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SOME OBSERVATIONS ON THE MORPHOLOGY AND GERMINATION OF *Bromus secalinus* L. CARYOPSIS

Mihaela Ioana GEORGESCU[1], Nicolae IONESCU[2], Aurelian PENESCU[1], Florentina Cezarina VRABIE[1], Elena SĂVULESCU[1], Vasilica LUCHIAN[1], Vlad Ioan POPA[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, 011464, Bucharest, Romania
[2]Agricultural Research and Development Station Pitesti, 5 Pitesti-Slatina Road, Pitesti, Romania

Corresponding author email: mihaelaigeorgescu@yahoo.com

Abstract

The morphological features and aspects of the germination process of the caryopsis of a Bromus secalinus population out of a wheat field from Pitesti Research Station were studied. The average value of the lemma - 8.11 mm distributes this population in the lemma long-sized group and the length of the dorsal awn - 4.85 mm on average and their appearance, allocate this population to var. secalinus, f. elongatus. At different moments of the germination process, on the surface of the coleorhiza hairs were noticed. The germination rate of seeds of Bromus secalinus is strongly stimulated by the presence of Triticum durum caryopsis while Brassica napus seeds reduce the number of Bromus germinated caryopsis.

Key words*: Bromus secalinus, caryopsis, coleorhiza hairs, germination process, Pitesti Station population.*

INTRODUCTION

Bromus secalinus has its origin in the Mediterranean region of Eurasia (Ciocârlan, 2009). In Romania, it can be sporadically find in grain fields, meadows, wasteland, field borders, and roadsides from oak woodland zone to beech forest belt. Calcifuge species (Ciocârlan & Chirilă, 1982), *Bromus secalinus* prefer slightly acidic soils with pH ranging from 5.5 to 7.5 (Rzymowska et al., 2010) and a cool climate with rainfall during the year (Anghel et al., 1972). Beeing in regress at some point, in Europe their populations were considered becoming even endangered (Warcholińska in 1981 regarded this species like rare among cereals).

The increasing incidence of the species as a weed in crops is due to the reduced soil tillage (Szymankiewicz et al., 2003) which allows access of the seeds to the light: a large percentage of seeds germination was reported in the case of germination experiments with diaspores placed on the soil surfaces or at the 1.5 cm depth (Cussans et al., 1994; Adamczewski et al., 2015).

The germination ability of the seed decreases with age and it is limited to 1-2 years (Kapeluszny & Haliniarz, 2007).

A plant can produce up to 1400 caryopses (Ciocârlan et al., 2004). These are closely wrapped in paleas; lemma, strongly inrolled at maturity, of 6-9 (11) mm length, minutely bifid at apex is provided with a rudimentary awn or of variable length (4-9 mm) or sometimes it may be missing (Häfliger & Scholz, 1981). Some of caryopsis physical features, namely width, thickness and density of the seeds were used in the separation of *Bromus secalinus* from wheat caryopsis (Hauhouot-O'Hara et al., 2000).

Morphological variability reflects the genetic variance of a species and the ability of their populations to adapt to local environmental conditions (Ionescu et al., 2017; Ionescu et al., 2018). Ecological factors such as soil humidity and trophicity can influence the phenotypic characteristics of *Bromus secalinus* populations through seed storage proteins (Skrajna et al., 2012); also, the crop plants can affect the fertility rate of the *Bromus secalinus* seeds (Rzymowska et al., 2010).

The influence of local environmental conditions on the morphological characteristics and the germination process of the caryopsis of *Bromus secalinus* population from Pitești Station together with some crop plants was targeted in this investigation.

MATERIALS AND METHODS

Morphological observations and those on germination were carried on caryopsis collected in 2016 from a *B. secalinus* populations found in a durum wheat field from Agricultural Research and Development Station - Pitești (Argeș County).

The climate of the area is characterised by an average of the annual precipitation of 700 mm. The soil is of albic luvisols type with a low value of pH (around 5) and a small content of organic substances (total C = 2%); the level of NPK macro-elements is reduced, and aluminium ions are present in the soil solution.

