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RESEARCH ON THE RESPONSE TO PROLONGED DROUGHT OF AN ASSORTMENT OF WHEAT VARIETIES, THROUGH THE RATE OF WATER LOSS FROM THE FLAG LEAF, ON THE CHERNOZEM OF CARACAL

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Abstract

A collection composed of 220 wheat varieties of various origins was studied in terms of the water loss rate at 4 h and 24 h from the initial weighing of 6 flag leaves and through the relationship between the determinations on 15 ears of each variant of the analyzed assortment (ear length, number of spikelets/ear, ear density, number of grains/ear, weight of grains/ear, mass of 1000 grains, ear harvest index) on the one hand and yield, on the other. The lowest water loss at 4 hours was manifested by the Pajura variety (0.019) and at 24 h by the Izvor variety (0.343). The correlations between yield and each of the studied elements suggested that it is strongly correlated with the ear harvest index (r=0.208) and correlated with the thousand weight grains (r=0.150) in a positive sense. There wasn't correlation between yield and the rate of water loss in 24 h, but the results obtained suggest possibilities to direct the behavior of wheat in drought conditions, if genes with a favorable effect are accumulated.

Key words*: wheat, drought, flag leaf, rate of water loss, yield.*

INTRODUCTION

It is necessary to increase wheat yield through breeding or agronomic management to cope with the continuous population growth and global food demand (Liu et al., 2024).

Drought is a severe environmental constraint, which significantly affects plant growth, productivity, and quality. Plants have developed specific mechanisms that perceive the stress signals and respond to external environmental changes via different mitigation strategies (Ali et al., 2020). One of the main objective of researchers is to maintain high productivity of crops under climate changes condition. In support of this objective comes genetic engineering, which is revolutionising agriculture, increasing resilience and improving crop adaptation (Bonciu et al., 2021; De Souza and Bonciu, 2022).

Winter wheat is characterized by high water requirements and a transpiration coefficient of 400-500 L/kg dry matter (Kus, 2016). This species is particularly sensitive to the lack of water in the period from tillering to the end of the shooting stage. The size and stability of winter wheat yields are also affected by the optimal sowing date (Shah et al., 2020).

Among biotic constrainers of wheat, fungal pathogens are the most important yield and quality limiting factors leading to yield losses by 15-10% and in favorable climatic conditions even by 60-70% (Cristea et al., 2015; Cotuna et al., 2021, 2022; Paraschivu et al., 2021). The management of wheat fungal diseases complex is based on technological measures and also on alternative organic products with fungicide effects (Paraschivu et al., 2024).

Excised leaf water loss has been suggested as a technique to identify cereal genotypes that loose less water through cuticle and incompletely closed stomata, mainly during the night. Environmental conditions have a large influence on the water content of freshly harvested leaves and on water loss from excised leaves (David, 2010).

Assessment of water loss from excised leaves has shown promise for characterizing drought resistance and thermo tolerance in wheat genotypes (Kaur et al., 2016; Mir et al., 2012).

According to Petcu (2005), the quantity of water lost through cuticle is up to 10-20 time lower than water loss by stomata. Nevertheless, under water stress conditions, when the stomata are closed, it represents the main way of water loss. The analysis of variance regarding water loss by cuticular transpiration showed a very significant influence of the treatment, genotype and their interaction, but the variance of treatment was higher than the variance due to genotypes (Petcu, 2005).

The current task of wheat breeding is to obtain productive cultivars with improved quality characteristics, high nutritional value, and resistance to adverse environmental conditions (Juzoń-Sikora et al., 2024). Drought stress affects wheat plants on many levels: growth inhibition and developmental disorders (Vassileva et al., 2023; Yasir et al., 2019; Yu et al., 2024).

A pot experiment was conducted by Shi et al. (2014) to investigate the physiological and morphological mechanisms of water use in two cultivars of winter wheat via partial root-zone drying (PRD). The results indicated that the weight of 1000 grains was higher under PRD conditions for both cultivars. Total water consumption per plant significantly decreased by 11.6 and 17.3%, and water-use efficiency significantly increased by 17.2 and 20.3% under PRD. Stomatal density increased under PRD, but stomatal width and area declined. Overall, the two types of winter wheat had both common and individual means of improving WUE under PRD conditions (Shi et al., 2014).

