Germination of Freshly Harvested Seed of Some Western Range Species

HORTON M. LAUDE

Associate Professor, Department of Agronomy, University of California, Davis, California

The germination of seed and the emergence of seedlings from the soil are primary considerations for the rancher, whether in regard to the reseeding of desirable plants or the control of unwanted species.

Of the several aspects of germination, the retention of seed viability with considerable age (longevity) has been rather extensively studied. It is generally understood that after several years of storage viability declines, the rate of this decline being mainly a function of the species and of storage conditions.

The effect of stage of seed maturity at harvest has likewise received attention (McAlister, 1943; and Hermann and Hermann, 1939). This is of considerable importance in many grasses since parts of the inflorescence may ripen at different times, causing the seed obtained at harvest to vary in maturity. Selection of harvest date becomes a matter of timing to avoid both excess shattering and immaturity, yet to place the bulk of the seed at the desired stage of development.

A further aspect of germination and the one primarily considered by this paper is that transient period of delayed germination or dormancy commonly encountered in many freshly harvested seeds. Harrington (1923) discussed this problem with winter wheat, and Coffman and Stanton (1938) noted delayed germination in varieties of cultivated oats. Such dormancy has been reported in freshly harvested seed of numerous cultivated grasses including certain bluegrasses and orchardgrass (Sprague, 1940), ryegrass (Anderson, 1947), timothy (Toole, 1939), and crested wheatgrass (Hermann and Hermann, 1939). In the majority of these reports, however, the delayed germination did not persist long enough to interfere with stand establishment during the first normal planting period following seed harvest.

There is evidence in certain range and pasture species that dormancy of fresh seed more frequently may persist long enough to interfere with good emergence rates during the first planting season following harvest. Coukos (1944) noted such dormancy in big and little bluestem, Indiangrass, and some collections of sideoats grama. He stated, "Of the several peculiarities of native grass seeds, the character of dormancy is primary in influencing stand establishment." Dawson and Heinrichs (1952) reported difficulty in establishing stands of green stipagrass due to poor germinability of the seed. They noted that the freshly harvested seed seldom germinated over 20 percent and often as low as 2 percent. In the case of the wild oat, *Avena fatua*, Toole and Coffman (1940) found that average germination of seed when tested approximately 10 days after collection was 13.8 percent and that after 9 to 11 months storage this germination had increased to 64.5 percent.

It is well to note that complete germination at the first opportunity of all seed sown may not be, in many instances, the desired behavior for a range plant. Likewise, for a given species the degree of dormancy in freshly harvested seed may vary from year to year and even from different locations of harvest the same year. Still, species which exhibit dormancy in seed just harvested warrant study for this characteristic for it may influence the management and handling of the plant.

Delayed germination can affect emergence from seedings made while this dormancy persists and thus can contribute to poor stands and to the labeling of a species as hard-to-establish. It may influence germination tests such as are run on seed entering commercial channels. Low germination, as found in recently harvested seed, should be distinguished from low viability in seed due to excessive age, for the former condition need not necessarily signify low quality seed, it being a temporary condition. Furthermore, delayed germination relates to aspects of weed

control in that the time of germination of any undesirable seed crop is a factor in combating the unwanted plant.

The current studies were initiated when difficulty was encountered in obtaining satisfactory germination of freshly harvested seed of certain range species being employed in laboratory investigations. This paper reports on the dormancy of freshly harvested seed in species previously studied little or not at all for this characteristic.

Methods and Procedure

In earlier work (Laude, 1951), treatments to improve stands of smilo grass (*Oryzopsis miliacea*) were studied. Emergence of greenhouse plantings of the seed lots used in that investigation suggested that poor stands might be associated with the use of recently harvested seed. To clarify this observation, freshly harvested seed of smilo was germinated both immediately after stripping from the parent plants and following intervals of laboratory storage. Since smilo does not shatter readily in the field, seed was taken from the plants periodically between late June and early November. The seed crop at Davis normally is considered mature near mid-July.

Seed of two sources was used; namely, California certified smilo and a strain provided by the Soil Conservation Service bearing the accession number P-726-CF-N-2. Both exhibited the same behavior relative to dormancy.

The germination tests of smilo were run in a seed germinator at a temperature of 21° to 22°C. One-hundred-seed samples of plump seed were placed in Petri dishes on four layers of paper toweling covered with a filter paper and moistened with tap water. Reported percentages are the average of eight 100-seed samples after a test of 28-day duration. Some gain in germination was obtained by extending the duration of the test. Lengthening the germination period from 28 to 42 days resulted in an average increase in germination of 10.3 percent. However, as this increase was rather uniform among representative seed lots, reliable comparisons could be made using the 28-day test.