The measurements were made on 100 caryopses collected from the low part of spikelets (usually, the second floret from bottom) (Stace, 2011). A stereomicroscope type S8APO, equipped with a video camera Leica DFC 295 and a SEM FEI Inspect S50 were used to reveal the specific morphological and micromorphological features of the *B. secalinus* population.

In order to observe the behaviour of B. secalinus as well as those of crop plants during the germination process in cases of dense populations of *Bromus secalinus* caryopsis, germination variants were selected based on a 2:1 ratio.

Germination experiments were conducted in the subsequent configurations:

- control variant - 20 caryopsis of *B. secalinus*;
- variant I - 40 caryopsis of *B. secalinus* and 20 of *Triticum durum*;
- variant II - 40 caryopsis of *B. secalinus* and 20 seeds of *Brassica napus* subsp. *napus*.

The variants were experimented with 3 separated repetitions each, at one-week intervals, during 12 to 29 March 2018.

22 hours after the sowing, *B. secalinus* caryopsis have been observed and phases of the germination process were noted. The germination rate was noted during 3 days in all 3 variants.

RESULTS AND DISCUSSIONS

The morphology and micromorphology of the caryopsis of *Bromus secalinus* (Pitești population)

Lemmas of the *B. secalinus* - Pitești population are 7-9 mm long (8.11 mm on average; 0.373 - STD) (Table 1). According to different papers (Häfliger & Scholz, 1981; Ciocârlan et al., 2004; Hauhouot-O'Hara et al., 2000), the length of the lemmas ranges from 6 to 9 (11) mm.

Table 1. The morphological characteristics of the *B. secalinus* - Pitești populations lemma and awn

	Length interval (mm)	Average (mm)	STD
Lemma	7 - 9	8.11	0.37
Awn	2 -7.2	4.85	1.33

The average value distributes this population of *B. secalinus* in the lemma long-sized group, so the caryopsis. It is well known that seed size may determine the viability of the seedlings and the vigour of the adult plants (Massimi, 2018).

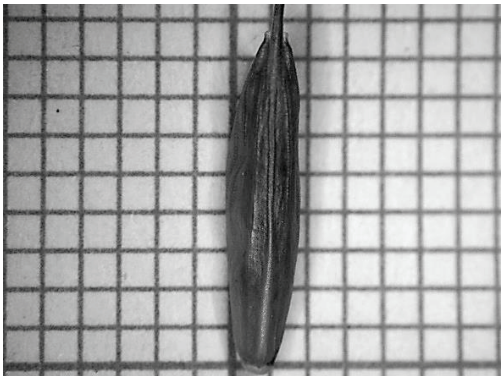

Figure 1. Lemma on dorsal side

The lemma is rounded on dorsal side, 7-veined (Figure 1) and has membranous margins that can be seen from the middle to the upper region (Figure 2).

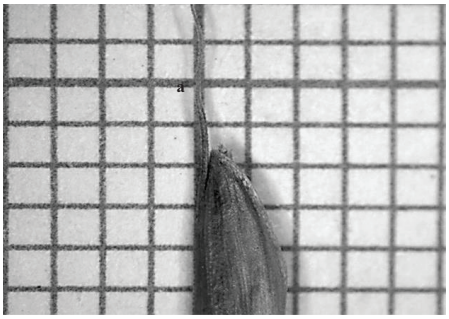

Figure 2. Lemma - margins and apex (a - awn)

At the apex, lemma is minutely bifid and covered with short bristles, similar to those

seen on the awn (Figure 3). The same type of bristle can be discerned at the base of the lemma, above the callus region (Figure 4).
The awn is variable in length, from 2 to 7.2 mm, with 4.85 mm on average (STD = 1.33) (Table 1). It can be straight or slightly flexuous (Figure 2).

