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Seeds of Bromus Secalinus and Commutatus

Duane Isely
Iowa State College

Seeds of Bromus Secalinus and Commutatus[1]

By DUANE ISELY[2]

Seeds of *Bromus commutatus* Schrad. and *B. secalinus* L. frequently occur together as admixtures in agricultural seed. The latter is designated as noxious by seed laws of a number of states while, with one exception, the former is not. Hence the accurate diagnosis of these seeds becomes a matter of considerable importance to analysts and seed control officials.

In a recent investigation of the seed characters of weedy and cultivated species of *Bromus*, Isely, West, and Pohl, (in press) concluded that the seeds of these species, although frequently confused by seed analysts, could usually be distinguished. They emphasized consideration of the length of the lemma and palea as diagnostic characters in determining the identity of these seeds. However, they pointed out that accuracy of identification would be reduced if the seeds were injured or dehulled during processing.

The present study reports further data on the distinctions between *Bromus secalinus* and *B. commutatus*, and compares the validity of various characters in distinguishing between "problem" seeds.

MATERIALS AND METHODS

Two hundred seeds of each species were studied. These seeds were removed from about 100 agricultural seed samples from different parts of the United States. The identity of all doubtful seeds was verified by growing progeny to maturity. Determinations were made on each seed for the following characters: weight and thickness, flare (degree to which lemma flared out towards the tip), length of the lemma, length of the palea relative to the lemma, length of the awn, curvature of the awn, and curvature of the rachilla. Measurements were made under 15X magnification through the use of an ocular micrometer.

RESULTS

Bromus secalinus seeds average considerably thicker and heavier than those of *B. commutatus*. In attempting to evaluate the consistency of this distinction the seeds were classified in three groups, viz: (1) those which were thick and heavy, the *secalinus* type, (2) those which were by comparison thin and relatively light, the *com-*

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[2]Figures prepared by Mary M. Rehm.

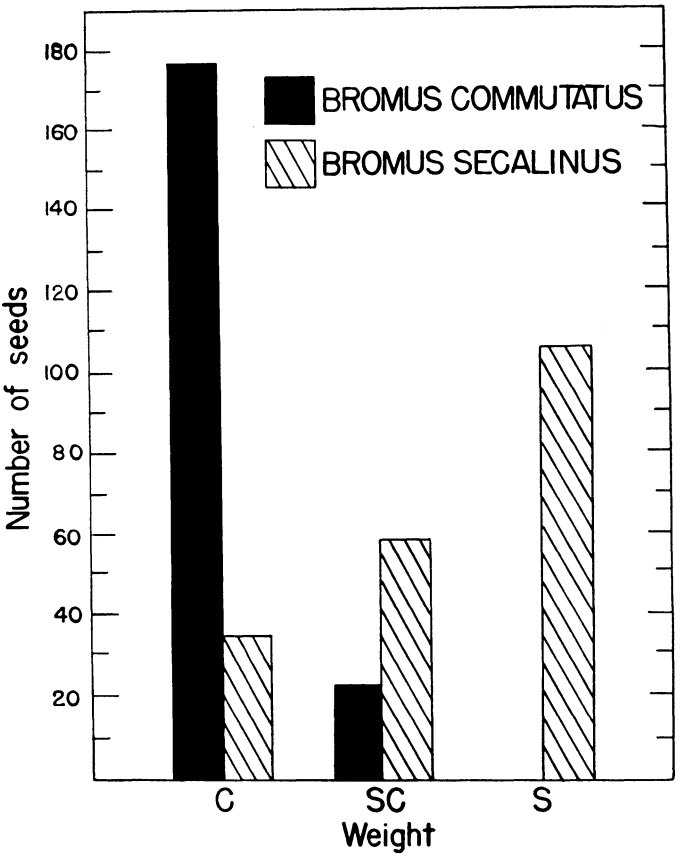

Figure 1. Weight and thickness characteristics of *Bromus secalinus* and *B. commutatus* seeds. C—The thinner, lighter type of seed ordinarily associated by analysts with *B. commutatus*. S—The thicker, heavier type of seed ordinarily associated with *B. secalinus*. SC—Seeds intermediate, not easily associated with either of the two extremes.