Saeidi and Abdoli (2015), reported that post anthesis water stress caused 34 and 27% reduction in grain yield and 1,000 grain weight in average, respectively. Also, post anthesis water stress significantly decreased harvest index in most cultivars. Under post-anthesis water stress, a positive correlation was found between grain weight and harvest index (Saeidi and Abdoli, 2015).

MATERIALS AND METHODS

Among the methods for identifying wheat (*Triticum* spp.) cultivars with better drought tolerance, the rate of water loss (RWL) from detached leaves was used, a method proposed by Clarke and McCaig (1982) and Clarke et al. (1989).

Six flag leaves were detached from the 220 wheat cultivars tested from each of the 3 replicates in the experimental field plots. The detached leaves were transported to the laboratory no later than 30 minutes and weighed to obtain the initial water content (IWC). Then, the leaves were dried for 4 hours under laboratory conditions in the PANASONIC climate chamber (20°C, in the dark) and weighed to obtain W_{4h} (weighing after 4 hours). The water lost after 4 hours by drying was calculated using the formula:

$WL_{4h} = (IWC-W_{4h})/DW$

where: IWC is the initial weight, W_{4h} – the weight after 4 hours and DW – the dry weight of the leaves.

Next, the leaves were dried for another 20 hours at 20°C in the same climate chamber and reweighed to obtain W_{24h} (weighing after 20 hours). After this, the leaves were oven-dried at 70°C to obtain the dry weight (DW).

Throughout the experimental period, the leaves were dried in controlled environments, in air-conditioned rooms, the parameters (temperature, light and humidity) being uniform throughout the experimental period.

Water loss in the period between 4 hours and 24 hours was estimated using the formula:

$WL_{4h-24h} = (W_{4h}-W_{24h})/DW$.

The differentiation was made according to the average of all tested varieties. The varieties that recorded values of the amount of water lost after 24 h above this average by 25% minus were highlighted – the maximum limit difference that is perceived as correct in statistical calculation. In our case: 0.580.

Determinations were made on 15 ears of each variant of the analyzed assortment regarding ear length, number of spikelets/ear, ear density, number of grains/ear, grain weight/ear, mass of 1000 grains, ear harvest index.

RESULTS AND DISCUSSIONS

Food security has a fundamental importance for human existence, and increasing wheat production under climate change is, from this point of view, one of the permanent challenges for farmers (Bonciu et al., 2021; Dihoru et al., 2023; Paunescu et al., 2021; 2023; Rădoi et al., 2022; Rosculete et al., 2023). Also, wheat

contribute to economic stability and growth in rural communities (Bonciu, 2023).

Water scarcity in agricultural systems can occur slowly or suddenly. Plant responses to water stress differ depending on the degree of manifestation and its duration. The level of sensitivity of plants under water scarcity conditions depends primarily on the management of its content and the adjustments of their own metabolism (Juzoń-Sikora, 2024).

The rate of water loss from detached leaves, determined using the initial water content of the leaves, fresh biomass or dry biomass, has been proposed by many authors as a criterion for the selection of drought-tolerant plants (David, 2010). Numerous national and global studies have highlighted significant and positive correlations between water content in cut leaves and wheat production under drought conditions (Bhutto et al., 2023; Geravandi et al., 2011; Hussein et al., 2023), but there have also been studies that have not highlighted this aspect (Clarke et al., 1989; Dabiry et al., 2015).

Lower values of water loss indicate better tolerance of plants to water deficits, and significant negative correlations between water loss and yield were found in doubled haploid wheat lines (Czyczylo-Mysza et al., 2018). The results of the above study indicated that genotypes with the lowest values of water loss are characterized by efficient water management and can perform better under water deficit conditions, unlike those with high values of this parameter.

In our study, genetic variability was identified for the wheat genotypes analyzed for the analyzed indicator. The results showed that the dynamics of water loss differed significantly between varieties, the coefficient of variability being 18.1%. The highest initial water content was recorded by the varieties Exsal, Lemmy, Agilis, Klima, Tika Taka, Unic, all above the average values (1.930 g).

