COMMUNICATION

AFTERRIPENING PERIOD OF GRAIN SEEDS IN THE CONDITIONS OF THE MIDDLE PRE-URALS

Nadezhda N. Yarkova*

Plant Growing Department, Federal State Budgetary Educational Institution of Higher Education, Perm State Agro-technological University named after Academician D.N. Pryanishnikov, 23 Petropavlovskaya Str., 614990, Perm, RUSSIA

ISSN 0976-3104

ABSTRACT

By the time when the phase of full (technical) ripeness is reached, the grain of many crops removed from the field usually has reduced seed and technological advantages. The physiological maturity of the grain, at which the seed (high germination) and technological properties become pronounced, occurs only after some time. This period of time is called the after ripening period. The paper presents data on the after ripening period of spring crops under conditions which are typical for Middle Pre-Urals, namely high humidity and reduced temperature during formation and maturation of grains. As a result of three years of research, it was revealed that spring sown cereals form seeds with laboratory germination on sod-podzol medium developed soil that meet the requirements of the sowing standard (92% and higher). The after ripening period duration is more dependent on the weather conditions of a year and the crop.

KEY WORDS
Spring wheat, spring barley, oats, viability and laboratory germination of seeds, afterripening period

Received: 20 Sept 2019
Accepted: 17 Dec 2019
Published: 9 Jan 2020

INTRODUCTION

At first glance, the issue of assessing the seed and grain quality has been resolved yet: grain is dried, sorted and submitted for analysis. However, in regions with high humidity, immediately after harvest seeds are characterized by low germination ability and germinate energy. The period that coincides with the time interval between the onset of physical (harvesting) ripeness in grains and until they reach physiological ripeness is called the after ripening period. At this point, after harvesting crops, a complex of physiological and biochemical processes continues in the grain, laboratory germination and germination energy of seeds in this period of time are at the level of 20 - 70%, and after completion of the after ripening period they increase to sowing conditions (92 - 100%). Also, the quality of gluten improves in commercial wheat grains during ripening. This leads to an increase in the yield of flour during grinding and improvement of baking properties. In oilseeds, oil yield increased during their processing. In the production of malt, high germination of grain is also very important. This complex of processes occurring in grain can be characterized as the conversion of simple substances which are unstable during storage (sugar, amino acids) into complex and more stable storage substances (starch, proteins). In practical work, it is necessary to take into account the duration of the after ripening period in order to correctly evaluate the seed and technological advantages. A long after-ripening period is undesirable from the point of view of storage and processing of grain, but in some cases it plays a positive role. For example, a crop and variety having a long after ripening period are of economic value in areas with wet autumn, as this eliminates the germination of grain standing in ears in rainy weather. Studies show that weather conditions do affect the sowing quality of seeds of spring cereal crops [4, 6], but the value of their laboratory germination ability can be regulated by agro technical methods: mineral nutrition [1, 3, 7], sowing and care methods [2], terms and methods of harvesting and post-harvest processing [5]. The issue on determining the after ripening period duration for modern varieties of cereal crops remains relevant for regions with high humidity during formation and ripening of grain.

MATERIALS AND METHODS

The studies were carried out in the conditions of the Middle Pre-Urals, on sod fine-podzole and heavy loamy medium-cultivated soil of the experimental field belonging to the Perm State Agricultural Academy in 2008 – 2010, where the field experiment was laid according to the following scheme: spring wheat (varieties of *Irgina* and *Krasnoufimskaya* 100), barley (varieties of *Ecolog* and *Fakir*), oats (varieties of *Dens* and *Fakir*). The distribution of options was systematic, using the split plots method, the plot area was 40 m2, and the replication is fourfold. Laboratory studies to determine the sowing qualities of viability and laboratory germination ability were carried out in the Plant Production Department laboratory. The tetrazolium-topographic method was used to determine the seed viability. Laboratory germination was determined from the phase of firm ripe stage (grain moisture of 21% and below), and then with an interval of 4 days in four multiple repetitions.