mutatus type, and (3) those which are intermediate, and could not be readily associated with either of the two types. The results are tabulated in figure No. 1. It is to be noted that if the seeds were thick and heavy they were always of *B. secalinus*, but the intergrade and light specimens included seeds of both species.[1]

Casual observation readily indicates that seeds of *Bromus commutatus* tend to flare at the apex, and thus appear wider than those of *B. secalinus* in which the edges of the lemma are usually somewhat inrolled. In order to examine this characteristic, the seeds

[1]On basis of actual weight determinations made on seeds from several seed lots, those of *Bromus secalinus* averaged 0.58 grams and those of *B. commutatus* 0.31 grams per hundred seeds. The range for each species was: *Bromus commutatus* 0.25 to 0.37 grams, and *B. secalinus* 0.39 to 0.75 grams per hundred seeds. This variability is probably due to differences in maturity of seeds; in the case of brome seeds mixed with agricultural seed lots, an additional factor may be selective cleaning processes which remove the lightest or heaviest seeds.

were again divided into three groups, the *secalinus* type, the *commutatus* type, and the intermediate forms. Figure No. 2 verifies the fact that most *B. commutatus* seeds tend to be flared while those of *secalinus* are not, but it is obvious that identifications made on the basis of this character alone would involve a rather large percentage of error.

It is frequently stated that the awn is longer in *Bromus commutatus* than in *B. secalinus*, that it is straight or nearly so in the former, while it has a characteristic curve or "wiggle" near the base in the latter. The tabulation of measurements in figure 3 indicates awn length to be variable although the greater proportion of the seeds of *B. commutatus* are in the range, 4—6 mm. while the majority of

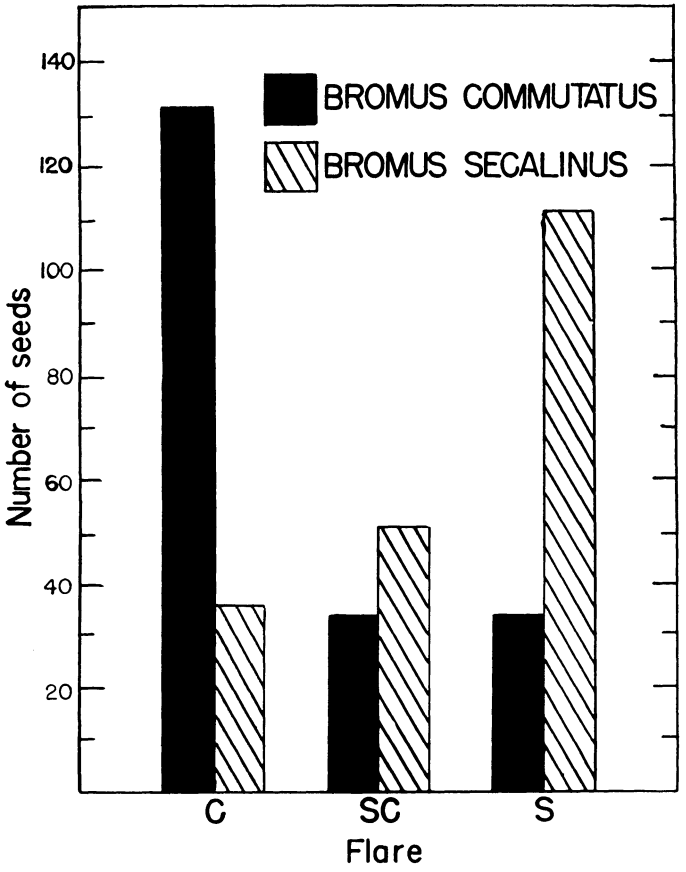

Figure 2. Tendency of seeds of *Bromus secalinus* and *B. commutatus* to flare towards the apex. C—Seeds flared at apex, type ordinarily associated by analysts with *B. commutatus*. S—Seeds not flared at apex, edges contiguous, type ordinarily associated with *B. secalinus*. SC—Seeds intermediate, not readily associated with either extreme.