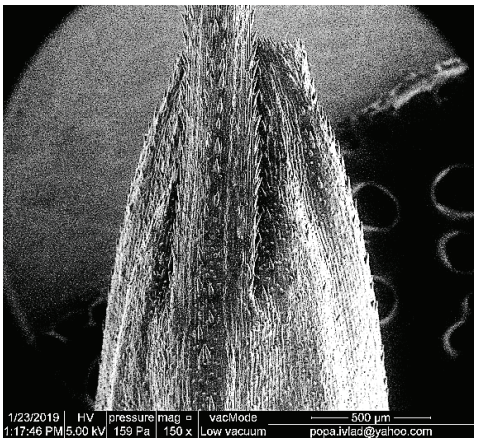

Figure 3. Lemma at the apex

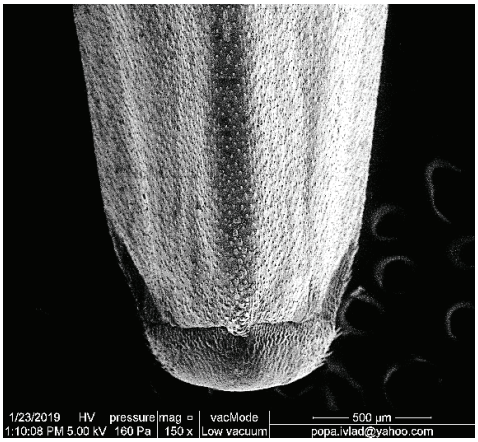

Figure 4. Lemma at the base

According to Flora RSR (Săvulescu, 1972), the length of the dorsal awn and their appearance, allocate this population to var. *secalinus*, f. *elongatus*.
On the ventral side, the caryopsis is protected by a palea almost equalling lemma at the distal end (Figure 5); palea is provided on the edges, from the middle to the base, with stiff bristles (Figure 6).

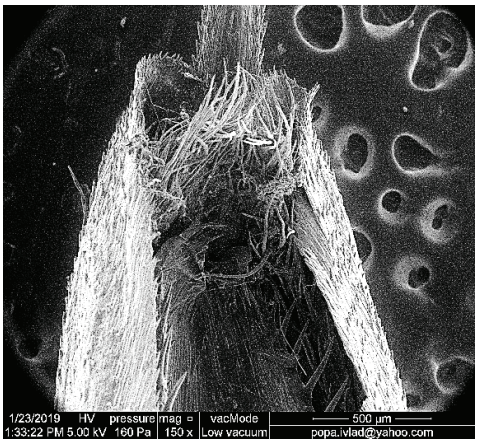

Figure 5. Palea at the distal end

Figure 6. Palea at the base

The germination processes
At 22 hours after sowing, germination was initiated in all three variants. First, the coleorhiza and then the radicle were observed to *B. secalinus* germinated caryopsis.
At different moments of the germination process, on the surface of the coleorhiza hairs were noticed (Figure 7).
The origin and the role of this coleorhiza type, observed in other species, have been discussed in different scientific papers (Nishimura, 1922; Nostrog, 1955; Morita et al., 1990; Debaene-Gill et al., 1994; Chistyakova et al., 2016).
There are no reports on *Bromus* species with this kind of coleorhiza in the reviewed scientific works.

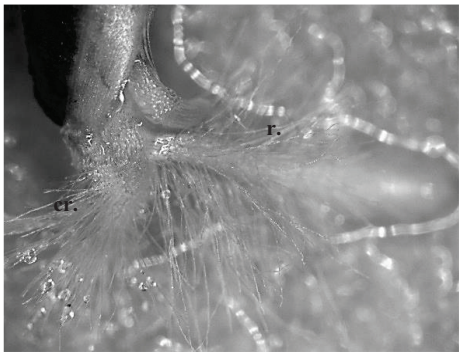

Figure 7. Phase of the germination process;
cr - coleorhiza; r - radicle

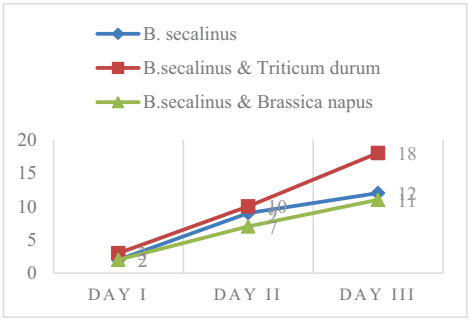

Figure 8. The numbers of *Bromus secalinus* germinated caryopses in three days of experiment
(repetition I: 03. 13 – 03. 15. 2018)

