Some Aspects of Hemerocallis Seed Germination[1]

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The following is the first of what is hoped to be a series of papers dealing with various scientific aspects of *Hemerocallis* culture. The experimental work described in the present paper, as well as work to be reported on in subsequent articles, was begun in the autumn of 1952 with the purpose of obtaining subject matter for a doctoral dissertation. The investigations were carried out in the botany laboratories, greenhouses and gardens of the University of Chicago, under the direction of Professor Paul D. Voth.

This paper is concerned chiefly with the nature of seed dormancy in *Hemerocallis* and considers the influence of temperature in the natural breaking of such dormancy.

Seed dormancy has been the object of much research during the present century. Although a great deal has been learned about the subject, there is much that still awaits explanation. Unfortunately it is not possible to include a detailed description of the general subject of seed dormancy at this time, therefore, suffice it to say, that dormancy in the broad sense of the term might be the consequence of any of the following:

1. Immature embryo
2. Improper internal (chemical) environment resulting from the presence or lack of some particular substance
3. Seed coat and possibly other enveloping layers acting as a barrier against passage of water and/or oxygen
4. Seed coat and possibly other layers acting as a mechanical hindrance to germination

As well as moisture, oxygen, and in some cases light, proper temperature conditions are likewise a necessary prerequisite for germination. Aside from the direct role of temperature in controlling rates of biochemical reactions accompanying germination, temperature often indirectly influences the process through its action on seed coat destruction.

TEMPERATURE AND GERMINATION OF FRESHLY HARVESTED SEEDS—Normally, if Hemerocallis seeds are planted immediately or following several months of dry storage at room temperature, emergence is slow and sporadic. Essentially the same pattern of germination prevails if fully saturated seeds are placed between sheets of moist paper toweling or on the surface or moistened filter paper in glass laboratory containers (petri dishes). It was soon learned that rate of germination under these conditions (no pretreatment) was greatly influenced by temperature.

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Data of two separate experiments concerning the relation of temperature and germination are summarized in Tables I and II.

Table I: Emergence of Seedlings in Soil (24 days after sowing). Parentage of Seeds—DOLLY VARDEN X DOMINION (100 seeds/lot).

	50-60° F	70-75° F.	85-90° F.
% Emergence	0	9	76

Table II: Germination in Petri Dishes (after 30 days). Parentage of Seeds—Hybrid Mixture 1 (63 seeds/lot).

	50-55° F.	60-65° F.	70-75° F.	80-85° F.	90-95° F.	95-100° F.
% Germination	0	6.4	47.6	77.8	36.5	0

It was next decided to investigate the role of the seed coat in dormancy. Quite surprisingly it was found that following removal of the seed coat, germination was generally quite rapid and occurred over a greater range of temperature conditions. Combined results of two different experiments are contained in Table III.

Table III: Germination in Petri Dishes (after 7 days). Parentage of Seeds—Hybrid Mixtures Nos. 1 and 2.

	50-55° F.		60-65° F.		70-75° F.	
Seeds/lot	Intact 100	Peeled 75	Intact 100	Peeled 75	Intact 100	Peeled 75
% Germination	0	0	2	44	28	96

	80-85° F.		90-95° F.	
Seeds/lot	Intact 100	Peeled 75	Intact 100	Peeled 75
% Germination	20	89	0	23

Differential peeling experiments have shown that only the portion of the seed coat covering the slightly protruding tip of the embryo need be removed in order to bring about germination while removal of portions of the seed coat other than at this site has little or not effect on the rate of germination.

The first peeling experiments performed, were at times slightly erratic. Thus, in some cases germination of peeled seeds was less than one-hundred percent even though kept at the optimum temperature. Upon close inspection of such quiescent seeds it was observed that in all cases there was a thin, transparent and tight-fitting membrane covering the tip of the protruding embryo. When this membrane, the nature of which is presently under investigation, was removed germination invariably followed within one to three days. In one instance, thirty-four out of two-hundred

and fifty peeled seeds had failed to germinate during the course of two months. At the end of this period the transparent membrane was removed from the tip of each of the remaining seeds and within three days, thirty-one of them had germinated, the last three sprouting a few days later. Apparently then, it is not so much the relatively thick and hard black seed coat that ordinarily inhibits germination, but rather the delicate membrane located just internal to it. Undoubtedly the increased rate of germination obtained in the early experiments was due to damaging the membrane unwittingly during the peeling operation. Subsequent experiments have indicated that the inhibitory effect of the membrane is probably the consequence of its low permeability to oxygen rather than of its chemical or mechanical properties.

INFLUENCE OF TEMPERATURE IN NATURAL BREAKING OF DORMANCY—According to common horticultural practice, Hemerocallis seeds are usually sown outdoors in late autumn. Such seeds lay dormant until spring at which time they normally germinate very rapidly. In view of this natural pattern of germination, experiments were designed to determine the relation of intensity and duration of cold treatments on subsequent germination. Although these experiments are still in progress some data have already been collected and appear in Table IV.

Table IV: Effect of Duration and Intensity of Cold Treatment of Saturated Seeds on Subsequent Germination in Petri Dishes (% germination after 8 days at 70-75°F). Parentage of Seeds—Hybrid Mixtures Nos. 1 and 2.

		Temperature of Cold Treatment			
		28° F.	38° F.	50° F.	No. of Seeds
Duration (weeks) of Cold Treatment	0	23%	23%	23%	100
	2	—	83%	25%	40
	4	21%	93%	48%	63

It will be noted from Table IV that cold treatments at 38° F. and 50° F. have a stimulatory effect on germination and that this effect increases with time. Furthermore, it can be seen that cold treatment at 38° F. is considerably more effective than at 50° F. Although, results are at present still somewhat inclusive it might well be that storage of fully-imbibed seeds at temperatures considerably below freezing has an inhibitory rather than stimulatory effect on subsequent germination. Effort is presently being made to determine the nature of the response to cold treatments. Apparently cold treatment does not act through mechanical deterioration of the seed coat alone since it has been found that germination of seeds which are peeled subsequent to the treatment differs from that of the non-treated control seeds.

Table V: Germination in Petri Dishes (after 8 days) With and Without a Two Weeks Cold Treatment (38° F.). Parentage of Seeds—Hybrid Mixture 2, (25 seeds/lot).

	50° F.		60° F.		70° F.	
	Cold	Control	Cold	Control	Cold	Control
% Germination	20	0	96	52	100	100

	80° F.		90° F.	
	Cold	Control	Cold	Control
% Germination	100	76	80	24

As the data comprising Table V suggest, cold-treated seeds germinate over a greater range of temperature conditions than non-treated control seeds. As would be expected, the laboratory data fit in nicely with the situation prevailing under natural conditions whereby freshly-sown seeds do not ordinarily germinate well in autumn (unless the temperature is exceptionally high for at least several days in succession) but, do germinate readily in spring though the daily average temperature might be quite low.

CONCLUSION—Since the present paper is actually little more than a progress report on the study of dormancy and germination in Hemerocallis, it does not seem proper to outline definite procedures for practical application at this time. Certain experimental results as reported at this time, however, do suggest methods which might be of specific value to the hybridizer, who, of course is always extremely interested in shortening the period from pollination to flowering. It should be mentioned in this regard that many of the beautiful red seedlings seen at the David F. Hall Gardens in 1953 were the consequence of Mr. Hall's efforts in peeling the particular crop of seeds giving rise to them.—Wasted labor? No, true vision indeed!

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