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STUDIES ON STABILITY OF GRAINS NUMBER FROM PANICLE TO A COLLECTION OF OATS AUTUMN (*Avena sativa l.*) GENOTYPES

ISTRAŽIVANJA STABILNOSTI BROJA ZRNA OD METLIČENJA DO UBIRANJA OZIMOG OVSA (Avena sativa l.) GENOTIPA

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ABSTRACT

The study aimed at assessing stability the grains number from panicle to autumn oats, under the influence of climatic conditions. The study was conducted over a period of three years. The biological material consisted of 73 genotypes. The experimental data was obtained by performing biometric measurements. The experimental data was processed by various linear regression analysis modelesses: Finlay-Wilkinson, Hardwick-Wood, Muir, Wrike but also the concordance between the ranks of different models of appreciation. The values of grains number in panicle fluctuate according to the climatic conditions of the year, both as an average value and as intrapopulational variability. The Jeferson, Carie, Florina varieties, and the 4458, PA 725-4743, PA 822-818 lines exhibits a high dynamic stability associated with values above the average of the experience for the number of grains in panicle. In the case of this character, 53.10% of the genotype x environment interaction is due to heterogeneity of variances.

Key words: *oats, stability, grain number per panicle.*

REZIME

Studija je imala za cilj procenu stabilnosti broja zrna od metličenja do ubiranja ozimog ovsa, pod uticajem klimatskih uslova. Studija je sprovedena u periodu od tri godine. Biološki materijal se sastojao od 73 genotipa. Eksperimentalni podaci dobijeni su biometrijskim merenjima. Eksperimentalni podaci su obrađeni različitim modelima linearne regresione analize: Finlai-Vilkinson, Hardvick-Vood, Muir, Vrike, ali i usklađenost između rangova različitih modela uvažavanja. Vrednosti broja zrna u metlici variraju u zavisnosti od klimatskih uslova godine, i kao prosečna vrednost i kao intrapopulacijska varijabilnost. Sorte Jeferson, Carie, Florina i linije 4458, PA 725-4743, PA 822-818 pokazuju visoku dinamičku stabilnost povezanu sa vrednostima iznad proseka iskustva za broj zrna u metlici. U slučaju ovog karaktera, 53,10% interakcije genotipa k sredine je posledica heterogenosti varijansi.

Ključne reči: *ovas, stabilnost, broj zrna po metlici.*

INTRODUCTION

Interaction of genotype with the environment has very significant effects on the production of grains and of quality characteristics. Under the influence of environmental conditions, the oat genotypes fluctuate in terms of grain production, the weight of 1000 grains, the percentage of chaff, the starch content and β-glucan. The genotypes with high values for production and quality features, which also have good character stability, have the ability to convey these attributes to descendants (Mut Zeki et al. 2018).

The performances of productivity to autumn oat genotypes can be evaluated in correlation with precocity, winter resistance, plant height, panicle length, the number of spikes in the panicle, the number and weight of the grains in panic and the weight of 1000 grains. By studying these characters, it is possible to carry out the selection of genotypes in the programs of amelioration, but can also be highlighted the genotypes which can be used as a genitors in hybridization programs (Panayotova Galina et all. 2018).

The diversification of production characters is also attempted through the use of biotechnology in breeding programs. The value of regenerated plants from mature embryos is recommended to be evaluated through height of plant, length of panicle, number of spikes in panicle, the number of grains on the panicle, the weight of the grains of panicle, the weight of 1000 grains. In addition to the morphological features of productivity, it is also necessary to evaluate the quality elements: the protein and fat content. The regenerated plants may be higher, with longer panicles and larger numbers of grains in panicle (Dyulgerova Boryana and Savova Todorka, 2017).

Of the climate factors that have a major influence on paniculous productivity, the drought is the most important. Due to genetic variability, some genotypes tolerate drought, others not. The evidence of valuable genotypes can be achieved by applying different genetic variability assessment systems and determining the percentage of influence of the stress factor on the manifestation of the morphological character. One of the characters that is recommended to be evaluated is the number of grains in panicle, alongside which can be estimated the weight of the grains in the panicle or the weight of 1000 grains. Among the stability indicators, can be determined, the stress factor sensitivity index and the tolerance index (Atefah Zaheri and Sohbat Bahraminejad, 2012).

