COMPARISON OF METHODS FOR THE EVALUATION OF VIABILITY OF WHEAT SEEDS MECHANICALLY INJURED

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INTRODUCTION

Increasing mechanization of agriculture (combining, threshing, cleaning, transport) undoubtedly is greatly advantagous, but is also followed by some undesirable effects. Some of them are crop injuries which are particularly hazardous in seed material [1, 3, 6, 11, 13, 18]. The susceptibility to such injuries is among others on the grain structure. According to Strona [17] soft wheat kernels may be damaged up to 50-60%, hard wheats — to 80-90%, rye — to 100% and maize — to 80-95%. The most hazardous are the cases when the whole embryo or its part is broken off or damaged [16]. Injuries to the pericarp and seed coat, resulting in losses in the endosperm lead to a reduction of germination energy and ability (according to Kuperman the germination ability may be reduced up to 30% with increasing percentage of removed endosperm). In addition such seeds are more susceptible to the infection by pathogenic microflora and their sensitivity to unfavorable soil conditions is increased (in case of soil exposed to drying. Differences in germination ability between intact and damaged seeds amounted to 24-40%). The growth, development and overwintering of seedlings orginated from damaged seeds are markedly depressed. Czazow [2] reported that plants from intact and damaged seeds overwintered in 94 and 67 percent, respectively. The presence of damaged seeds in the seed material affects considerable yields reductions. In Kuperman's [9] four year experiments the intact, slightly damaged, and gravely damaged seeds produced yield of 22.6; 15.5 and 8.5 q/ha, respectively. According to Strona [17] damaged seeds reduced yields by 3-3.5 q/ha in winter cereals, and by 6 q/ha in spring cereals.

The results of standard tests on germination ability of mechanically injured seeds carried out under laboratory conditions have not reflected the real sowing value of these seeds when planted in the field [2, 7, 8,

16]. This discrepancy of results indicates that it is necessary to select a method which would make it possible to objectively determine the sowing value of mechanically injured seeds.

MATERIAL AND METHODS

Three methods for the assessment of the sowing value of wheat seeds were compared in the preliminary experiments: 1) The standard method — direct germination for the determination of germination ability, according to PN (Polish Standard)-69/R-65950; 2) The Germ method — the seeds were placed in rolled filter paper and incubated in the dark at a temperature of 20°C for 14 days; 3) The Derlitzky method — the seeds were planted in zinc containers with perforated bottoms, of size 10 × 10 × 10 cm, filled with sterilized sand of 1 mm in diameter. They were covered by a 2 mm layer of coarse-grained sand (1.5-2.5 mm in diameter). The containers were placed in water to ensure good infiltration and were kept in light at 20°C. The seedling vigor was determined after 14 days. In addition, the length of shoots and roots of washed seedlings was measured.

The experiments were conducted on intact and injured seeds of Etoile de Choisy winter wheat harvested in 1973. Four replications with 100 seeds each were applied. The proper experiments were carried out in two succesive years on Grana and Kaukaz winter wheat seeds from 1974 and 1975 harvests. The seeds which had been exposed to varying directions and levels of quasi-static loads were tested with the use of both standard and Derlitzky methods. On the basis of preliminary experiments the size of zinc container was increased to 12 × 12 with height of 14 cm. The undamaged handthreshed seeds were used as the control.

RESULTS

The analysis of preliminary experiments (Table 1) indicated that the standard and Derlitzky methods gave similar results. However, with the standard method the injured seeds used to get molded rendering the appropriate evaluation difficult. Even with replacing the filter paper after determination of germination energy (i.e. after 4 days) a secondary infection took place. The Germ method produced deviating results probably owing to covering the seeds with strips of tomofan which was applied to hamper infection and make the unrolling of paper easier. The purpose of tomofan was also to facilitate the measuring of roots which otherwise used to grow through the paper.

