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THE INFLUENCE OF SOME AGROTECHNOLOGICAL CONDITIONS ON THE VARIABILITY OF THE BASIC MECHANICAL PROPERTIES OF WHEAT GRAIN

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The variability of the physical properties of cultivable plants is determined both by genetic factors (type, species, variety) and by outer factors, covered by the term "agroecological conditions". Quite a long time ago it was noticed that the intervariety variability of different physical properties of plants influence the quality and the types of utilization of variety of certain type. Insufficient, however, is the factographical proof concerning the differentiation of some properties of plant material in relation to particular external factors. Although more and more time and labour consuming investigations are being undertaken recently [1—4], the changes taking place in the level of cultivation, being the result of progress in agriculture, entail further differentiation of almost all the physical properties of cultivable plants and require a permanent carrying out of investigations.

Up to recent times 200 kg/ha of pure NPK component was considered the limit of profitable fertilization of cereal plants (in Poland). The introduction to cultivation of new productive varieties pushed the limit upward, although it is not always that increase of mineral fertilization entails increase of crops. This does not mean that higher fertilization level remains without any effect on many physical properties of whole cereal plants, and on grain, which is the basic product. Similar effect can be caused by many agrotechnological measures.

The getting to know the relationships occurring between the agrotechnological conditions and the physical properties of cereal grain can be of importance in the fields of plant breeding grain utilization, grain storage, mechanization of many production processes, etc.

In the present report we present the introductory results of experiments with winter wheat, on the basis of which we have determined the variability of some physical properties of grain.

These investigations involved 3 varieties of winter wheat (Sawa, Grana and Kaukaz), 3 quantities of sowing (180, 250 and 320 kg/ha) and 3 levels of mineral fertilization (150, 300 and 450 kg NPK/ha) in a system of completely randomized blocks.

The following were determined: grain crop, weight of 1000 grains, weight of 1 hl, porosity of grain layer in heap condition, immediate resistance of grain to mechanical loading (at known thickness of grains) and the value of the immediate deformation of grain, caused by loading.

PRESENTATION OF RESULTS OBTAINED

The agroecological conditions of the field experiment were on a medium or higher level, which is proved by the crops obtained (Table 1). Indeed the highest crops were observed ni the case of the Yugoslav variety Sava, which at the same time turned out to react truly positively to increased fertilization (450 kg NPK/ha), which is not true in relation to the Polish variety Grana, and the Russian variety Kaukaz even lowered its crops at the level of fertilization. Not too differentiated — within one variety — crops of grain do not necessarily indicate the lack of influence of the applied measures on other properties.

One of the more important indicators of the quality of crops is the weight of 1000 grains, the value of which indicates the quality of grains produced. Results presented in Table 2 have a direction of changes similar to crops. And thus for both the Grana and Kaukaz varieties increased density of plants on an unit of area (greater quantity of sowing) leads to retardation of grain quality. Such a relationship was to be expected, which is confirmed by data existing in literature of the subjects. Also, in the case of these two varieties, there is no positive influence of increased fertilization on the weight of 1000 grains, and with the Kaukaz variety even a significant drop of the value of this property was observed. Sava reacted differently, since increased density of sowing did not have significant influence on the property in question, and greater doses of fertilizers led to increased weight of 1000 grains.

Differentiation of the weight of 1 hl (the volumetric weight) is presented in Table 3. The greatest differences occur among the varieties. Sava, characterized by the smallest grain among the investigated varieties (mean values of the weight of 1000 grains — 33.8 g), shows at the same time the highest value of the weight of 1 hl (75.77 kg). Grana and Kaukaz, differing less in the weight of 1000 grains, show almost identical weight of 1 hl (72.41 and 72.39 kg). The value of this property drops in the Grana and Kaukaz varieties with increase of fertilization (as does

Table 1

Crop yields of winter wheat (q/ha) in dependence from variety, level of fertilization and grian quantity sown (1975)