In the first 4 hours, on average, the lowest water losses were suffered by the varieties Pajura, Ekonom, Izvor, Tarroca, Papillon, Thalamus, Dacic, Evident, Litera, Biharia, Bezostaia, Foxil Gruia, Capo and Nikifor, all with values below 0.3 g. The results coincide with the information we have about the tested varieties, but it should be noted that most of them are Romanian varieties, much better adapted to the area conditions.

It is known that the Izvor variety is a drought-resistant variety, an aspect confirmed by Păunescu R.A. and Păunescu G. (2019) who determined the water loss rate of an assortment of 50 varieties on the luvosol from Șimnic. Also, the Biharia variety achieved some of the highest productions in the area despite the drought.

Regarding water loss after another 20 hours, on average, the Izvor, Izalco and Carom varieties stood out, with very low losses, below 0.5 g. The results are confirmed by the fact that the Carom wheat variety, the newest creation of the University of Craiova, was obtained through the improvement process under the conditions of Caracal, where the testing was done (Table 1).

In addition, based on the results, the varieties Absint, Tarroca, Solveig, Atuan, Pibrac, Cazimir, Mobile, Novic and Palmeo stood out with water loss in 24 hours above the average of all varieties reduced by 25%. In conclusion, the rate of water loss from the flag leaf can be an indicator based on which to make an assessment of drought tolerance, at least for the type of drought that occurred in Caracal.

The correlation between production and water loss after 24 hours is not evident for the 220 wheat varieties tested (r=-0.05). The cloud of points placed in the form of a ball next to the right of the equation visually indicates this finding. However, the result suggests that the Concret and Stromboli varieties that recorded very high yields (over 9000 kg/ha) lost little water after 24 hours, and they can be recommended as tolerant to the drought manifested in Caracal (Figure 1).