The proper experiments were conducted with the use of both the

Table 1

Results of preliminary experiments

Method	Injured seds			Intact seds		
	viable seds %	shot length cm	root length cm	viable seds %	shot length cm	root length cm
Direct germinatien	61.7			97.1		
Derlitzki's method	60.7	18.7	11.0	97.0	20.6	13.3
Germ's method	46.7			69.0		

standard and Derlitzky methods. The conformity of results obtained with the use of both methods was evidenced by high coefficients of correlations (r = 0.83-0.92) which existed between the seedling vigor and germination ability (Table 3). The precision of both methods wah high (LSD constituted 6.97 and 4.65 percent of the mean for the standard and Derlitzky methods, respectively), but the Derlitzky method was more sensitive, enabling one to discern differences resulting even from small seed injuries. The calculated F value for this method amounted to 100.99, as compared to 46.16 computed in the case of the standard method (Table 2). In addition, the Derlitzky method permits the determination of the shoot and root lengths which differ depending on the levels of quasi-static loads, and show high correlation with the seedling vigor (r = 0.89 and 0.79 for shoots and roots, respectively).

With the use of Derlitzky method the seedlings have to overcome the resistance of the layer of coarse-grained sand covering the seeds. Their ability to do it reflects their strength and soundness. In comparison with the standard method the percentage of normally germinating seeds in this method was lower (86.8 as compared to 89.1%) as well as that of abnormal seedlings (2.3 vs. 4.4%). On the other hand, the number of molded and decayed seeds was markedly increased (from 4.1 to 10.3%). These seeds on petri dishes produced abnormal seedlings, just started to germinate, or did not germinate at all.

Additional information of considerable importance could be obtained on the basis of Kietreiber's [5] investigations by making observations on the germination of seeds placed in rolled filter paper together with soil collected in the field. These observations would make it possible to reveal the influence of pathogenic microflora on the germination ability of mechanically injured seeds. In preliminary experiments along this line the germination ability of injured seeds amounted to 46 and that of intact seeds — to 98 percent.

Table 2

Comparison of calculated F and LSD % from different methods of the assessment of sowing value of winter wheat seeds harvested in 1974 and 1975

Cultivar	Grain arrangement along its axis	1974				1975							
		Date I				Date I				Date III			
		germination ability	Derlitzki's method			germination ability	Derlitzki's method			germination vigor	Derlitzki's method		
			seedling vigor	shoot length cm	rot length cm		seedling vigor	shoot length cm	rot length cm		seedling ability	shoot length cm	rot length cm
Grana	shortest	128.43	33.88	5.65	10.58	1.82	6.99	4.95	11.43	9.43	827.22	8.57	4.88
	medium	69.22	120.71	59.16	8.25	112.91	46.69	39.39	3.73	37.66	34.53	11.58	10.79
	longest	19.07	12.40	7.39	11.00	9.89	32.71	20.69	8.28	75.95	50.53	14.84	21.83
Kaukaz	shortest	75.26	11.57	26.76	14.52	16.63	65.09	64.55	1.25	47.88	34.56	4.47	14.15
	medium	15.44	1.53	1.18	0.71	0.57	80.20	20.42	13.28	9.09	53.96	5.65	6.99
	longest	176.26	194.29	44.56	60.56	31.37	9.37	13.57	0.82	23.98	86.92	9.10	3.36
$\bar{x}$		78.61	80.40	23.95	17.62	28.87	40.17	27.26	6.47	34.00	182.41	8.54	10.34
NRU %		14.51	7.40	4.89	11.56	3.11	3.15	2.51	3.29	3.29	3.39	3.01	3.30

* — Significant at the 0.05 level.
** — Significant at the 0.01 level.

Table 3

Average correlation coefficients between seedling vigor, germination ability, shoot and root length of winter wheat seeds harvested iin 1974 and 1975

Cultiver	Germination ability		Shoot length			Root length		
	I	II	I	II	III	I	II	III
Grana	0.91	0.92	0.81	0.93	0.81	0.80	0.90	0.74
Kaukaz	0.89	0.83	0.87	0.84	0.80	0.80	0.83	0.63

** — Significant at the 0.01 level.

The presented results are in agreement with findings of some authors [4, 11, 12, 16, 17]. These investigators demonstrated the necessity of testing injured seeds for seedling vigour and produced evidence of high correspondence of this trait with field emergence.