The rate of the germination process was different in the three variants, indicating the presence of allelopathy between germinated seeds. Figures 8-10 shows that the germination of seeds of *B. secalinus* is strongly stimulated by the presence of durum wheat caryopsis while *Brassica napus* seeds reduce the number of *B. secalinus* germinated caryopsis. On the other hand, it can be observed, from the explications below, that the rate of germination of the seeds of *Brassica napus* was not influenced by the presence of *B. secalinus* germinated caryopsis whereas the germination of the caryopsis of *Triticum durum* has been influenced.

On the third day of the first repetition had germinate (Figure 8):

- 12 out of 20 caryopsis of *B. secalinus* in the first variant;
- 18 out of 40 caryopsis of *B. secalinus* as well as 8 out of 20 caryopsis of *Triticum durum* in the second variant;
- 11 out of 40 caryopsis of *B. secalinus* as well as 18 out of 20 seeds of *Brassica napus* in the third variant.

On the second repetition, on the third day, the rate of germination was (Figure 9):

- 14 out of 20 caryopsis of *B. secalinus* in the first variant;
- 25 out of 40 caryopsis of *B. secalinus* as well as 14 out of 20 caryopsis of *Triticum durum* in the second variant;
- 14 out of 40 caryopsis of *B. secalinus* as well as 20 out of 20 seeds of *Brassica napus* in the third variant.

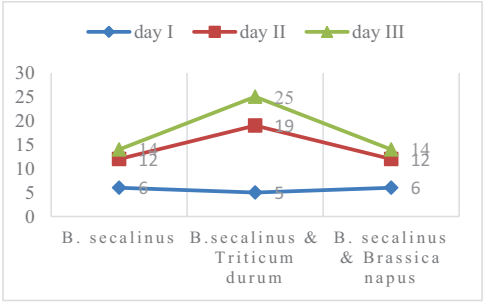

Figure 9. The numbers of *Bromus secalinus* germinated caryopses in three days of experiment
(repetition II: 03. 20- 03. 22. 2018)

On the third day of the last repetition had germinate (Figure 10):

- 16 out of 20 caryopsis of *B. secalinus* in the first variant;
- 25 out of 40 caryopsis of *B. secalinus* as well as 15 out of 20 caryopsis of *Triticum durum* in the second variant;
- 25 out of 40 caryopsis of *B. secalinus* as well as 20 out of 20 seeds of *Brassica napus* in the third variant.

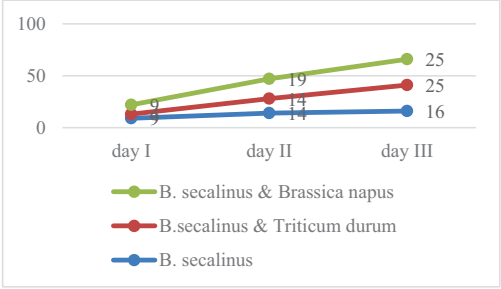

Figure 10. The numbers of *Bromus secalinus* germinated caryopses in three days of experiment
(repetition III: 03. 27- 03. 29. 2018)

The role of this type of experiment is to point out the nature of relationships established between plants in an agricultural biocoenosis; also, it can contribute to an appropriate management practice (Penescu & Ionescu, 2013).

CONCLUSIONS

The soil and climate of the Pitesti Station favoured the development of *Bromus secalinus* populations, the size of their caryopsis being close to the upper limit of the length range.
The populations of *B. secalinus* from Piteşti are included in the var. *secalinus*, f. *elongatus* and form flexible and slightly divergent awns.
B. secalinus is a species with hairy coleorhiza noticed at the beginning of the germination process.
The germination rate of the *B. secalinus* seeds was influenced by the presence of exudates from the root of the plant species grown together.

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