The study of productivity stability can also be done by comparing some hybrid populations with parental forms. The assessment of generational behavior over several years has been achieved by studying the number of panicles per plant, the number of grains of panicle and the weight of panic. In studying such materials an important role is played by the combinatorial ability of the genitors, the feature on which the character manifestation depends and their response to the action of the environmental factors (Igor Pirez Valério et al., 2009). In the study of character stability in autumn oats, the correlations between characters can also be used. Studies in Turkey used linear stability regressions and determinants as stability indices. The studied characters are affected differently by the interaction of the genotype with the environment. The coefficients of the correlation between the characters differ according to the environmental conditions. There are stable, the links between panic productivity and its length, possibly also between the number of grains of panic and productivity (Özgen, 1993).

The managing of oat productivity can be improved by better knowledge of critical phenological phases. Some studies have tracked the achievement of grains number in panicle, before the anthesis until after the anthesis. The characters specific to the pre-anthesis phase are in a positive linear relation with the productivity and the grains number of panicle. The post-anthesis characteristics are correlated with the decrease of the grains number and their weight, in response to the action of external factors (Finnan and Spink, 2017).

To achieve the number of grains in panicle, fertilization plays a very important role. The application of fertilizers with nitrogen, but also the rotation of crops contributes to the increase in the number of spikes in panic and the number of grains in panicle (Rubia Diana Mantai et al., 2018). The study of a collection of oat varieties with regard to the stability of the number of grains of panicle, shows that this character is more stable compared to other characters that contribute to the production of the plant, but these characters have a greater influence on production. Interaction of genotype with climatic conditions specific to each year is more important for achieving production, the percentage of grain chaff and the protein content (Dumlupinar Ziya et al., 2011).

Concerning the behavior of autumn oats compared to spring oats, it is found that grain production is higher in autumn oatmeal because there are more spikes in panicle, the fertility of the spikelets is better, making two grains in the spikelets. The productivity differences between autumn and spring oats are due to the number of beans in panicle, in a proportion of 80% (Crampton et al., 1997). The study aimed at assessing the stability of the number of grains of main panicle in a collection of autumn oat genotypes.

MATERIAL AND METHOD

The study was conducted over three years (2015-2017) under field conditions, in Timisoara, in the plain of western Romania. The first year of experiments showed satisfactory climate conditions. In the second year, in the spring, rainfall was less. In the third year, the drought was prolonged until early summer. In the three years, the temperatures were close to multi-year averages. The experimental soil was moderately cambicated chernozem. The biological material consisted of 73 genotypes of autumn oat which were compared with the Romanian variety Florina. The experimental data were obtained by determining the number of grains from panicle, being constituted representative samples for each genotype.

This method of assessing the stability of genotypes under different environmental conditions is based on the fact that the different components of genotype x environment interaction are linearly related to the effects of environmental conditions expressed by the average of the performances of all genotypes for the studied character.

The relative adaptability of a genotype to different environmental conditions is appreciated through three parameters: the average of its performance, the genotype response to different environmental conditions (regression coefficient), stability of performance (deviations from regression). According to the “static” concept, Type I stability exists if the performance of a genotype is constant across environments (regression coefficient bi =0). Therefore, “dynamic” or Type II stability exists if the response to environments is parallel to the mean response of all genotypes from the study. Type III stability exists if the deviation to the regression line is small (Annicchiarico, 2002; Bernardo, 2002).

For data processing different models were used: Finlay-Wilkinson, Hardwick-Wood, Wrike (Ciulca, 2006).

The relative adaptability of a genotype to different environmental conditions is appreciated through three parameters: the average of its performance, the genotype response to different environmental conditions (regression coefficient), stability of performance (deviations from regression) (Bernardo, 2002).

For analyzing the genotype x environment interaction, two components are separated: one due to heterogeneity of genetic variants and another due to imperfect correlations. The association between the results of the different methods of assessing the stability of the studied characters was achieved using the coefficient of concordance (Muir et al., 1992).

RESULTS AND DISCUSSION

Based on the data presented in Table 1, it is observed that the highest Type I stability recorded the genotypes: 4451, Chamois, Penwin, Emperor, Thonson, which according to the static concept achieve constant values of this character irrespective of the environmental conditions in which they were tested (*Becker and Leon, 1988; Annicchiarico., 2002*). The lowest Type I stability in terms of the number of grains in the main panicle showed the lines and varieties: 4492, PA 522-23, 4482, Barra, Fergushon, which have made very different values of this character during the experimental years.