Variety	Quantity sown kg/ha	Fertilization (kg/ha) NPK 150	300	450	Mean values independent from fertilization
Grana	180	37.62	38.21	39.76	38.53
	250	38.69	39.29	33.81	37.26
	320	37.38	36.67	39.05	37.70
Mean values independent from the quantity sown		37.90 c	38.06 c	37.54 cd	37.83 b
Sava	180	35.24	41.19	46.67	41.03
	250	36.79	42.00	45.36	41.38
	320	36.90	42.74	43.81	41.15
Mean values independent from the quantity sown		36.31 d	41.98 b	45.28 a	41.19 a
Kaukaz	180	29.52	31.31	27.50	29.44
	250	28.81	30.36	27.74	28.97
	320	27.98	27.98	25.12	27.02
Mean values independent from the quantity sown		28.77 ef	29.88 e	26.79 f	28.48 c
Mean values independent from variety	180	34.13	36.90	37.98	36.34
	250	34.76	37.22	35.64	35.87
	320	34.09	35.80	35.99	35.29
Mean values independent from variety and quantity sown		34.33 b	36.64 a	36.54 a	35.83

Lack of significant differences between the particular variants is marked with the same letters.

their weight of 1000 grains), while with Sava it stays on the same level. The density of sowing in relation to the particular varieties did not have significant influence on the value of the property in question.

Even more interesting are the ersults concerning the porosity of grain layer (Table 4). It turnes out that the lowest porosity is shown by the grain of Sava (47.48%) and it is not subject to significant influence of fertilization, while with Grana (48.69%) and Kaukaz (49.05%) increased fertilization causes increase of porosity.

Table 2

Mass of 1000 grains of winter wheat (g) in dependence from variety, level of fertilization and the quantity sown (1975)

Variety	Quantity sown kg/ha	NPK fertilization (kg/ha) 150	300	450	Mean values independent from fertilization
Grana	180	42.14	40.07	41.28	41.17 c
	250	40.39	37.95	36.79	38.38 d
	320	40.55	37.65	38.44	38.88 d
Mean values independent from quantity sown		41.03 c	38.56 d	38.84 d	39.48 b
Sava	180	33.78	34.11	34.87	34.26 e
	250	33.42	33.71	34.38	33.84 e
	320	32.43	33.57	33.86	33.29 e
Mean values independent from quantity sown		33.21 f	33.79 ef	34.37 e	33.80 c
Kaukaz	180	44.84	43.91	43.31	44.02 a
	250	43.33	42.89	41.50	42.58 b
	320	43.82	42.02	39.90	41.91 bc
Mean values independent from quantity sown		44.00 a	42.94 b	41.57 bc	42.84 a
Mean values independent from variety	180	40.26	39.37	39.82	39.82 a
	250	39.05	38.19	37.56	38.17 b
	320	38.93	37.75	37.38	38.03 b
Mean values independent from variety and quantity sown		39.41 a	38.43 b	38.26 b	38.70

Explanations as below Table 1.

The characterization of the immediate resistance of grain to mechanical loading is presented in Fig. 1. The greatest variability of force (from 12 to 175 N) is observed for Kaukaz, then comes the value for Grana (lower) and the lowest for Sava. The direction of variability of the values of this property depends in the quality of grain (thickness), fertilization, and the quantity of sowing. Small grains (thickness of 2.0 mm) are decidedly less resistant to loading and the destruction of their structure occurs already at low forces. Thicker grains (2.5 and 3.0 mm) can stand much higher loadings. Hence the conclusion that the better quality the

Table 3

Mass of 1 hl of winter wheat (kg) in dependence from variety, level of fertilization and the quantity sown (1975)

