HortScience. 12(6):572–573. 1977.

Factors Influencing Seed Germination of *Freesia refracta* Klatt cv. Royal Mix[1]

Terry L. Gilbertson-Ferriss and H. F. Wilkins[2]
Department of Horticultural Science, University of Minnesota, St. Paul, MN 55108

Additional index words. seed leaching, light, temperature

Abstract. **Seed germination of 'Royal Mix' freesia was most rapid and uniform at 15.5° or 18.5°C under clear polyethylene or at 13° or 21.5°C under black polyethylene. Soaking seeds in running water prior to germination or removal of the seed coat did not improve seed germination**

Various cultural recommendations have been given for rapid germination of *Freesia refracta* seeds (1-8). Light and temp treatments appear to be a common consideration. Recommended germination temp range between 18.5° to 21.5°C, although 13° has also been suggested (4). Reports have shown that light inhibits *F. refracta* seed germination (6, 7, 9). Scennels (7) observed delayed germination under normal greenhouse light conditions, but when the seed flats were shaded by a portion of the greenhouse structure or when the flats were moved to a shady area, germination was more rapid. Regardless of the procedure used, germination has required 3 to 4 weeks (3, 4, 6, 7).

In England the favored practice is "chitting" where seeds are placed in moist peat or vermiculite until radicle emergence, then the seeds are selectively planted (2, 6, 7, 9). "Chitting" was and still remains, for a few propagators, a favored germination practice for freesia seed.

Presoaking seeds in water for 1 to 4 days has also been practiced (1, 3, 7). Scennels (7) recommended using a 15.5°C water soak for 2 to 4 days whereas others suggested preplant soakings but did not indicate specific water temp (1, 3). Wet seeds readily adhere to one another making sowing cumbersome and time consuming when compared to sowing dry seed. Seed coat removal has also been suggested but there is no data to show that this process will hasten germination (1, 3).

Heydecker (6) has experimentally used polyethylene glycol (PEG), on freesia seed as a preplant osmotic treatment. Treating seed with PEG at osmotic concn similar to that of the seed allows for water uptake without inducing germination. Treated seeds frequently germinate more uniformly than non-treated seeds.

The intention of this study was to further evaluate the effects of water soaks, temp, and light conditions on seed germination of freesia.

Seeds of 'Royal Mix' freesia with seed coats intact were suspended in a double layered cheese cloth in controlled, stirred water baths for 4 days at 13°C, 18.5°, 24° or 29.5°. Non-soaked seed with and without seed coats were used as statistical controls. Seeds were sown on a 3 soil:2 peat: 2 sand: medium (by vol) in plastic germination flats and covered with 0.6 cm of medium grade vermiculite, watered thoroughly and kept moist. Seed lots from each soaking treatment were subdivided and germinated in growth chambers at 4 temp (13°, 15.5°, 18.5° or 21.5°) with 12 hr light period. Half of the flats were covered with clear, 2 mil polyethylene (CP) or with black, 2 mil polyethylene (BP). The polyethylene did not touch the medium. Soil temp under the 2 types of coverings fluctuated ± 2° from one another during germination.

The light source was a combination of 8 incandescent 25 watt bulbs and 15 cool white fluorescent, 1.75 m long tubes. The light intensity was 21,500 lux at seedling level with 100-200 lux reaching the seed under the CP and the 0.6 cm of vermiculite. No light reached the seeds under the BP treatment. The BP was removed when all seeds germinated. A 3-factor factorial, replicated twice in time was used with 10 seeds per treatment. Germination was recorded daily by noting the no. of emerged shoots 1 cm or longer. Statistical tests showed homogeneity of error between experiments which permitted subsequent combining of germination data for analysis (8).

The germination data from each treatment were used to calculate the mean no. of days for the first seed to germinate, mean no. of days to reach maximum germination, mean % germination after 22 and 30 days, mean no. of days between the first and last germination and the linear slopes of the germination curves. Analyses of variances and treatment means computed for each of the above parameters were used to evaluate and compare the rates and uniformities of the germination treatments.