Table 1. Stability of the grain number/main panicle through (FINLAY-WILKINSON) linear regression for winter oat genotypes

No	Genotype	Average	Regression coefficient	Stability			Regression constant o	Deviation from regression
				Type I (rank)	Type III (rank)	Type II (rank)		
1	Florina (control)	47.17	1.476	54	49	34	-14.29	61.10
2	Norline	44.71	0.459	17	38	38,5	25.61	37.31
3	Arlingthon	36.34	0.823	28	22	18	2.06	10.31
4	Blamouth	33.16	0.587	22	30	26	8.72	24.02
5	CI 1908	29.45	0.515	19	53	37	8.01	69.65
6	Cimarron	28.47	0.883	34	65	5	-8.30	148.96
7	Crater	34.64	1.148	43	63	16	-13.18	118.04
8	Earlygrain	29.93	0.333	14	18	44	16.04	4.63
9	Excel	42.72	1.779	66	43	59	-31.36	49.60
10	Fergushon	44.88	2.169	69	68	63	-45.43	297.41

11	Fulwood	44.94	0.666	25	8	22	17.19	2.44
12	Jeferson	43.29	1.006	36	24	3	1.39	12.33
13	Le Conte	29.84	0.214	8	45	49	20.92	50.89
14	Nortex	37.82	1.086	41	1	11	-7.41	0.01
15	Suergrain	48.07	1.165	45	41	17	-0.43	44.88
16	Thonson	40.75	-0.160	5	26	69	47.41	13.38
17	Walken	37.16	1.021	38	17	1	-5.36	4.55
18	Compact	46.35	1.251	48	20	27	-5.76	6.86
19	Pennwin	41.54	0.128	3	37	62	36.21	35.11
20	2288	47.92	0.623	23	55	25	21.97	77.09
21	3378	54.75	1.623	61	7	53	-12.85	1.95
22	834-4-1-3	39.31	0.667	26	27	21	11.55	14.49
23	3412	36.59	-0.485	18	51	73	56.80	64.32
24	S Dak 40	63.93	1.453	53	5	33	3.43	0.94
25	3868	43.33	1.313	50	50	29	-11.35	63.47
26	Cocker 41-51	39.79	-0.195	6	42	70	47.91	46.17
27	4444	61.64	2.063	67	14	60	-24.27	3.90
28	4451	36.89	-0.085	1	32	66	40.41	26.64
29	4458	45.11	0.824	29	35	14	10.79	29.65
30	4472	31.26	0.263	12	19	46	20.31	5.57
31	4475	36.54	1.541	56	66	38,5	-27.63	193.98
32	4476	49.74	1.219	46	23	19	-1.01	11.44
33	4477	37.78	-0.225	9	58	71	47.16	87.89
34	4478	26.62	0.854	32	71	7,5	-8.94	348.61
35	4480	38.51	0.411	16	11	40	21.38	2.83
36	4482	45.85	2.317	71	67	67	-50.64	280.29
37	4483	43.94	1.653	63	57	56	-24.90	82.17
38	4484	28.91	0.826	30	13	12,5	-5.51	3.72
39	4488	28.83	0.542	21	2	32	6.25	0.04
40	4492	49.40	2.831	73	56	72	-68.50	79.93
41	5029	41.47	1.010	37	73	2	-0.59	673.01
42	5032	55.12	1.711	65	44	58	-16.14	49.94
43	Marrettos Anderson	46.86	1.619	60	9	52	-20.58	2.50
44	8276	45.62	1.566	57	39	41	-19.57	40.45
45	PA 522-7	47.71	1.598	58	64	42	-18.85	145.17
46	PA 522-23	44.41	2.428	72	15	68	-56.71	4.39
47	PA 621-3274	52.59	2.168	68	21	61	-37.70	7.66
48	PA 724-2580	33.82	0.840	31	6	12,5	-1.14	1.42
49	PA 725-2154	45.70	0.723	27	4	20	15.59	0.06
50	PA 725-4743	45.38	1.086	42	62	10	0.16	116.52
51	PA 725-4787	42.12	0.410	15	69	43	25.06	327.16
52	PA 725-6113	34.62	0.250	11	33	47	24.23	27.18
53	PA 822-818	48.59	0.935	35	48	4	9.64	53.59
54	ARK 0151-61	44.17	1.321	52	10	31	-10.84	2.73
55	AR 104-18	47.88	1.221	47	29	24	-2.96	20.29
56	Marys Quest	39.44	0.534	20	12	35	17.21	3.06
57	Wodan	52.56	1.635	62	3	54	-15.52	0.04
58	Gospodarski 48	31.43	0.232	10	28	48	21.76	17.96
59	5183	41.28	1.046	39	61	6	-2.27	99.17
60	Tripolis	51.64	1.317	51	52	30	-3.19	65.86
61	Krusevac	40.28	1.607	59	16	50	-26.61	4.52
62	Boer	45.02	1.663	64	47	57	-24.25	53.37
63	Algerian	27.78	1.058	40	72	9	-16.26	397.35
64	Mirabel	39.78	1.265	49	60	28	-12.89	96.80
65	Gerald	39.95	1.526	55	54	36	-23.62	73.75
66	Nuptiale	35.94	0.200	7	36	51	27.60	33.70
67	Solva	39.79	0.633	24	25	23	13.44	13.15
68	Valiant	48.97	1.148	44	40	15	1.15	41.08
69	Barra	56.75	2.289	70	46	64	-38.59	52.20
70	Carie	44.06	0.881	33	31	7,5	7.39	24.14
71	Krypton	31.15	0.272	13	59	45	19.82	93.29
72	Chamois	32.48	0.091	2	70	65	28.69	335.38
73	Emperor	37.54	0.130	4	34	55	32.14	28.39