Variety	Quantity sown kg/ha	NPK fertilization (kg/ha) 150	300	450	Mean values independent from fertilization
Grana	180	73.25 cdefgh	72.65 fghi	72.80 fghi	72.90 b
	250	73.15 defgh	71.83 fghi	70.80 hi	71.93 b
	320	73.00 defghi	72.25 fghi	71.97 fghi	72.41 b
Mean values independent from quantity sown		73.13 b	72.24 b	71.86 bc	72.41 b
Sava	180	75.70 abc	75.95 ab	75.85 ab	75.83 a
	250	75.45 abcd	75.30 abcde	75.80 ab	75.52 a
	320	75.65 abc	76.00 ab	76.25 a	75.97 a
Mean values independent from quantity sown		75.60 a	75.75 a	75.97 a	75.77 a
Kaukaz	180	74.25 abcdef	73.52 bcdefg	71.05 ehi	72.94 b
	250	73.95 abcdef	72.85 efghi	71.36 ehi	72.72 b
	320	73.25 cdefgh	70.50 i	70.80 hi	71.52 b
Mean values independent from quantity sown		73.82 ab	72.29 b	71.07 c	72.39 b
Mean values independent from variety	180	74.40	74.04	73.23	73.89 a
	250	74.18	73.33	72.65	73.39 b
	320	73.97	72.92	73.01	73.30 b
Mean values independent from variety and quantity sown		74.18 a	73.43 b	72.94 c	73.52

Explanations as below Table 1.

grains, the more they are resistant to mechanical damage. On the basis of the results obtained we can assume that the variability of this property is more stabilized in the case of Sava (the smallest ranges of values) than with the other two varieties. The influence of fertilization and the density of sowing is particularly apparent with the Kaukaz wariety, where clear differentiation among the particular combinations of the experiments were observed.

Evaluating the values of the immediate deformations of grain, first of all high intervariety differences were observed (Table 5). The greatest