Soaking seed at various temp or removal of seed coats had no influence on the rate or % germination (Table 1). There were no interactions between the light or dark and soaking treatments or between the germination temp and soaking treatments. There was an interaction between light treatments and germination temp and there were differences between mean slopes of the germination curves, mean % germination after 22 days, mean no. of days to final % germination, mean no. of days until the first seed germinated, and the mean no. of days from first to final % germination (Table 2).

The no. of days for the first seed to germinate was most rapid (16-17 days) at 13°, 15.5° or 21.5°C under BP and at 15.5° under CP. After 22 days 61 to 78% of the seeds germinated in the above treatments (Table 2). Onset of germination at 13°, 18.5° or 21.5° under CP or at 18.5° under BP was delayed an average of 3 days with only 28 to 48% germination after 22 days.

Germination rate (% per day) was most rapid (4.0 to 7.3 days to reach the maximum percentage) at 13° or 21.5°C under BP and at 18.5° under CP. Seeds completed germination at 15.5° within 7.7 to 9.8 days, respectively, under CP or BP. Other treatments required 7.5 to 11.8 days to reach their final % germination. Neither CP or BP treatments nor germination temp altered the final germination percentage, which averaged 72%.

The light germination temp interaction is best illustrated by the differences between the BP and CP treatments at 18.5°C. With this temp the time from seeding to first germination was faster under BP but the rate of germination from the first to the last day of germination was faster under the CP.

Germination at 15.5° to 18.5°C under CP or at 13° or at 21.5° under BP can be suggested for maximum, rapid uniform germination. Covering with BP shortened the time between seeding and first germination. When germinated under BP, the covering must be removed after emergence of the first shoot to avoid shoot etiolation and to promote additional germination. After emergence of the first shoot, subsequent germination at 15.5° and 18.5° was more rapid in seed flats under CP. Covering the seed with BP at 13.0° or 21.5° until first emergence followed by exposure to light at 18.5° was not tried but may be a germination pro-

[1]Received for publication April 14, 1977. Scientific Journal Series Paper 9823. Minnesota Agricultural Experiment Station.

[2]Graduate student and professor, respectively. The authors wish to express their appreciation to Dr. R. Stucker, Agronomy Dept., Univ. of Minnesota, for writing the computer program and assisting with the statistical interpretations.

Table 1. Effects of a preseeding water soak treatment on germination of *Freesia refracta* seeds.[z]

Treatment	No. of days until the first seed germination	No. of days from first to last day of germination	No. of days to maximum percent germination	% germination after 22 days	% germination after 30 days	Slope of germination curve (%/day)
Control – no soak	18.3	7.8	25.0	62.5	82.5	11.9
Control with seed coat removed	17.6	7.8	24.3	52.5	72.5	9.3
Intact seed coats						
13.0°C soak	18.7	6.7	24.3	48.1	66.9	11.2
18.5° soak	18.3	9.8	27.0	51.3	70.0	6.3
24° soak	18.8	7.5	25.3	49.4	69.4	9.0
29.5° soak	18.2	7.3	24.4	53.8	70.0	8.6

[z]Treatment effects were not sifnificant at the 5% level, by LSD.

Table 2. Effects of germination temps and black or clear polyethylene covering the germination trays of *Feeesia refracta* seeds.

Treatment (°C)	No. of days until the first seed germinated	No. of days from first to last day of germination	No. of days to maximum % germination	% germination after 22 days	% germination after 30 days	Slope of germination curve (%/day)
Black polyethylene						
13.0	16.8 c[z]	6.9 bcde	22.6 bc	61.7 abcd	75.8 abc	12.3 ab
15.5	16.5 c	9.8 ab	25.4 ab	66.7 abc	78.3 ab	8.1 abcd
18.5	17.6 bc	11.8 a	28.5 a	47.5 bcde	73.3 abc	4.8 d
21.5	15.7 c	6.3 cde	21.1 c	68.3 ab	72.5 abc	11.7 abcd
Clear polyethylene						
13.0	20.3 ab	8.5 bc	27.6 a	29.2 e	67.5 abc	8.3 abcd
15.5	16.1 c	7.7 bcd	23.4 bc	78.3 a	84.2 a	12.1 abc
18.5	21.1 a	4.0 e	24.1 bc	43.3 bcd	69.2 abc	12.8 a
21.5	21.6 a	7.3 bcde	27.8 a	28.3 b	54.2 c	5.1 cd