The highest Type II stability (coefficients of regression close to 1) presented varieties and lines: Walken, 5029, Jeferson, PA 822-818, Cimarron, where the number of panic in the climatic conditions of the three experimental years is parallel to the average of the other genotypes in the collection The lowest dynamic stability was observed in the genotypes: 3412, 4492, 4477, Cocker 41-51, Thonson.

The highest Type III stability was observed in genotypes: Nortex, 4488, Wodan, PA 725-2154, S Dak 40. At genotypes 5029, 4478, Algerian, Chamois, PA 725-4787, which exhibit reduced type III stability, the values of the number of grains in the main panic during the three experimental years show great deviations from the right of the regression.

Considering the low and insignificant value of the F test for the regression heterogeneity, it is noted that the regression model is suitable for studying the stability of this character and estimates adequately the performance of varieties and lines over the three years of experimentation. It is also noted that there are significant differences between genotypes and between experimental years for the average values of the number of grains from the main panic by genotypes in the collection (table 2)

Table 2.Linear regression analysis of variance (HARDWICK – WOOD) for grain number/main panicle in the winter oat genotypes studied during 2001-2004

Source of variability	SS	DF	MS	F
Total	50714	218		
Genotypes	13947	72	193,72	F=2.65**
Years	23963	2	11981	F=164.13**
Genotype x years	16803	144	116,69	F=1.59*
Regression heterogeneity	7481	72	103,90	
Error	5322	72	73,92	

*; ** Significant at P ≤ 0.05 and P ≤ 0.01, respectively

The lowest significant values of ecovalence, respectively a high stability of the number of grains in the main panicle presents the genotypes: Nortex, Walken, PA 724-2580, Jeferson, 4484. High values of ecological valence, indicating a marked instability of the character in different climatic conditions, were observed in the varieties: 4492, 4482, 3412, Fergushon, PA 522-23. Generally, at the studied collection it is observed that the high values of ecovalence, or the reduced stability of this character, are associated with higher values of the number of beans in the principal panicle (table 3).

Table 3. Stability of grain number/main panicle through (WRIKE) ecovalence for winter oat genotypes

No	Genotype	Average	Ecovalence	Ecovalence variance	F test	Stability rank
1	Florina (control)	47.17	135.43	388.05	11.70**	37
2	Norline	44.71	133.46	53.21	1.85	36
3	Arlingthon	36.34	20.56	116.43	21.57**	6
4	Blamouth	33.16	80.04	68.55	4.71**	23
5	CI 1908	29.45	146.87	78.36	1.25	39
6	Cimarron	28.47	153.46	202.44	1.72	42
7	Crater	34.64	125.28	275.50	3.67*	31
8	Earlygrain	29.93	150.48	20.56	7.88**	40
9	Excel	42.72	248.92	544.39	20.95**	51
10	Fergushon	44.88	745.91	920.81	5.19**	70
11	Fulwood	44.94	38.96	74.13	59.58**	13
12	Jeferson	43.29	12.31	172.29	26.91**	4
13	Le Conte	29.84	253.60	32.98	0.30	52
14	Nortex	37.82	2.46	193.71	25335**	1
15	Suergrain	48.07	53.78	245.05	9.92**	17
16	Thonson	40.75	151.95	10.88	0.63	41
17	Walken	37.16	4.70	173.36	75.11**	2
18	Compact	46.35	27.61	260.45	74.87**	9
19	Pennwin	41.54	284.72	20.25	0.15	56
20	2288	47.92	123.71	102.29	1.65	30
21	3378	54.75	129.54	433.55	441.45**	34
22	834-4-1-3	39.31	50.95	80.21	10.07**	16
23	3412	36.59	788.52	70.82	1.20	71
24	S Dak 40	63.93	68.30	346.98	735.01**	20
25	3868	43.33	95.65	314.72	8.92**	24
26	Cocker 41-51	39.79	514.99	29.33	0.27	64
27	4444	61.64	374.96	700.62	358.05**	59
28	4451	36.89	412.81	14.50	0.09	61
29	4458	45.11	39.82	126.28	7.52**	14
30	4472	31.26	183.85	14.15	4.07*	44
31	4475	36.54	290.05	486.74	4.02*	57
32	4476	49.74	27.14	249.50	42.62**	8
33	4477	37.78	580.71	52.27	0.19	65
34	4478	26.62	355.60	294.04	0.69	58
35	4480	38.51	116.57	29.19	19.60**	27