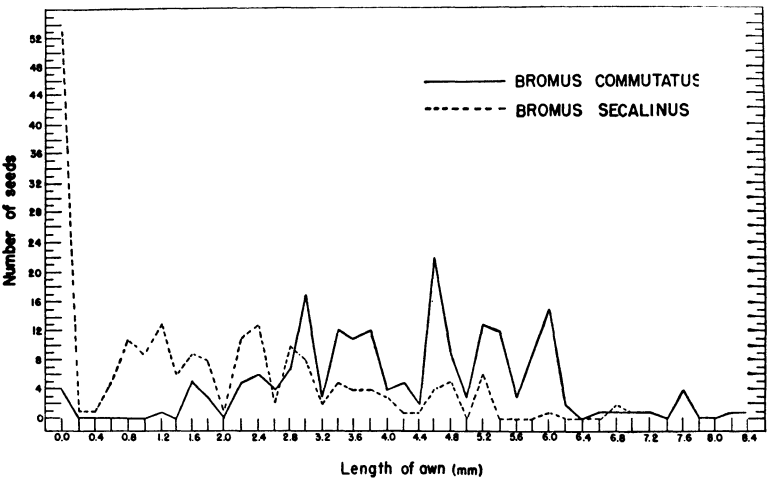

Figure 3. Length of awn in seeds of *Bromus secalinus* and *B. commutatus*.

those of *B. secalinus* are less than 4 mm. in length. Observation of entire spikelets usually reveals that the lower florets (especially in *B. secalinus*) have considerably shorter awns than the upper ones.

It was not possible to prepare an orderly tabulation of the degree of curvature of the awns. Awns in both species may be straight or variously curved. Those of *Bromus secalinus* frequently, but not invariably, do possess an abrupt twist at the base. As far as could be determined there was no difference in the relative thickness and rigidity of the awns in the two species.

Grass specialists usually distinguish between *Bromus secalinus* and *B. commutatus* by the fact that the rachis of mature spikelets is visible externally, while it is hidden from view by the margins of the overlapping lemmas in *B. commutatus*. This suggests that rachilla position with reference to the lemma and palea might be an aid in distinguishing the seeds. However, rachilla position in both species proved so variable that attempts to prepare an orderly tabulation proved futile; it was evident that this character had little taxonomic value inasfar as the seeds were concerned. Probably, this was in part due to immaturity of many of the seeds, but the taxonomic value of this character, as currently used, may also be open to question.

Seeds of *Bromus commutatus* usually appear somewhat longer than those of *B. secalinus*. Measurements of lemma length—exclusive of the awn—tabulated in figure 4, verify this fact. However, length is not diagnostic for all individual seeds.