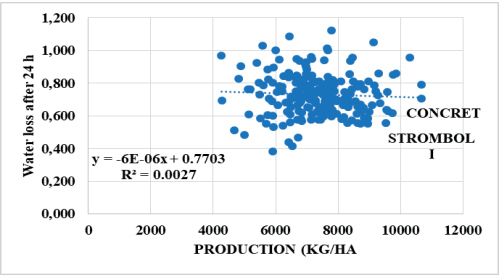

Figure 1. Production - water loss relationship after 24 hours

Table 1. Results regarding water loss from flag leaves of the tested variety

VARIETIES	WEIGHINGS			LOSSES after		dry weight	WL_{4h}	$WL_{24\ h}$
	initial weight	after 4 h	after 20 h	4 h (W_{4h})	24 h (W_{24h})			
IZVOR	2.312	2.204	1.961	0.108	0.351	0.709	0.152	0.343
IZALCO	2.565	2.178	1.846	0.387	0.719	0.765	0.506	0.434
CAROM	2.312	1.953	1.639	0.359	0.673	0.720	0.498	0.436
ABSINT	2.06	1.832	1.534	0.228	0.526	0.588	0.388	0.507
TARROCA	2.512	2.347	1.947	0.165	0.565	0.745	0.221	0.537
SOLVEIG	1.437	1.285	1.018	0.152	0.419	0.492	0.309	0.543
ATUAN	1.982	1.687	1.39	0.295	0.592	0.542	0.544	0.548
PIBRAC	1.984	1.606	1.265	0.378	0.719	0.620	0.610	0.550
CAZIMIR	1.902	1.618	1.291	0.284	0.611	0.592	0.480	0.552
MOBILE	1.696	1.409	1.081	0.287	0.615	0.588	0.488	0.558
NOVIC	1.693	1.421	1.128	0.272	0.565	0.525	0.518	0.558
RGT PALMEO	1.44	1.234	0.953	0.206	0.487	0.492	0.419	0.571
AMANDUS	1.836	1.519	1.151	0.317	0.685	0.630	0.503	0.584
LENNOX	2.602	2.045	1.551	0.557	1.051	0.844	0.660	0.585
MOSCHUS	2.122	1.793	1.442	0.329	0.68	0.599	0.549	0.586
TRUBLION	1.846	1.527	1.103	0.319	0.743	0.722	0.442	0.587
KWS FLEXUM	1.858	1.534	1.114	0.324	0.744	0.714	0.454	0.588
JOKER	2.396	2.051	1.628	0.345	0.768	0.712	0.485	0.594
BASALTIC	1.447	1.282	0.988	0.165	0.459	0.490	0.337	0.600
EPILOG	2.086	1.758	1.368	0.328	0.718	0.650	0.505	0.600
SOMTUOSO	1.86	1.595	1.242	0.265	0.618	0.588	0.451	0.600
ATHLON	1.599	1.123	0.854	0.476	0.745	0.448	1.063	0.600
KWS USUEL	2.088	1.755	1.341	0.333	0.747	0.683	0.488	0.606
SORRIAL	2.036	1.81	1.445	0.226	0.591	0.602	0.375	0.606
RGT VENEZIO	1.885	1.568	1.217	0.317	0.668	0.575	0.551	0.610
SOSTHENE	2.11	1.844	1.482	0.266	0.628	0.592	0.449	0.611
KWS ULTIM	1.346	1.145	0.905	0.201	0.441	0.392	0.513	0.612
HY FI	2.334	1.421	1	0.913	1.334	0.682	1.339	0.617
RGT CESARIO	1.751	1.526	1.183	0.225	0.568	0.548	0.411	0.626
KWS STROMBOLI	2.137	1.884	1.514	0.253	0.623	0.590	0.429	0.627
PROMITOR	1.795	1.516	1.129	0.279	0.666	0.616	0.453	0.628
AURELIUS	1.651	1.438	1.138	0.213	0.513	0.475	0.448	0.632
SY ROCINANTE	1.844	1.671	1.341	0.173	0.503	0.522	0.331	0.632
ASTERION	1.248	1.119	0.88	0.129	0.368	0.377	0.342	0.634
BC OPSESIJA	1.401	1.177	0.893	0.224	0.508	0.445	0.503	0.638
THALAMUS	1.331	1.217	0.964	0.114	0.367	0.390	0.292	0.649
ADELINA	1.192	0.884	0.666	0.308	0.526	0.336	0.917	0.649
PG 102	2.12	1.734	1.354	0.386	0.766	0.585	0.660	0.650
ATTRAKTION	1.714	1.427	1.08	0.287	0.634	0.534	0.537	0.650
MAXENCE	2.16	1.813	1.42	0.347	0.74	0.603	0.575	0.652
MUTIC	1.355	1.186	0.922	0.169	0.433	0.405	0.417	0.652
AVENUE	1.48	1.246	0.964	0.234	0.516	0.432	0.542	0.653
OMERSSON	1.714	1.484	1.128	0.23	0.586	0.544	0.423	0.654