Delayed germination was encountered in freshly harvested seed of a number of annuals. Seed of broad-leaf filaree (*Erodium Botrys*) and of the following grasses was collected upon maturity from native stands in California in 1952 and 1953: barb goatgrass (*Aegilops triuncialis*), slender wild oats (*Avena barbata*), wild oats (*A. fatua*), soft chess (*Bromus mollis*), ripgut (*B. rigidus*), red brome (*B. rubens*), downy chess (*B. tectorum*), medusa-head (*Elymus caput-medusae*), foxtail fescue (*Festuca megalura*), Mediterranean barley (*Hordeum hystrix*), mouse barley (*H. leporinum*), and Stebbins barley (*Hordeum stebbinsii*).[1] Seed of each was planted within a few days of collection and at intervals thereafter in a sandy loam soil in the greenhouse under conditions favorable for germination. Unless otherwise noted, the results are expressed as the average percentage of seedlings emerged 28 days after planting, based on 50-seed samples.

The seed was planted leaving attached any adhering glumes or coverings that remained on the seed when it was stripped from the parent plant. Particular care was taken to plant only well-developed, plump caryopses. To insure this, much of the seed was counted out over a lighted ground glass which enabled separation of empty from filled florets by revealing the silhouette of the kernel.

Results and Discussion

Smilo Grass

In 1951, smilo seed was harvested at Davis periodically between June and November, and germination was tested on each lot immediately after harvest and subsequently after periods of laboratory storage. Pronounced dormancy was encountered in all freshly harvested samples except those collected on November 5 (Table 1).

Between September 10 and November 5 a marked change occurred in the physiological condition of the seed remaining on the plants in the field. In some species chilling temperatures hasten the termination of seed dormancy. The increased coolness of autumn probably contributed to the breaking of dormancy of those seeds remaining in the field until November 5. All samples collected earlier and stored in the laboratory displayed similar behavior in regard to possessing extremely low germination at first followed by a gradual increase in germination with storage time.

Those samples harvested upon maturity in July still possessed low germination six months later, a period long enough to extend

[1] *The assistance of Mr. Beecher Crampton, Herbarium Botanist, in collecting and identifying the seed is gratefully acknowledged.*

Table 1. Germination percentages of smilo seed upon harvest and after periods of laboratory storage.

Seed collection date, 1951	Date 28-day germination test commenced									
	1951									1952
	June 26	July 10	July 17	July 24	Aug. 7	Aug. 14	Aug. 28	Sept. 11	Nov. 12	Jan. 17
					%					
June 25	2.5	0.0	—	0.0	2.0	—	—	—	5.9	37.1
July 9		0.0	—	0.0	1.2	—	—	—	—	—
July 16			0.1	—	—	—	—	—	4.2	16.3
July 23				1.0	1.8	—	—	—	—	—
Aug. 13						5.2	—	—	12.2	22.6
Aug. 27							1.1	—	—	25.2
Sept. 10								2.4	—	31.3
Nov. 5									97.6	98.1

Table 2. Seedling emergence from freshly harvested seed of annual grasses planted in greenhouse soil at intervals after collection.

Species	Seed collection date		Dates of planting during year of collection							
			1952 collections				1953 collections			
	1952	1953	June 18	July 11	Aug. 19	Oct. 14	June 13	July 20	Aug. 25	Oct. 15
			Percent emergence, 28 days after planting							
Barb goatgrass	6/24	.....	0*	72	94	100	—	—	—	—
Slender wild oats	6/14	5/28	—	0	—	66	0	0	50	82
Wild oats	6/16	5/15	0	2	—	14	0	—	49	78
Soft chess	6/15	6/12	20	76	—	100	0	80	85	96
Ripgut grass	6/14	5/16	24	86	—	96	0	—	93	—
Red bromegrass	6/14	6/12	2	32	90	100	0	0	50	98
Downy chess	6/14	6/12	0	20	74	94	0	—	29	68
Medusa-head	6/14	.....	6	4	—	92	—	—	—	—
Foxtail fescue	6/14	5/12	2	58	98	98	2	0	78	98
Mediterranean barley	6/14	5/7	20	70	—	98	64	—	96	—
Mouse barley	6/13	5/26	2	78	100	100	2	25	94	—
Stebbins' barley	6/21	5/11	2*	32	62	94	0	—	100	—

*Planted July 3.

beyond any autumn planting made the year of harvest. The importance of this in stand establishment becomes clearer when it is realized that germination percentages obtained in a germinator are generally considerably higher than emergence percentages of the same seed planted in soil. On lots of smilo so compared, the germination percentage in Petri dishes ran as much as 40 percent higher than the seedling emergence from seed planted in soil in the greenhouse.