Agrotechnics in the experiment was generally accepted for early spring cereal crops in the Perm Territory. The preceding crop was a bean-barley mixture for grain. Soil cultivation included: 1) under-winter ploughing in autumn to the depth of the arable layer (20 - 22 cm), prevernal harrowing at spring and pre-sowing cultivation with harrowing in two tracks to a depth of 8 - 10 cm with the onset of physical ripeness of the soil. Fertilizers were applied under pre-sowing cultivation at a dose (NPK)30, the form of fertilizers was diammofoska at (NPK 10:26:26) and ammonium nitrate (N 34). Sowing was carried out during the day

***Corresponding Author**
Email:
nadezhda.yarkova@yandex.ru

IIOAB JOURNAL
ISSN: 0976-3104

after pre-sowing cultivation to a depth of 3-4 cm in an ordinary way with the SSNP-16 seeder. For sowing, varieties differing in early maturity were used: early ripening - *Irgina, Dens*, mid-ripening - *Krasnoufimskaya 100*, *Ecolog*, *Gonar*, and *Fakir*. The seeding rates were optimal for the Perm Territory: spring wheat - 7, barley - 5, oats - 6 million viable seeds per hectare. Crop tending consisted of one treatment with agritox herbicide (2 kg / ha) in the tillering phase. Cleaning was single-phased and carried out in the phase of firm ripe stage.

RESULTS

Meteorological conditions in the years of research were different. The year of 2008 was favorable as to temperature and humidification conditions for the growth and development of spring crops (hydrothermal humidity factor value = 1.5). 2009 was characterized by dry and hot weather in May - June and cool and humid until mid-July (hydrothermal humidity factor value = 1.1). From May to mid-June 2010, favorable conditions were observed for the growth and development of plants (hydrothermal humidity factor value = 1.4), and the period from mid-June to the end of August was characterized by increased air temperature and dry weather (hydrothermal humidity factor value = 0.5), which led to reduction of the forming and ripening phases of grain and reduction of the after ripening period.

As a result of three years of research, it was found that in the conditions of the Middle Pre-Urals, seeds of the spring cereals are formed with a high viability of 93 - 99 % [Table 1]. Also, starting from the firm ripe stage phase, laboratory germination was determined in order to establish the duration of the after ripening period.

Table 1: Viability and laboratory germination ability of seeds of spring crops before and after the after ripening period, %, 2008 – 2010

Crop	Variety	Seed viability, %			Laboratory germination ability, %					
					2008		2009		2010	
		2008	2009	2010	before ripening	after ripening	before ripening	after ripening	before ripening	after ripening
Wheat	*Irgina*	99	97	99	32	98	60	91	46	93
	Kr. 100	99	93	99	37	99	64	87	71	97
Barley	*Ecolog*	97	97	99	10	96	48	90	76	97
	Fakir	99	96	99	12	89	45	95	81	93
Oats	*Dens*	94	94	99	20	87	21	93	52	93
	Fakir	95	95	98	13	89	23	91	58	96

During the years of research, laboratory seed germination ability was different with breakdown by crops. Immediately after harvesting (harvesting was carried out at a firm ripe stage, two out of three wheat seeds had laboratory germination ability higher by 10 - 11% in 2008 and by 12 - 41% in 2009 than barley and oats. In 2010, barley seeds immediately after harvest had the highest laboratory germination (76 - 81%).

After the release of the seeds of cereal crops from a dormant state, all of them had high laboratory germination ability (87 - 99%).

[Table 2] shows data on the duration of the after ripening period for three years of research, which was calculated from the onset of firm ripe stage of the seeds until they reach a laboratory germination ability of not less than 92%. According to the requirements of the state standard, seeds intended for sowing must have a laboratory germination ability of at least 92 % (GOST R 52325-2005). In our studies, the achievement at the laboratory germination ability level of 92% was taken as a criterion that the seeds underwent after ripening and reached full ripeness.

Table 2: The after ripening period, %, 2008 – 2010

Crop	Grade	The after ripening period duration					
		2008		2009		2010	
		date of ripening	days	date of ripening	days	date of ripening	days
Wheat	*Irgina*	15.08-09.09	25	08.29-21.09	23	06.08-27.08	21
	Kr. 100	17.08-09.09	23	09.09-30.09	22	08.08-20.08	12
Wheat average					22		
Barley	*Ecolog*	18.08-19.09	34	04.09-26.09	22	09.08-16.08	7
	Fakir	17.08-19.09	35	09.09-30.09	28	07.08-16.08	9
Barley Average					25		
Oats	*Dens*	11.08 -05.12	117	03.09-14.10	40	04.08-23.08	19
	Fakir	15.08–05.12	113	05.09-14.10	38	06.08-23.08	17
Oats average			115		39		18