COLUMNA	2.397	2.077	1.626	0.32	0.771	0.689	0.464	0.655
CONCRET	1.511	1.24	0.95	0.271	0.561	0.442	0.613	0.656
PYTHON	2.001	1.668	1.27	0.333	0.731	0.605	0.550	0.658
KWS PEPLUM	2.096	1.835	1.449	0.261	0.647	0.585	0.446	0.660
KWS RHUM	2.18	1.807	1.411	0.373	0.769	0.599	0.623	0.661
EMBLEM	1.765	1.457	1.092	0.308	0.673	0.550	0.560	0.664
PERKUSSIO	1.425	1.27	0.942	0.155	0.483	0.493	0.314	0.665
KWS USUELLUM	1.309	1.13	0.881	0.179	0.428	0.374	0.479	0.666
CORDIAL	1.457	1.241	0.908	0.216	0.549	0.498	0.434	0.669
RGT LETSGO	1.415	1.16	0.873	0.255	0.542	0.429	0.594	0.669
FLAVOR	2.434	1.538	1.073	0.896	1.361	0.694	1.291	0.670
BOGDANA	1.558	1.308	0.99	0.25	0.568	0.470	0.532	0.677
AIRBUS	2.042	1.799	1.401	0.243	0.641	0.587	0.414	0.678
SOPHIE	1.736	1.55	1.201	0.186	0.535	0.511	0.364	0.683
LG ABSALON	1.286	1.131	0.9	0.155	0.386	0.338	0.459	0.683
AGX	1.805	1.482	1.109	0.323	0.696	0.544	0.594	0.686
SACRAMENTO	1.872	1.577	1.166	0.295	0.706	0.597	0.494	0.688
CONCURENT	1.906	1.605	1.273	0.301	0.633	0.482	0.624	0.689
RUBISKO	1.146	0.974	0.726	0.172	0.42	0.358	0.480	0.693
ASCONA	1.217	1.02	0.771	0.197	0.446	0.358	0.550	0.696
FAGUR	1.741	1.473	1.061	0.268	0.68	0.592	0.453	0.696
EVERY	2.376	1.949	1.431	0.427	0.945	0.744	0.574	0.696
FOXIL	1.909	1.754	1.365	0.155	0.544	0.557	0.278	0.698
RGT PACTEO	1.611	1.47	1.142	0.141	0.469	0.469	0.301	0.699
SILAS	1.594	1.389	1.078	0.205	0.516	0.444	0.462	0.700
PROVIDENCE	1.517	1.243	0.917	0.274	0.6	0.464	0.591	0.703
CONSORTIUM	1.808	1.614	1.239	0.194	0.569	0.533	0.364	0.704
BASILIO	1.714	1.372	0.983	0.342	0.731	0.552	0.620	0.705
SIMNIC 60	1.902	1.677	1.245	0.225	0.657	0.612	0.368	0.706
SOTHYS	1.734	1.507	1.147	0.227	0.587	0.509	0.446	0.707
AMBURGO	1.762	1.481	1.091	0.281	0.671	0.550	0.511	0.709
TARASCON	1.914	1.672	1.261	0.242	0.653	0.579	0.418	0.710
CSIKO	2.601	2.181	1.627	0.42	0.974	0.780	0.538	0.710
OTILIA	2.239	1.551	1.079	0.688	1.16	0.664	1.036	0.711
BOLOGNA	1.731	1.453	1.066	0.278	0.665	0.544	0.511	0.711
LG APILCO	1.711	1.172	0.875	0.539	0.836	0.416	1.296	0.714
RGT VIVENDO	1.463	1.285	0.945	0.178	0.518	0.475	0.375	0.716
CENTURION	2.096	1.741	1.295	0.355	0.801	0.622	0.571	0.717
SY EXALTATION	1.602	1.391	1.101	0.211	0.501	0.402	0.525	0.721
COMBIN	1.554	1.295	0.96	0.259	0.594	0.464	0.558	0.722
SOLENZARA	1.659	1.482	1.156	0.177	0.503	0.451	0.392	0.723
MIX CEREALE	2.28	1.881	1.368	0.399	0.912	0.709	0.563	0.724
SY SANLUCA	2.236	1.981	1.488	0.255	0.748	0.680	0.375	0.725
ANDINO	1.492	1.283	0.927	0.209	0.565	0.491	0.426	0.725
SONATHINE	2.24	1.968	1.474	0.272	0.766	0.680	0.400	0.726
BRIA	2.325	1.868	1.316	0.457	1.009	0.757	0.604	0.729
LUXEO	1.535	1.314	0.99	0.221	0.545	0.444	0.498	0.730