36	4482	45.85	849.93	1021.52	6.29**	72
37	4483	43.94	222.18	489.60	10.92**	49
38	4484	28.91	13.62	113.96	60.13**	5
39	4488	28.83	68.80	48.30	2019**	21
40	4492	49.40	1190.98	1355.81	32.92**	73
41	5029	41.47	673.04	503.95	0.50	68
42	5032	55.12	216.09	505.71	19.25**	48
43	Marrettos Anderson	46.86	128.48	431.72	343.34**	33
44	8276	45.62	145.49	422.56	19.89**	38
45	PA 522-7	47.71	262.70	491.90	5.78**	53
46	PA 522-23	44.41	674.08	970.03	440.17**	69
47	PA 621-3274	52.59	455.67	775.45	201.27**	63
48	PA 724-2580	33.82	9.87	116.40	163.12**	3
49	PA 725-2154	45.70	25.24	85.84	2534**	7
50	PA 725-4743	45.38	118.96	251.84	3.32*	28
51	PA 725-4787	42.12	441.54	191.14	0.17	62
52	PA 725-6113	34.62	212.00	23.82	0.75	47
53	PA 822-818	48.59	54.97	170.38	5.36**	18
54	ARK 0151-61	44.17	36.58	287.82	209.65**	12
55	AR 104-18	47.88	36.31	254.80	24.11**	11
56	Marys Quest	39.44	74.38	48.31	30.55**	22
57	Wodan	52.56	132.39	438.76	21514**	35
58	Gospodarski 48	31.43	211.47	17.83	0.99	46
59	5183	41.28	99.87	229.12	3.62*	26
60	Tripolis	51.64	98.80	317.51	8.64**	25
61	Krusevac	40.28	125.28	425.88	187.31**	32
62	Boer	45.02	197.86	480.85	17.02**	45
63	Algerian	27.78	398.45	382.33	0.92	60
64	Mirabel	39.78	119.87	311.07	5.43**	29
65	Gerald	39.95	164.74	419.33	10.37**	43
66	Nuptiale	35.94	243.71	23.43	0.39	50
67	Solva	39.79	57.45	72.27	9.99**	19
68	Valiant	48.97	48.30	236.94	10.53**	15
69	Barra	56.75	597.96	886.37	32.96**	66
70	Carie	44.06	28.82	139.36	10.54**	10
71	Krypton	31.15	267.20	58.80	0.26	54
72	Chamois	32.48	606.56	169.06	0.01	67
73	Emperor	37,54	277,10	16,95	0,19	55

*; ** Significant at P ≤ 0.05 and P ≤ 0.01, respectively

The analysis of genotype x environment interaction (Table 4), attests that the highest stability of the number of grains in the main panic, respectively a low x genotype interaction, is presented by genotypes: Nortex, Walken, Jeferson, PA 724-2580, 4484, PA 725-2154. A high genotype x environment interaction associated with a high instability for this character, was observed in the genotypes: 4492, 4482, 3412, Fergushon.