IIOAB JOURNAL
ISSN: 0976-3104

The after ripening period duration was counted from the onset of the firm ripe stage of seeds (grain moisture below 21%) to achieve laboratory germination ability that meets the requirements of standard GOST R 52325-2005. As a result of the studies, it was revealed that after ripening depends on the conditions of a year and on the hereditary pattern of the crop. A close inverse correlation was revealed for wheat and barley (r = -0.86 and -0.81, respectively) between the average daily air temperature during grain formation and the duration of the after ripening period; for oats, the relationship between these indicators had medium indicator value (r = -0, 48). A direct and close relationship was noted between the length of the ripening period and the amount of precipitation for oats and barley (r = 0.98), the medium indicator value was obtained for wheat (r = 0.36).

The ripening of seeds was the longest for oats, while it varied from year to year for wheat and barley. In a more humid year of 2008 (hydrothermal humidity factor value for the period of grain formation was 1.5), the after ripening period for membranous crops (barley, oats) was longer than for wheat. For wheat, it averaged 2–4 days, for barley - 34 days, and for oats it was more than three months. In the drier years of 2009 and 2010, this period for barley was reduced to 8 - 25 days, and for oats it was to 18 - 39 days, i.e. was comparable to the after ripening period of wheat. Therefore, the adage that “barley begins to grow when streams flow” can be considered obsolete for modern varieties. Thus, a large variation in the duration of the after ripening period in the years of research was observed for oats and barley, the coefficient of variation (V) was 56 and 53%, and it was less changed for wheat (V = 48%). Probably, this may be due to the heterogeneity of seed quality in these crops.

When comparing the after ripening period by varieties, it was revealed that for earlier ripe varieties (Irgina, Fakir, Dens), the firm ripe stage occurs 2-6 days earlier than in mid-ripening varieties, but the after ripening period is longer. However, when seeds ripen in dry and hot weather, the after ripening period is reduced, especially for membranous crops (barley, oats).

CONCLUSION

Thus, the after ripening period duration depends on the conditions of the year and the hereditary nature of the crop. It was established that the after ripening period of spring wheat seeds is by years of research more consistent and amounted to about 20 days. The conditions of a year affect the after ripening duration for barley and oat seeds; in hot and dry weather (2010), this period was reduced. Knowing the duration of this period, we can say that it is impractical to assess grain quality immediately after harvesting, especially in regions with a lack of sunny warm days, and with high humidity. For example, in the conditions of the Middle Pre-Urals, it is advisable to determine the sowing qualities of spring wheat and barley from November, oats in dry years also from November, and in cold wet years it is better to perform in spring, after preliminary air-thermal heating.

CONFLICT OF INTEREST
There is no conflict of interest.

ACKNOWLEDGEMENTS
None.

FINANCIAL DISCLOSURE
None.

REFERENCES

[1] Voitovich NV, Fokanov AM, Marchenkova LA. [2006] Features of the formation of properties and sowing qualities of grain seeds depending on the conditions of mineral nutrition, Bulletin of the Russian Academy of Agricultural Sciences, 1:38 - 41.
[2] Ivanov VM, Chernukha SL. [2010] Influence of seeding rate and physiologically active substances on productivity, quality of grain and seeds of spring wheat in the Trans-Volga region near to Volgograd city, Agrarian Bulletin of the Urals, 4:74–76.
[3] Kryuchkov A, Shatalov A. [1973] Effect of fertilizers on seed quality. Ural fields, 11:19.
[4] Pospelova LD. [2009] Yield and sowing qualities of barley seeds of the Veresk variety under different weather conditions, Agrarian Bulletin of the Urals, 4:60–61.
[5] Romanov P, Romanova Z. [1973] Dates and methods of harvesting wheat for seeds, Ural fields, 7:25.
[6] Trubnikova LI. [2009] Sowing qualities of seedings of spring soft wheat grown in different climatic zones of the Tyumen region, Agrarian Bulletin of the Urals, 7:66 - 67.
[7] Eliseev SL, Yarkova NN. [2010] Yields and the after ripening period of spring wheat in the Urals, Scientific support for the innovative development of the agro-industrial complex: Collection of scientific articles of the International scientific and practical conference dedicated to the 80th anniversary of the Perm State Agricultural Academy / FSEI HPE Perm State Agricultural Academy, Perm, 271-274.