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PRÓBA USTALENIA METODYKI OCENY WARTOŚCI SIEWNEJ NASION PSZENICY MECHANICZNIE USZKODZONYCH

Streszczenie

Wzrastające nasilenie mechanizacji rolnictwa prowadzi obecnie do uszkadzania nasion, co jest szczególnie groźne przy materiale siewnym i powoduje zmniejszanie jego zdolności kiełkowania. W prowadzonych badaniach zaistniała konieczność wybrania obiektywnej metody, która pozwoli na ocenę wartości siewnej materiału mechanicznie uszkodzonego.

W badaniach wstępnych stwierdzono, że uszkodzone mechanicznie nosiona kiełkowane na szalkach, w bibule i metodą Germa wykazują dużą skłonność do pleśnienia i wtórnej infekcji, co utrudnia ocenę skiełkowanych nasion. Bardziej obiektywną okazała się metoda Derlitzkiego, dzięki której oprócz możliwości oceny siły wzrostu ogranicza się wtórną infekcję nasion kiełkowanych w utrudnionych warunkach.

Wybór metody potwierdziły doświadczenia przeprowadzone w latach 1974 i 1975 na dwóch odmianach pszenicy ozimej Grana i Kaukaz, które poddano działaniu różnych kierunków i poziomów obciążeń quasi-statycznych.

W celu porównania przydatności do badań metody oceny zdolności kiełkowania i metody Derlitzkiego obliczono współczynnik korelacji $r = 0{,}94—0{,}97$. Mimo dużej ścisłości porównywanych metod ($NRU\% = 6{,}97\%$, $NRU\% = 4{,}65\%$) bardziej czułą, o 2,5 × wyższych wartościach F_{emp} okazała się metoda Derlitzkiego. Siła wzrostu wykazała dużą korelację z długością pędów ($r = 0{,}89$) i długością korzeni ($r = 0{,}95$).

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ПОПЫТКА УСТАНОВЛЕНИЯ МЕТОДИКИ ОЦЕНКИ ПОСЕВНОЙ СТОИМОСТИ СЕМЯН ПШЕНИЦЫ, ПОВРЕЖДЕННЫХ МЕХАНИЧЕСКИ

Резюме

Развитие механизации сельского хозяйства приводит к повреждению семян, что особенно опасно в отношении посевного материала ивлечет за собой уменьшение его всхожести. В проводимых исследованиях возникла необходимость избрать объективные методы, позволяющие оценивать посевную стоимость механически поврежденного материала.

В предварительных исследованиях установлено, что механически поврежденные семена, прорастающие в чашечках Петри, промакательной бумаге и по методу Герма, обнаруживают большую склонность к плесневению и вторичной инфекции, что затрудняет оценку проросших семян. Более объективным оказался метод Дерлитцкого, благодаря которому, кроме возможности оценки силы роста, ограничивается вторичная инфекция семян, прорастающих в осложненных условиях.

Избрание этого метода подтвердилось опытами, проведенными в 1974 и

1975 г.г. на двух сортах озимой пшеницы „Грана" и „Кавказ", подвергнутых воздействию разных направлений и уровней квазистатических нагрузок.

С целью сравнения пригодности к исследованиям метода оценки всхожести и метода Дарлитцкого был подсчитан коэффициент корреляции $r = 0{,}94$-$0{,}87$. Несмотря на большую точность сравниваемых методов (НСР % = 6,97%, НСР % = 4,65%) более чувствительным, с 2,5× высшими величинами F_{emp} оказался метод Дерлитцкого. Сила роста обнаружила высокую корреляцию с длиной ростков ($r = 0{,}89$) и корней ($r = 0{,}79$).

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