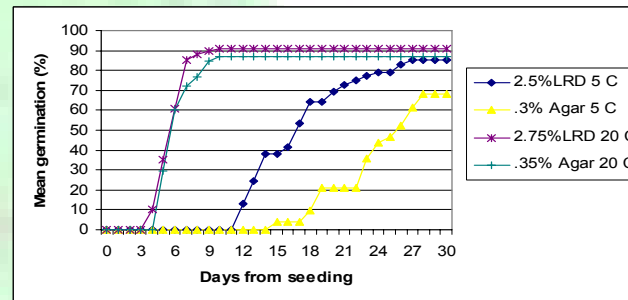


Fig. 6: Mean germination percentage of carrot seeds sown in laponite RD and agar gels at contrasting temperature regimes 5°C and 20°C. (cv. Oranza)

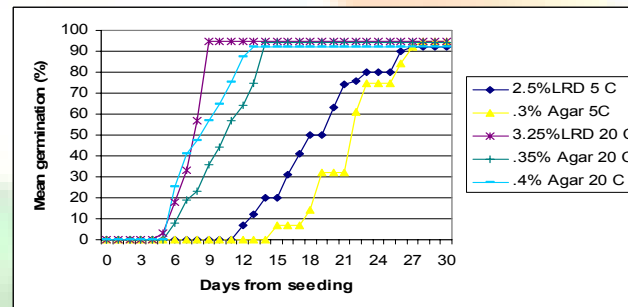


Fig. 7: Mean germination percentage of carrot seeds sown in laponite RD and agar gels at contrasting temperature regimes 5°C and 20°C. (cv. Sugarsnax)

Mean germination percentage and velocity of germination for both cultivars incubated at 5°C were significantly delayed (fig. 6 and 7). At low temperature a change in configuration of water molecules would have reduced water availability (Bewley and Black, 1982). This would have limited imbibitions thereby, delaying and reducing germination. However, when laponite RD 2.5g/100ml and agar 0.3g/100ml were used the highest mean germination percentage for both cultivars observed over a 27 day period was 85% for cv. Oranza and 92% for cv. Sugarsnax. In contrast, at 20°C, there was no significant difference in mean germination percentage and for velocity of germination among different gel treatments. The highest mean germination percentage for both cultivars observed over a 13 day period was, 91% for cv. Oranza and 95% for cv. Sugarsnax. Laponite RD 2.75g/100ml, 3.25g/100ml and agar 0.3g/100ml hastened germination (fig. 6 and 7).

## Conclusion

In conclusion, germination delayed at 5°C. In contrast, at 20°C germination began on day 4 and 5 and completed on day 10 and 13, respectively. Both at 5°C and 20°C, laponite RD 2.5g/100ml, 2.75g/100ml, 3.25g/100ml and agar 0.3g/100ml and 0.35g/100ml all have promoted germination resulting in the highest mean germination percentage for both the cultivars. Laponite RD 2.5 g/100ml and 2.75g/100ml have shown a greater advantage over other gel types, which could be chosen to provide a possible protective delivery system and could serve as an “artificial exosperm” for carrot seeds. This will aid in developing a synergistic approach for carrot stand establishment.

## Acknowledgement

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## References

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