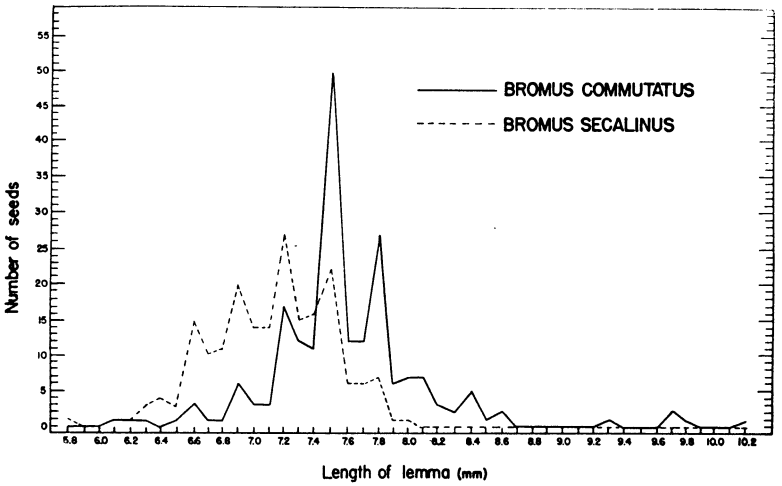

Figure 4. Length of lemma in seeds of *Bromus secalinus* and *B. commutatus.*

Figure 5 tabulates the length of the palea in relation to the lemma. The palea is subequal to the lemma or slightly shorter in *Bromus secalinus,* while it tends to be distinctly shorter in *Bromus commutatus.*

Data relative to palea and lemma length are portrayed simultaneously in figure 6. This figure is based on a scatter-diagram with a dot representing the proper position of each specimen on the basis

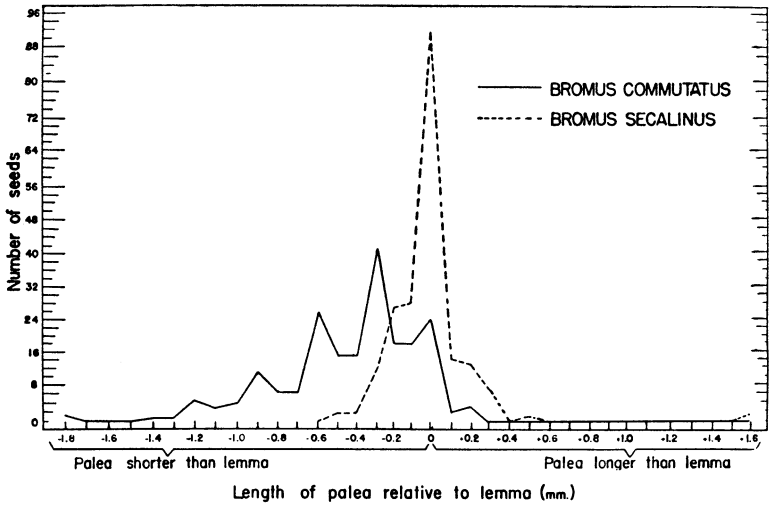

Figure 5. Length of palea relative to lemma in *Bromus secalinus* and *B. commutatus.* Plus figures indicate extent to which palea is longer than lemma; minus figures indicate extent to which palea is shorter than lemma.

of length of its palea and lemma. While the size of the figure does not allow reproduction of the individual dots, it does clearly portray the differential variability exhibited by *Bromus secalinus* and *B. commutatus* with regard to these characters. It is to be noted that any attempt to divide the distributional area into two parts on the basis of lemma length by drawing a horizontal line (A), or on the basis of palea length, a vertical line (B), will not accurately separate the *B. secalinus* and *commutatus* portions of the area. However, the proportion of misdeterminations can be reduced if the separation is made on the basis of the oblique line, (C).