Table 4. Stability of the grain number/ main panicle through (MUIR) heterogeneous variances (HV) and imperfect correlations (IC) for winter oat genotypes studied during 2001-2004

No	Genotype	Average	SS		SS		SS	
			(HV)	(%)	(IC)	(%)	(GE)	(%)
1	Florina (mt.)	47.17	85.42	0.96	97.39	1.24	182.81	1.09
2	Norline	44.71	116.98	1.31	64.84	0.82	181.82	1.08
3	Arlingthon	36.34	76.94	0.86	48.43	0.61	125.37	0.75
4	Blamouth	33.16	103.22	1.16	51.89	0.66	155.11	0.92
5	CI 1908	29.45	96.11	1.08	92.41	1.17	188.53	1.12
6	Cimarron	28.47	61.40	0.69	130.42	1.65	191.82	1.14
7	Crater	34.64	64.46	0.72	113.27	1.44	177.73	1.06
8	Earlygrain	29.93	165.85	1.86	24.49	0.31	190.33	1.13
9	Excel	42.72	134.45	1.51	105.11	1.33	239.55	1.43
10	Fergushon	44.88	303.73	3.40	184.33	2.34	488.06	2.90

11	Fulwood	44.94	99.04	1.11	35.53	0.45	134.57	0.80
12	Jeferson	43.29	63.81	0.72	57.45	0.73	121.26	0.72
13	Le Conte	29.84	142.58	1.60	99.31	1.26	241.89	1.44
14	Nortex	37.82	61.84	0.69	54.49	0.69	116.32	0.69
15	Suergrain	48.07	61.90	0.69	80.08	1.02	141.98	0.84
16	Thonson	40.75	192.67	2.16	149.90	1.90	342.57	2.04
17	Walken	37.16	63.88	0.71	53.76	0.68	117.44	0.70
18	Compact	46.35	62.99	0.71	65.91	0.84	128.90	0.77
19	Pennwin	41.54	166.56	1.87	90.89	1.15	257.45	1.53
20	2288	47.92	82.78	0.93	94.17	1.19	176.95	1.05
21	3378	54.75	97.76	1.10	82.11	1.04	179.86	1.07
22	834-4-1-3	39.31	94.90	1.06	45.67	0.58	140.57	0.84
23	3412	36.59	101.48	1.14	407.87	5.18	509.35	3.03
24	S Dak 40	63.93	76.00	0.85	73.24	0.93	149.24	0.89
25	3868	43.33	69.94	0.78	92.97	1.18	162.92	0.97
26	Cocker 41-51	39.79	148.59	1.67	224.00	2.84	372.59	2.22
27	4444	61.64	198.02	2.22	104.56	1.33	302.57	1.80
28	4451	36.89	181.26	2.03	140.24	1.78	321.50	1.91
29	4458	45.11	73.58	0.82	61.42	0.78	135.00	0.80
30	4472	31.26	182.28	2.04	24.74	0.31	207.01	1.23
31	4475	36.54	114.31	1.28	145.81	1.85	260.12	1.55
32	4476	49.74	62.17	0.70	66.50	0.84	128.66	0.77
33	4477	37.78	117.94	1.32	287.51	3.65	405.45	2.41
34	4478	26.62	66.77	0.75	226.12	2.87	282.89	1.74
35	4480	38.51	148.82	1.67	24.55	0.31	173.38	1.03
36	4482	45.85	356.70	4.00	183.36	2.33	540.95	3.21
37	4483	43.94	115.26	1.29	110.92	1.41	226.18	1.35
38	4484	28.91	77.87	0.87	44.03	0.56	121.90	0.73
39	4488	28.83	122.24	1.37	27.25	0.35	149.49	0.89
40	4492	49.40	547.44	6.14	158.14	2.01	705.58	4.20
41	5029	41.47	120.10	1.35	331.51	4.21	451.61	2.69
42	5032	55.12	120.70	1.35	102.43	1.30	223.14	1.33
43	Marrettos Anderson	46.86	97.22	1.09	82.11	1.04	179.33	1.07
44	8276	45.62	94.61	1.06	93.23	1.18	187.84	1.12
45	PA 522-7	47.71	116.02	1.30	130.42	1.65	246.44	1.47
46	PA 522-23	44.41	329.31	3.69	122.82	1.56	452.13	2.69
47	PA 621-3274	52.59	232.15	2.60	110.77	1.41	342.93	2.04
48	PA 724-2580	33.82	76.95	0.86	43.08	0.55	120.03	0.71
49	PA 725-2154	45.70	91.40	1.02	36.31	0.46	127.71	0.76
50	PA 725-4743	45.38	62.32	0.70	112.25	1.42	174.57	1.04
51	PA 725-4787	42.12	62.00	0.69	273.86	3.47	335.86	2.00
52	PA 725-6113	34.62	158.88	1.78	62.22	0.79	221.09	1.32
53	PA 822-818	48.59	64.06	0.72	78.52	1.00	142.58	0.85
54	ARK 0151-61	44.17	65.94	0.74	67.44	0.86	133.38	0.79
55	AR 104-18	47.88	62.54	0.70	70.71	0.90	133.25	0.79
56	Marys Quest	39.44	122.23	1.37	30.05	0.38	152.28	0.91
57	Wodan	52.56	99.22	1.11	82.01	1.04	181.29	1.08
58	Gospodarski 48	31.43	172.32	1.93	48.50	0.62	220.82	1.31
59	5183	41.28	61.25	0,.69	103.78	1.32	165.03	0.98
60	Tripolis	51.64	70.42	0.79	94.02	1.19	164.49	0.98
61	Krusevac	40.28	95.45	1.07	82.19	1.04	177.73	1.06
62	Boer	45.02	112.37	1.26	101.65	1.29	214.02	1.27
63	Algerian	27.78	84.01	0.94	230.31	2.92	314.32	1.87
64	Mirabel	39.78	69.34	0.78	105.68	1.34	175.03	1.04
65	Gerald	39.95	93.70	1.05	103.76	1.32	197.46	1.18
66	Nuptiale	35.94	159.69	1.79	77.26	0.98	236.95	1.41
67	Solva	39.79	100.39	1.13	43.43	0.55	143.82	0.86
68	Valiant	48.97	61.50	0.69	77.74	0.99	139.24	0.83
69	Barra	56.75	286.21	3.21	127.86	1.62	414.07	2.46
70	Carie	44.06	69.89	0.78	59.61	0.76	129.50	0.77

