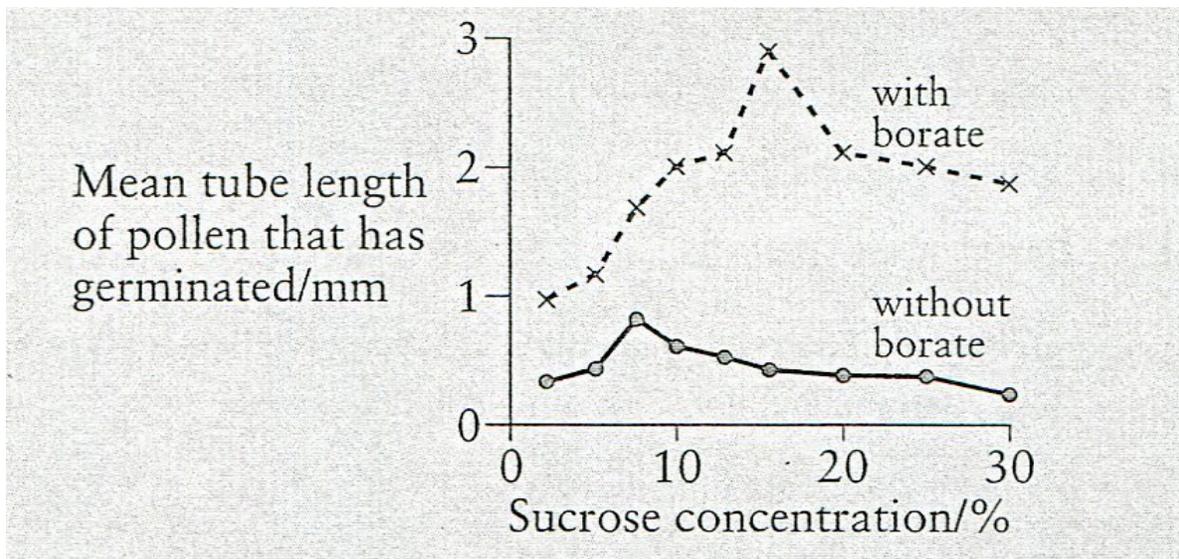


Pollen from many species of plants will germinate on artificial media. Germination on water is generally poor, and any pollen tubes formed usually burst.

The figure below shows the effect of sucrose concentration on pollen tube growth, with or without the addition of a very small amount of borate. (Borate is a salt containing the element boron.) The pollen tubes were measured at a fixed time after germination had occurred.



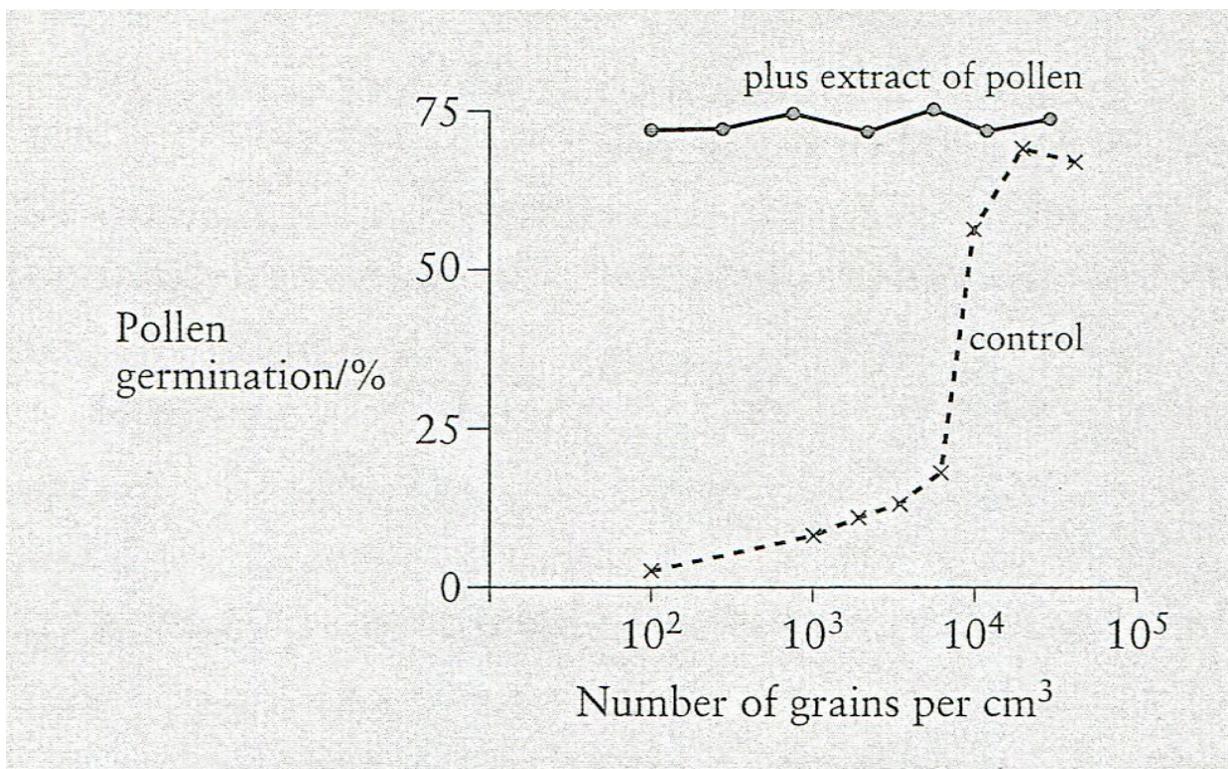
Two different hypotheses were put forward to explain the role of sucrose in pollen tube growth.