[z]Mean separation within columns by LSD test, 5% level.

cedure for obtaining rapid, uniform freesia seedlings. Starting germination at 15.5° under CP then increasing to 18.5° when emergence begins may give similar results.

Literature Cited

1. _____ . Growing freesias from Van Staaveren's freesia seed. Van Staaveren, Aalsmeer, Holland.
2. _____ . Instructions for the culture of seed freesia. Van Staaveren, Aalsmeer, Holland.
3. Ball, V. 1972. Freesia. p. 330. *In* Vic Ball, Ball red book, 12th ed. West Chicago, Ill.
4. Hartman, H. T., and D. E. Kester. 1968. Propagation of selected annuals and herbaceous perennials used as ornamentals. p. 671. *In* H. T. Hartman and D. E. Kester, Plant propagation principles and practices, 2nd ed. Prentice-Hall, Englewood Cliffs, N.J.
5. Heide, O. M. 1965. Factors controlling flowering in seed-raised freesia plants. *J. Hort. Sci.* 40:267-84.
6. Heydecker, Walter, and Celia Morris. 1976. Throwing light on notoriety. *Gard Chron.* 179(3):34-36.
7. Scennels, N. J. 1951. Rules for sowing. p. 16-31. *In* N. J. Scennels, Freesia. J. E. Ohlsens Enke, Publ., Copenhagen, Denmark.
8. Steel, R. G. D. and J. H. Torrie. 1960. Testing the hypothesis of equality of variance. p. 82-83. *In* R. G. D. Steel and J. H. Torrie, Principles and procedures of statistics. McGraw-Hill, New York.
9. Whitehead, G. 1956. Freesias from seed. *Gard. Illus.* p. 389.

HortScience. 12(6):573–574. 1977.

Comparison of Chrysanthemum Growth in Pine Bark or Commercial Soilless Mixes[1]

Steven M. Still[2]

Department of Horticulture and Forestry, Kansas State University, Manhattan, KS 66506

Additional index words. Chrysanthemum morifolium, growth media

Abstract. **Growth of *Chrysanthemum morifolium* Ramat was evaluated in ground pine bark:sand mixes; a soil:peat:perlite mix; and commercially mixed media. Flowering stem:dry weight of plants grown in bark:sand (3:1 or 2:1, by volume) were comparable to commercial mixes but 100% pine bark or soil:peat:perlite significantly reduced plant height and flowering stem dry weight.**

Commercial growers of pot plants have traditionally used soil and peat moss combined with a neutral aggregate such as sand, perlite, or vermiculite. The diminishing supply of peat (5) and the cost of locating and processing soil have recently directed growers toward alternative potting mixes. A 1973 survey (6) indicated the average cost for the grower preparing 1 m^3 of soil was \$43 (\$33/yd^3). Many commercial soilless mixes are available which contain peat, vermiculite, or bark (6). These mixes are sterile, uniformly mixed, and can be obtained in 0.084m^3 (3 ft^3) bags which can be easily stored. However, present costs of \$44 (\$34/yd^3) to \$61 per m^3 (\$47/yd^3) in bulk quantities has been a deterrent to grower acceptance. An alternative to the above group of media is for the grower to blend ground pine bark sand. This medium would require

[1]Received for publication
Contribution No. 597-j Department of Horticulture and Forestry, Agricultural Experiment Station, Kansas State University, Manhattan, KS 66506.

[2]Research Horticulturist, Ornamentals.

The author gratefully acknowledges the donation of plant material by Yoder Bros., Barberton, Ohio.