71	Krypton	31.15	111.53	1.25	137.17	1.74	248.69	1.48
72	Chamois	32.48	64.23	0.72	354.14	4.49	418.37	2.49
73	Emperor	37.54	174.56	1.96	79.08	1.00	253.64	1.51
TOTAL			8922.37	53.10	7881.05	46.90	16803.42	100.00

HV-Heterogenity variance; IC-Imperfect correlations; GE-Genotype x environment interaction; SS – Sum square

In this case, 53.10% of the genotype x environment interaction is due to heterogeneity of variants. In assessing the stability of the number of grains in main panicle, can be effectively used the imperfect correlations and heterogeneity of variants. Taking into account the variance heterogeneity, the most stable values of the number of grains in the panicle were recorded by the varieties: Cimarron, Nortex, Suergrain, Valiant and the lines: PA 725-4787, 5183.

There is a very close concordance between the results of the four models for assessing the stability of the number of grains from the main panicle to the studied genotypes. According to these models, the greatest stability of this character is represented by the genotypes: Nortex, Walken, PA 725-2154, Jeferson, Fulwood. A strong instability was observed in varieties and lines: 4482, 4492, Fergushon, Barra, PA 522-23 (table 5).

Table 5. The concordance of ranks for different stability estimation models for grain number/mainpanicle in winter oat genotypes

No.	Genotype	Average	Ranks stability				Amounts ranks	SS_R
			Type I	Type II	Type III	Ecovalence		
1	Florina (mt.)	47.17	54	34	49	37	174	676
2	Norline	44.71	17	38.5	38	36	129,5	342.25
3	Arlingthon	36.34	28	18	22	6	74	5476
4	Blamouth	33.16	22	26	30	23	101	2209
5	CI 1908	29.45	19	37	53	39	148	0
6	Cimarron	28.47	34	5	65	42	146	4
7	Crater	34.64	43	16	63	31	153	25
8	Earlygrain	29.93	14	44	18	40	116	1024
9	Excel	42.72	66	59	43	51	219	5041
10	Fergushon	44.88	69	63	68	70	270	14884
11	Fulwood	44.94	25	22	8	13	68	6400
12	Jeferson	43.29	36	3	24	4	67	6561
13	Le Conte	29.84	8	49	45	52	154	36
14	Nortex	37.82	41	11	1	1	54	8836
15	Suergrain	48.07	45	17	41	17	120	784
16	Thonson	40.75	5	69	26	41	141	49
17	Walken	37.16	38	1	17	2	58	8100
18	Compact	46.35	48	27	20	9	104	1936
19	Pennwin	41,.54	3	62	37	56	158	100
20	2288	47.92	23	25	55	30	133	225
21	3378	54.75	61	53	7	34	155	49
22	834-4-1-3	39.31	26	21	27	16	90	3364
23	3412	36.59	18	73	51	71	213	4225
24	S Dak 40	63.93	53	33	5	20	111	1369
25	3868	43.33	50	29	50	24	153	25
26	Cocker 41-51	39.79	6	70	42	64	182	1156
27	4444	61.64	67	60	14	59	200	2704
28	4451	36.89	1	66	32	61	160	144
29	4458	45.11	29	14	35	14	92	3136
30	4472	31.26	12	46	19	44	121	729
31	4475	36.54	56	38,5	66	57	217,5	4830.25
32	4476	49.74	46	19	23	8	96	2704
33	4477	37.78	9	71	58	65	203	3025
34	4478	26.62	32	7,5	71	58	168,5	420,25
35	4480	38.51	16	40	11	27	94	2916
36	4482	45.85	71	67	67	72	277	16641
37	4483	43.94	63	56	57	49	225	5929
38	4484	28.91	30	12,5	13	5	60,5	7656.25
39	4488	28.83	21	32	2	21	76	5184
40	4492	49.40	73	72	56	73	274	15876
41	5029	41.47	37	2	73	68	180	1024
42	5032	55.12	65	58	44	48	215	4489
43	Marrettos Anderson	46.86	60	52	9	33	154	36
44	8276	45.62	57	41	39	38	175	729
45	PA 522-7	47.71	58	42	64	53	217	4761