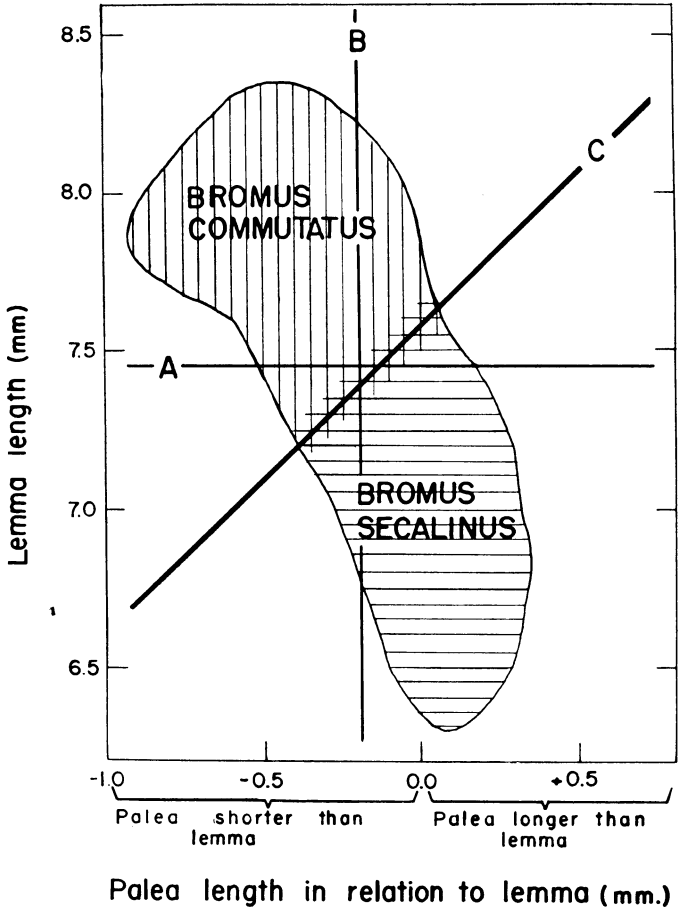

Figure 6. Relation of lemma length and comparative lemma-palea length in *Bromus secalinus* and *B. commutatus* (adapted from a scatter-diagram). Line A—Separation between *Bromus secalinus* and *B. commutatus* at point of minimum error on basis of lemma length. Line B—Separation between *B. secalinus* and *B. commutatus* at point of minimum error on basis of palea length in relation to lemma. Line C—Separation between *B. secalinus* and *B. commutatus* at point of minimum error on basis of both lemma length and lemma-palea relationship.

Discussion

"Typical" seeds of *Bromus secalinus* and *commutatus* differ from one another in a number of aspects and can be easily recognized. Intermediate seeds are frequently difficult to definitely associate with either species. The intermediate appearance of such seeds is frequently the result of immaturity—especially those of *B. secalinus* may resemble *B. commutatus*—but in some cases appears to be genetical in nature.

The data reported give an index to the degree of reliability of various characters in which seeds of these two species differ from one another. Inasmuch as the experimental material was drawn from a wide variety of sources, it probably gives a fairly complete picture of the range of variability of seeds of the two species as they exist in the United States. However, the averages might not hold true for seed coming from specific local areas.

Determinations made on the basis of any of the characters studied will involve a certain percentage of error. This error will be reduced to a minimum if determinations are made at the point where the least amount of overlapping occurs. For instance, in regard to lemma length, the lowest proportion of error will be obtained if all seeds 7.4 mm. or less in length are considered to be *B. secalinus*, and those 7.5 and above as *B. commutatus*. A comparison of the percentage of error in such determinations may indicate the relative dependability of identification made on various characters or combinations of characters. These are, from highest to lowest diagnostic value: (1) lemma length, relative palea-lemma length and weight, (2) lemma length and relative palea-lemma length, (3) relative palea-lemma length, (4) weight, (5) awn length, (6) lemma length, (7) flare, (8) awn curvature and (9) rachilla position.[1]

The highest proportion of accurate determinations can be made through simultaneous consideration of lemma length, relative palea-lemma length, and weight. Weight contributes to this combination in that all thick, heavy seeds are *Bromus secalinus*. The combination of lemma, and relative palea-lemma length is considerably more accurate than either one of the two considered separately. The key to this is in the oblique line (C) drawn in figure 6. This indicates that lemma and palea length do not vary entirely independently, but that the length of the palea in relation to the lemma is to some extent dependent upon the total length of the lemma (or *vice versa*). From the practical standpoint, for instance, one finds that a large seed of

[1]Percentage error figures are not reported since they have validity only for a mixture of equal amounts of *Bromus secalinus* and *commutatus*. However, the sequence of dependability of various characters as given above will not be modified by the proportion of seeds of the species in a given mixture.