GABRIO	1.779	1.483	1.101	0.296	0.678	0.522	0.567	0.732
ALGORITMO	2.005	1.618	1.13	0.387	0.875	0.662	0.585	0.737
PG 101	1.758	1.454	1.049	0.304	0.709	0.549	0.553	0.737
EXSAL	3.068	2.697	2.034	0.371	1.034	0.897	0.414	0.739
SOFRU	1.606	1.421	1.109	0.185	0.497	0.420	0.440	0.743
DALLARA	2.252	1.946	1.457	0.306	0.795	0.658	0.465	0.743
APEXUS	1.777	1.469	1.048	0.308	0.729	0.566	0.544	0.744
BARBA	2.119	1.819	1.392	0.3	0.727	0.572	0.524	0.747
VOLTEO	1.706	1.438	1.039	0.268	0.667	0.533	0.503	0.748
BASMATI	1.442	1.193	0.871	0.249	0.571	0.429	0.580	0.751
IRUN	2.028	1.823	1.373	0.205	0.655	0.599	0.342	0.751
LOVRIN 9Z	1.865	1.593	1.222	0.272	0.643	0.492	0.553	0.754
DARNIC	2.326	1.905	1.369	0.421	0.957	0.710	0.593	0.755
CARACAL 1	2.011	1.666	1.221	0.345	0.79	0.588	0.587	0.757
SILVERIO	1.672	1.385	1.032	0.287	0.64	0.466	0.616	0.758
OBIWAN	1.95	1.679	1.251	0.271	0.699	0.564	0.480	0.759
SY EXCEPTION	1.934	1.679	1.26	0.255	0.674	0.552	0.462	0.759
LOVRIN 90	1.914	1.62	1.215	0.294	0.699	0.533	0.552	0.760
ANAPURNA	1.426	1.183	0.857	0.243	0.569	0.429	0.566	0.760
CEZAR	1.639	1.397	1.038	0.242	0.601	0.472	0.513	0.761
GARAVUSA	1.914	1.547	1.01	0.367	0.904	0.702	0.523	0.765
SY LIRICO	1.565	1.385	1.086	0.18	0.479	0.390	0.462	0.767
RGT BORSALINO	2.006	1.713	1.21	0.293	0.796	0.652	0.449	0.771
SOCADE_CS	1.277	1.104	0.827	0.173	0.45	0.358	0.483	0.774
GK ARATO	2.369	1.922	1.348	0.447	1.021	0.740	0.604	0.775
VICTORAS	2.136	1.722	1.206	0.414	0.93	0.664	0.623	0.777
BALTAG	1.435	1.225	0.891	0.21	0.544	0.429	0.490	0.779
TOCAYO	1.713	1.423	0.989	0.29	0.724	0.555	0.523	0.782
SOLINDO	1.738	1.549	1.207	0.189	0.531	0.437	0.432	0.783
AIDA	1.98	1.687	1.235	0.293	0.745	0.577	0.508	0.783
MOISSON	1.694	1.465	1.096	0.229	0.598	0.469	0.488	0.787
GUIDO	2.51	1.951	1.341	0.559	1.169	0.774	0.722	0.788
WINDO	2.256	1.95	1.415	0.306	0.841	0.675	0.453	0.793
SY TRANSITION	2.368	2.05	1.533	0.318	0.835	0.652	0.488	0.793
PITAR	2.049	1.799	1.32	0.25	0.729	0.601	0.416	0.797
MUSIK	1.635	1.385	1.027	0.25	0.608	0.448	0.558	0.799
WINNER	1.44	1.187	0.837	0.253	0.603	0.437	0.579	0.801
SORELA	1.933	1.661	1.18	0.272	0.753	0.600	0.453	0.802
ARNOLD	1.079	0.898	0.642	0.181	0.437	0.319	0.567	0.803
ACHIM	2.543	2.198	1.602	0.345	0.941	0.740	0.466	0.805
UNIC	2.882	2.406	1.697	0.476	1.185	0.877	0.543	0.808
KWS LAZULI	1.795	1.523	1.104	0.272	0.691	0.518	0.525	0.809
MIRANDA FDL	2.392	1.95	1.345	0.442	1.047	0.748	0.591	0.809
KWS MILANUM	1.776	1.443	0.967	0.333	0.809	0.588	0.566	0.810
FOXX	1.956	1.547	1.068	0.409	0.888	0.591	0.692	0.810
KWS ETERNEL	1.73	1.5	1.046	0.23	0.684	0.559	0.411	0.812