46	PA 522-23	44.41	72	68	15	69	224	5776
47	PA 621-3274	52.59	68	61	21	63	213	4225
48	PA 724-2580	33.82	31	12,5	6	3	52,5	9120.25
49	PA 725-2154	45.70	27	20	4	7	58	8100
50	PA 725-4743	45.38	42	10	62	28	142	36
51	PA 725-4787	42.12	15	43	69	62	189	1681
52	PA 725-6113	34.62	11	47	33	47	138	100
53	PA 822-818	48.59	35	4	48	18	105	1849
54	ARK 0151-61	44.17	52	31	10	12	105	1849
55	AR 104-18	47.88	47	24	29	11	111	1369
56	Marys Quest	39.44	20	35	12	22	89	3481
57	Wodan	52.56	62	54	3	35	154	36
58	Gospodarski 48	31.43	10	48	28	46	132	256
59	5183	41.28	39	6	61	26	132	256
60	Tripolis	51.64	51	30	52	25	158	100
61	Krusevac	40.28	59	50	16	32	157	81
62	Boer	45.02	64	57	47	45	213	4225
63	Algerian	27.78	40	9	72	60	181	1089
64	Mirabel	39.78	49	28	60	29	166	324
65	Gerald	39.95	55	36	54	43	188	1600
66	Nuptiale	35.94	7	51	36	50	144	16
67	Solva	39.79	24	23	25	19	91	3249
68	Valiant	48.97	44	15	40	15	114	1156
69	Barra	56.75	70	64	46	66	246	9604
70	Carie	44.06	33	7,5	31	10	81,5	4422.25
71	Krypton	31.15	13	45	59	54	171	529
72	Chamois	32.48	2	65	70	67	204	3136
73	Emperor	37.54	4	55	34	55	148	0
Sum			2701	2701	2701	2701	10804	223496

SS_R – Regression sum square, χ^2 =124,12***; $\chi^2_{0,1\%}$ =112,32., *** Significant at $P \leq 0.001$

Within the studied collection, the number of genotypes with good stability for the number of grains in the panic is small. Other studies on character stability in oats, were conducted in six different locations to assess the stability of certain oats varieties from India. And in these studies, of the 11 genotypes evaluated, only three had good panicle stability, also tested by the number of grains in panicle. (Uzma et al., 2017) The oat character stability study can be performed by evaluating the characters in time or in more locations. Such combined studies are more selective, highlighting the genotypes with the highest degree of adaptation to different stress conditions. The plant productivity stability analysis aims to verify the response to environmental genotype interactions. Through such complex studies, it has been found out that of ten genotypes of oats, only two have good stability. Through such studies, the selection is rigorous (Mushtaq et all., 2013).

Applying the three methods is necessary because there is no method to accurately assess character stability in interaction with environmental factors.

CONCLUSIONS

The number of grains of panic is a major component of plant productivity. The values of this character are different from year to year. The varieties Jeferson, Carie, Florina, and lines 4458, PA 725-4743, PA 822-818 show high dynamic stability associated with high values of the number of grains of panicle, superior to the average of experience. For the breeding process, they are considered valuable, the genotypes with a number of grains in panicle, associated with low variability for all environmental conditions, as found in the Thonson, Penwin, Cocker 41-51 varieties. According to all processing models, it appears that the greatest stability of this character is represented by the genotypes: Nortex, Walken, PA 725-2154, Jeferson, Fulwood. In the studied collection, there are few genotypes with high values and good stability for the number of grains in panicle

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