Greenhouse plantings help to illustrate the problem which may arise from sowing recently harvested seed possessing delayed germination. One such lot of smilo, harvested when mature in 1948, and planted in the greenhouse on the following October 19, November 1, February 1, and March 24, yielded seedling emergence percentages 28 days after each planting of 13.8, 28.8, 30.5 and 50.0 percent respectively. Greenhouse plantings may logically be expected to emerge considerably better than range seedings.

In 1952, fresh seed from the planting studied the previous year as well as that from two additional plantings was evaluated for delayed germination. The results showed the same general pattern of behavior noted in Table 1. However, in 1952 the dormancy commenced to break in late August to early September and by mid-October those seed lots collected in July were averaging 47 percent germination. This illustrates the variation in dormancy of fresh seed from one year to the next. Seed remaining in the field the longest germinated more completely upon harvest, an October 27 collection reaching 95.2 percent.

It appears justified to propose that smilo seed, which retains an exceptionally low germination for as long as eight to ten weeks after harvest, not be sown the year of harvest. In California this would apply to fall seedings following seed harvests of the previous summer. Such a procedure would minimize delayed germination as a factor capable of impairing good stand establishment.

Annuals

Seedling emergence recorded for plantings soon after seed collection and periodically thereafter for

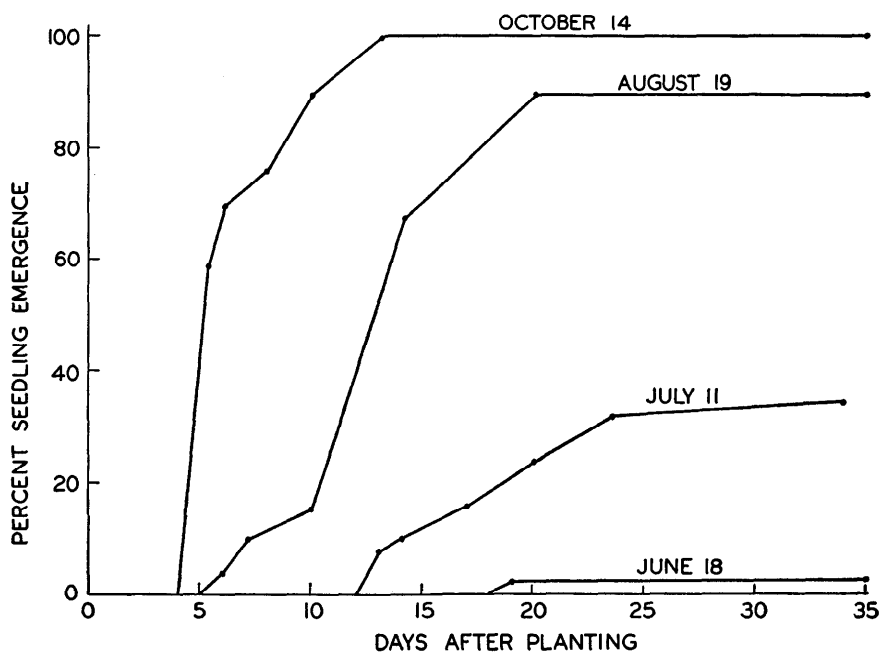

FIGURE 1. Germination of red bromegrass in greenhouse soil. Seed was collected June 14, 1952, and was planted the following June 18, July 11, August 19, and October 14.

twelve annual grasses is presented in Table 2. In all cases the 1953 collections were taken from different locations and on different dates than were those of the previous year. The stage of seed maturity within a collection undoubtedly varied somewhat since seeds stripped from a grass plant may differ in degree of ripeness. These factors aid in explaining the variation in emergence noted between the two years.

A uniform pattern of behavior is apparent. Seedling emergence, and presumably therefore seed germination, increased with greater storage time. Upon collection most species showed delayed germination. By the latter part of August this dormancy was broken in most cases and by mid-October in all except the 1952 wild oat collection.