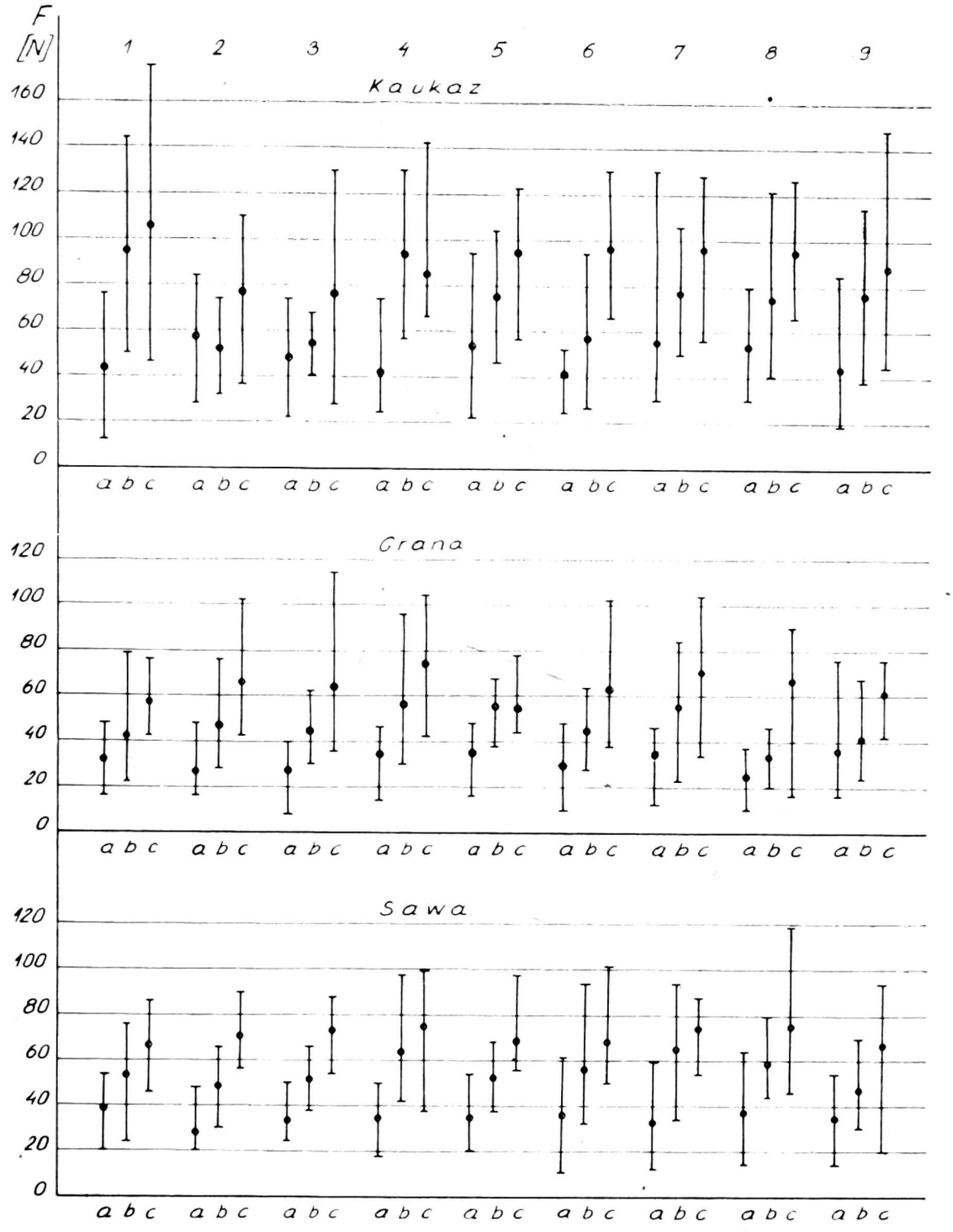

Fig. 1. Variability of the immediate resistance of winter wheat grain to mechanical loadings in relation to the density of sowing, level of fertilization and the thickness of grain. Thickness of grain: *a* — 2.0 mm, *b* — 2.5 mm, *c* — 3.0 mm, *1*—*9* — experimental combinations, o — mean values, — range of variability

deformations characterize the grain of the Kaukaz variety. With this variety also the influence of increased NPK fertilization on the increase of the values of deformations becomes apparent. Grana and Sava react less to differentiated agrotechnological factors, and the relative values of deformations are much lower than with Kaukaz.

Restricting ourselves in the present report to presenting a very condensed characterization of some properties of wheat grain, it seems that we have sufficient foundations for the following statement:

The influence of agroecological conditions does not always have to be apparent in the quantity of crops obtained. But the differentiation of some physical properties of grain can be very strong, the knowledge of which may and should be utilized in various branches of practical activities.

Table 4

Porosity of winter wheat grain layer (%) in dependence from variety, level of fertilization and the quantity sown (1975)

Variety	Quantity sown kg/ha	NPK fertilization (kg/ha) 150	300	450	Mean values independent from fertilization
Grana	180	47.40 jk	49.10 cde	49.25 cd	48.58 cd
	250	48.20 h	48.30 gh	49.80 b	48.77 bc
	320	47.40 jk	49.30 cd	49.50 bc	48.73 bc
Mean values independent from quantity sown		47.67 d	48.90 b	49.52 a	48.69 b
Sava	180	47.70 ij	47.90 hi	47.70 ij	47.77 e
	250	47.60 ij	47.70 ij	47.55 ij	47.62 e
	320	47.05 kl	47.25 jkl	46.85 l	47.05 f
Mean values independent from quantity sown		47.45 de	47.62 de	47.37 e	47.48 c
Kaukaz	180	48.20 h	48.25 h	48.85 de	48.43 d
	250	48.60 fg	48.90 de	49.15 cd	48.88 b
	320	48.75 def	49.75 b	51.00 a	49.83 a
Mean values independent from quantity sown		48.52 c	48.97 b	49.67 a	49.05 a
Mean values independent from variety	180	47.77 f	48.42 cd	48.60 bc	48.26 b
	250	48.13 e	48.30 de	48.83 b	48.42 a
	320	47.73 f	48.77 b	49.12 a	48.54 a
Mean values independent from variety and quantity sown		47.88 c	48.49 b	48.85 a	48.41

Explanations as below Table 1.