- (1) It is used to provide the pollen tube with energy.
- (2) It prevents the bursting of the pollen tube by osmosis.

(a) Describe a simple experiment you might carry out to eliminate one of these hypotheses.

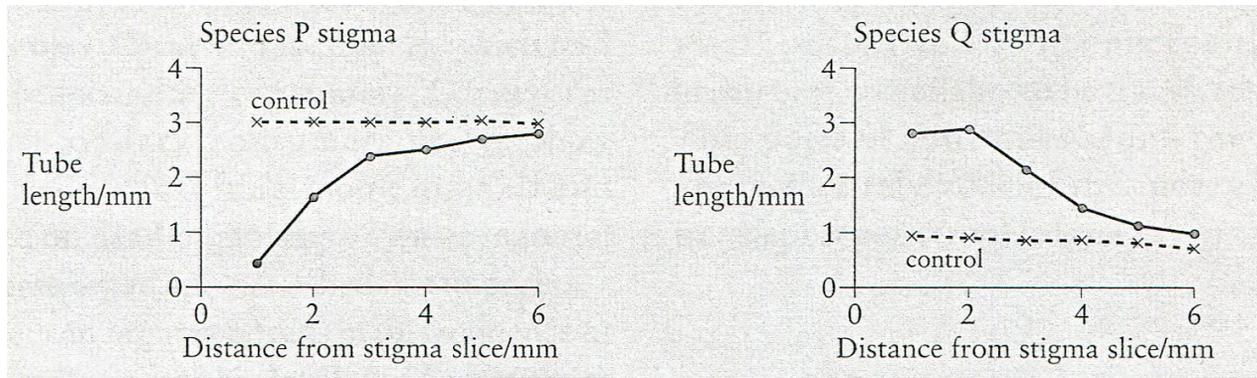
(b) Borate was used in these experiments at extremely low concentration. Suggest one possible explanation for its effect on pollen tube growth.

Suspensions of different densities of pollen grains were made up in solutions containing 10% sucrose with added borate and allowed to germinate under standardized conditions. The figure below shows the percentage germination of pollen at different densities for two series of suspensions. One series was made up with water ('control'). A second series was made up with water that had been shaken with a large amount of pollen and then filtered ('plus extract of pollen').



(c) Suggest an explanation for the results shown in the figure above.

Pollen from one species of plant was scattered on the surface of dishes containing sucrose agar medium. In two separate experiments, slices of stigmas of two different plant species, P and Q, were placed on individual dishes of the medium treated with pollen. The growth of the pollen tubes at different distances from the stigma slices is shown in the figure below.



- (d) i. Explain what the 'controls' represent in the last figure.  
 ii. What evidence is there from the graphs to indicate that the two experiments were carried out for different periods of time?
- (e) Suggest an explanation for results shown in the last figure.