Not only is dormancy reduced with time after maturity, but complete seedling emergence is more rapid and first emergence occurs sooner after planting (Fig. 1). The total emergence of the June 18 sample plotted in this figure continued to increase slowly with time, and reached 26 percent by late September. Little to no change was recorded for the other plantings with additional time.

Dormancy persisted longer in broad-leaf filaree than in any of the grasses. In a collection planted at intervals over 24 months, first emergence totaling 11 percent was obtained from a seeding made six months after seed maturity, this emergence continuing slowly throughout six weeks. One year after seed collection total emergence was 39 percent and at two years it was 91 percent. The more rapid emergence associated with the breaking of fresh seed dormancy was striking in that maximum emergence was obtained in 10 and 7 days for the one- and two-year-old seed, respectively.

Summary

Dormancy of freshly harvested seed was encountered in smilo grass, broad-leaf filaree and twelve annual grasses.

The duration of delayed germination varied with the species. For a given species it varied both from year to year and among locations of seed production. In the annual grasses studied dormancy of fresh seed persisted from one to five months, decreasing with time after seed maturity. It appears unlikely that seed of these species would germinate in the field during the spring of seed production, but by mid-summer or autumn most could germinate readily.

Certain lots of smilo seed, harvested at Davis when mature in July, possessed sufficient dormancy for six months to impair seedling emergence. As an aid to more rapid stand establishment with this species, it is suggested that smilo seed retaining low germination for eight to ten weeks after harvest not be sown the autumn following harvest. By the second year that dormancy prevailing after harvest would be negligible.

—o—

LITERATURE CITED

ANDERSON, A. M. 1947. The effect of alternating temperatures, light intensities, and moistening agents of the substratum on the germination of freshly harvested seed of Oregon grown ryegrass (*Lolium* spp.). Assoc. Off. Seed Anal. Proc. 37: 152-161.

COFFMAN, F. A. AND T. R. STANTON. 1938. Variability in germination of freshly harvested *Avena*. Jour. Agr. Res. 57: 57-72.

COUKOS, C. J. 1944. Seed dormancy and germination in some native grasses. Jour. Amer. Soc. Agron. 36: 337-345.

DAWSON, M. D. AND D. H. HEINRICHS. 1952. The effects of various germination techniques to overcome dormancy in green stipagrass seed. Scientific Agriculture 32: 266-271.

HARRINGTON, G. T. 1923. Forcing the germination of freshly harvested wheat and other cereals. Jour. Agr. Res. 23: 79-100.

HERMANN, E. M. AND W. HERMANN. 1939. The effect of maturity at time of harvest on certain responses of seed of crested wheatgrass, *Agropyron cristatum* (L) Gaertn. Jour. Amer. Soc. Agron. 31: 876-885.

LAUDE, HORTON M. 1951. Treatments to improve the emergence and stand of smilo grass. Jour. Range Mangt. 4: 88-92.

MCALISTER, D. F. 1943. The effect of maturity on the viability and longevity of the seeds of western range and pasture grasses. Jour. Amer. Soc. Agron. 35: 442-453.

SPRAGUE, V. G. 1940. Germination of freshly harvested seeds of several *Poa* species and of *Dactylis glomerata*. Jour. Amer. Soc. Agron. 32: 715-721.

TOOLE, E. H. 1939. Observations on the germination of freshly harvested Timothy seed. Proc. Int. Seed Test. Assn. 11: 119-139.

———, AND F. A. COFFMAN. 1940. Variations in the dormancy of seeds of the wild oat, *Avena fatua*. Jour. Amer. Soc. Agron. 32: 631-638.

This Society is the youngest in years, the most unique in character and the most democratic in membership of any agricultural scientific society in our beloved country.

It is the *youngest* because since the first society of this kind—the Philadelphia Society for Promoting Agriculture—was founded in 1785, no society for the promotion of range management was formed until 1947 when Joe Pechanec and the others of that small group of founders organized the movement which bears our name.

It is the most *unique* of any agricultural scientific society because it has no counterpart in any other nation or land in the world. The reason for that is that the word "range" has never been translated into any other tongue. There are the steppes of Russia, the veld of Africa, the pampas of Argentina, the pasture of Australia, but none of them mean what "range" means to an American.

It is the most *democratic* because its membership includes a broader group of technicians, grass-roots ranchers and scientists than any other similar organization.—FARRINGTON R. CARPENTER, Toastmaster at the 9th Annual Banquet of the American Society of Range Management.