Table 5

Volume of immediate deformations of wheat grains (%)

Variety	Density of sowing kg/ha	Thickness of grains mm	NPK fertilization (kg/ha) 150	300	450
Kaukaz	180	2.0	10.5	12.2	14.8
		2.5	15.0	17.8	16.9
		3.0	17.1	16.6	17.2
	250	2.0	12.0	12.0	16.3
		2.5	13.2	12.4	14.6
		3.0	11.7	12.4	14.3
	320	2.0	9.3	13.0	13.2
		2.5	12.5	13.3	17.5
Grana	180	3.0	11.6	14.4	14.6
		2.0	7.8	7.0	6.2
		2.5	8.8	11.9	11.2
		3.0	9.4	11.2	7.6
	250	2.0	7.1	8.3	5.6
		2.5	7.0	9.8	6.1
		3.0	9.6	7.8	9.7
	320	2.0	6.2	7.5	7.7
		2.5	9.8	9.6	9.8
		3.0	10.3	9.2	9.7
Sava	180	2.0	7.2	10.3	6.2
		2.5	9.0	11.2	9.7
		3.0	8.8	10.5	9.2
	250	2.0	8.1	10.3	7.7
		2.5	7.4	10.3	12.3
		3.0	8.8	9.9	8.9
	320	2.0	7.3	8.1	8.6
		2.5	7.2	9.6	7.5
		3.0	9.5	7.0	7.7

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WPŁYW NIEKTÓRYCH WARUNKÓW AGROTECHNICZNYCH NA ZMIENNOŚĆ PODSTAWOWYCH CECH MECHANICZNYCH ZIARNA PSZENICY

Streszczenie

Przeprowadzono badania podstawowych cech mechanicznych ziarna pszenicy na podstawie materiału pochodzącego ze zróżnicowanych warunków agrotehcnicznych. Doświadczenie obejmowało 3 odmiany pszenicy ozimej (Sawa, Grana, Kaukaz) przy 3 gęstościach wysiewu (180, 250, 320 kg/ha) oraz 3 poziomach nawożenia mineralnego (150, 300, 450 kg NPK/ha). Dla poszczególnych kombinacji doświadczenia określono plon ziarna, masę 1000 ziarn, masę 1 hl, porowatość warstwy ziarna w stanie usypnym, doraźną odporność ziarna na obciążenia mechaniczne (przy znanej grubości ziarniaków) oraz wielkość doraźnych odkształceń ziarna, powstałych na skutek obciążeń.

Na podstawie uzyskanych wyników badań stwierdzono, że wpływ warunków agroekologicznych nie zawsze musi ujawniać się w wysokości uzyskiwanych plonów. Zróżnicowanie natomiast niektórych cech fizycznych ziarna jest bardzo silne, a wpływ na nie ma zarówno gęstość wysiewu, jak i nawożenie NPK.

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ВЛИЯНИЕ НЕКОТОРЫХ АГРОТЕХНИЧЕСКИХ УСЛОВИЙ НА ИЗМЕНЧИВОСТЬ ОСНОВНЫХ МЕХАНИЧЕСКИХ СВОЙСТВ ПШЕНИЧНОГО ЗЕРНА

Резюме

Были проведены исследования основных механических свойств пшеничного зерна на основании материала, происходящего из дифференцированных агротехнических условий. Опыт охватывал 3 сорта озимой пшеницы (Сава, Грана, Кавказ) при 3 густотах посева (180, 250, 320 кг/га) и 3 уровнях минерального удобрения (150, 300, 450 кг NPK/га). Для отдельных комбинаций эксперимента определили урожай зерна, массу 1000 зерен, массу 1 гектолитра, пористость слоя насыпанного зерна, временную устойчивость зерна к механическим нагрузкам (при известной толщине зерновок) и величину временных деформаций зерна, возникших вследствие нагрузок.

На основании полученных результатов исследований констатировали, что влияние агроэкологических условий не всегда должно проявляться в уровне получаемых урожаев. В то же время дифференциация некоторых физических свойств зерна очень сильна, а влияние на нее имеют как густота посева, так и удобрение NPK.

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