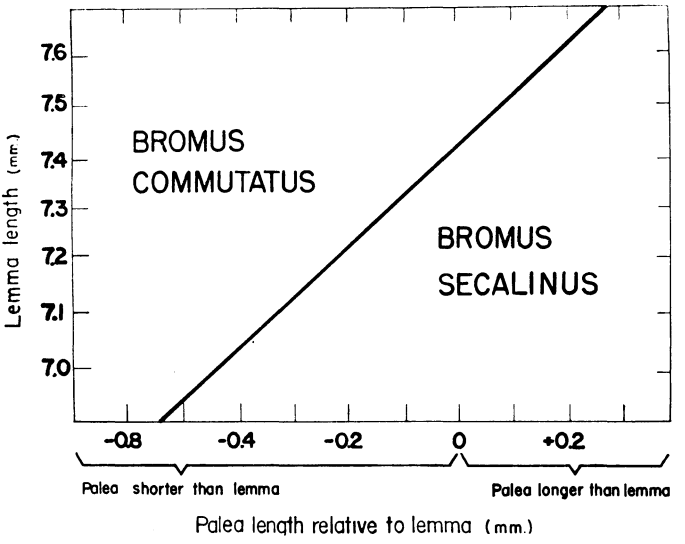

Figure 7. Chart for distinguishing seeds of *Bomus secalinus* and *B. commutatus* on basis of length of lemma and palea. If locus of lemma and lemma-palea length lies above diagonal line, seed is *B. commutatus;* if below, it is *B. secalinus.*

Bromus commutatus is more likely to have a palea equal to the lemma in length than a small seed.

Figure 7, adapted from data presented in figure 6, should be helpful in standardizing the identification of *Bromus secalinus* and *B. commutatus* seeds. Accurate identification of most seeds of either of these species can be made through use of this chart, and seeds of suspected hybrid origin can be associated with the species they most closely resemble.

Seed analysts will encounter difficulty with seeds of bromes in commercial seed (1) which have the awn and the tip of the lemma and palea destroyed, (2) which have been graded as to size, (3) which are dehulled. The first alternative is the most frequent. Determinations may have to be made on the basis of the weight of the seeds, and degree of flare, but length of the lemma and palea can frequently be estimated. It is wise to compare injured seed with uninjured seed from the same sample. It should also be borne in mind that destruction of the tip of the lemma is more frequent in *Bromus commutatus* than in *B. secalinus* since the lemma ordinarily protrudes further beyond the apex of the grain in the former. In reference to alternative "2," most frequently encountered in fescues and orchard grass, proper identification is ordinarily not too difficult if the tips of the seeds are intact; if these are destroyed, however, analysts may easily confuse small seeds of *B. commutatus* with

B. secalinus. In reference to dehulled seeds, those of mature *B. secalinus* can be readily identified by their thickness. Thinner grains may be either *B. commutatus* or immature *secalinus*, and accurate identification cannot always be made. Frequently there is a thickened flange along the edge of *B. secalinus* grains which does not exist in *B. commutatus*, and the degree of flare of the grain towards the tip is sometimes helpful. Further circumstantial evidence as to the identity of hulled seeds may often be obtained from unhulled seeds occurring in the same sample.

Summary

Seeds of *Bromus secalinus* and *B. commutatus* may be most accurately distinguished through differential palea-lemma length relationships. The chart in figure 7 is recommended as the basis for identifications. Thick, heavy seeds are always those of *B. secalinus*, but lighter seeds may represent either species. The flare of the seed toward the apex, and the nature of the awn are valuable as corroboratory characters, and may serve as the principal basis of identification of injured seeds.

Literature Cited

Isely, Duane, D. W. West, and R. W. Pohl. Seeds of agricultural and weedy *Bromus* spp. In press. Iowa State Coll. Jour. Sci.

Department of Botany
Iowa State College
Ames