ZENDALEE	1.519	1.258	0.915	0.261	0.604	0.422	0.618	0.813
ARMURA	2.029	1.781	1.303	0.248	0.726	0.588	0.422	0.813
SCRAMBLER	1.543	1.281	0.922	0.262	0.621	0.440	0.595	0.816
MONTE CARLO	1.898	1.645	1.249	0.253	0.649	0.485	0.522	0.816
SY PASSION	1.644	1.448	1.091	0.196	0.553	0.437	0.449	0.817
SY STARLORD	2.089	1.817	1.331	0.272	0.758	0.592	0.459	0.821
EXOTIC	2.331	2.088	1.502	0.243	0.829	0.711	0.342	0.824
TIBERIUS	1.845	1.631	1.155	0.214	0.69	0.577	0.371	0.826
LEXIO	1.799	1.549	1.108	0.25	0.691	0.532	0.470	0.829
KAPITOL	1.815	1.506	1.051	0.309	0.764	0.548	0.564	0.830
SY OLEN	1.664	1.456	1.061	0.208	0.603	0.475	0.438	0.832
CARACAL	2.847	2.178	1.437	0.669	1.41	0.890	0.752	0.833
KRALJICA	2.171	1.683	1.006	0.488	1.165	0.811	0.602	0.835
DJANGO	1.87	1.554	1.093	0.316	0.777	0.550	0.575	0.838
FALADO	2.188	1.814	1.262	0.374	0.926	0.657	0.569	0.840
KWS CRITERIUM	1.845	1.469	1.055	0.376	0.79	0.492	0.764	0.841
Mv Nador	2.504	2.159	1.515	0.345	0.989	0.765	0.451	0.842
VLADIMIR	1.828	1.485	1.003	0.343	0.825	0.571	0.600	0.844
SY MILTEO	1.892	1.674	1.209	0.218	0.683	0.550	0.396	0.845
ALCANTARA	1.651	1.476	1.127	0.175	0.524	0.412	0.425	0.847
BORSALINO	1.541	1.31	0.93	0.231	0.611	0.448	0.516	0.848
SIMNIC 1412	1.99	1.556	0.96	0.434	1.03	0.702	0.618	0.849
PROPULSO	1.996	1.724	1.229	0.272	0.767	0.583	0.467	0.849
FILON	1.598	1.342	0.97	0.256	0.628	0.438	0.584	0.849
BOEMA	1.742	1.474	1.011	0.268	0.731	0.545	0.492	0.850
SOLIFLOR	1.923	1.644	1.176	0.279	0.747	0.550	0.507	0.851
TIKA TAKA	2.978	2.586	1.878	0.392	1.1	0.831	0.472	0.852
PAPILLON	2.318	2.123	1.517	0.195	0.801	0.710	0.275	0.854
SOESKI	1.678	1.479	1.118	0.199	0.56	0.422	0.472	0.855
GLOSA	1.69	1.388	1.027	0.302	0.663	0.422	0.716	0.855
ABUND	1.615	1.273	0.917	0.342	0.698	0.416	0.822	0.856
DACIC	2.274	2.092	1.499	0.182	0.775	0.689	0.264	0.861
ORTOLAN	2.767	2.306	1.605	0.461	1.162	0.812	0.568	0.863
AMICUS	1.331	1.151	0.828	0.18	0.503	0.374	0.481	0.864
KWS ENCLUM	1.634	1.354	0.98	0.28	0.654	0.433	0.647	0.864
VIKTORIA	1.518	1.303	0.933	0.215	0.585	0.428	0.502	0.864
ACTIVUS	1.79	1.442	0.995	0.348	0.795	0.516	0.674	0.866
INGENIO	2.536	2.017	1.368	0.519	1.168	0.745	0.697	0.871
AXUM	1.8	1.553	1.106	0.247	0.694	0.512	0.482	0.873
AMURG	2.812	2.388	1.702	0.424	1.11	0.785	0.540	0.874
MODERN	1.877	1.624	1.216	0.253	0.661	0.466	0.543	0.876
IRIS 12	2.053	1.691	1.172	0.362	0.881	0.591	0.613	0.878
LEMMY	3.285	2.789	2.066	0.496	1.219	0.822	0.603	0.880
EUCLIDE	2.31	1.884	1.249	0.426	1.061	0.720	0.592	0.882
TATA MATA	2.014	1.713	1.181	0.301	0.833	0.602	0.500	0.884
COMPLICE	1.668	1.438	1.053	0.23	0.615	0.435	0.529	0.885

KORELI	2.103	1.655	1.117	0.448	0.986	0.603	0.743	0.892
KWS EXTREM	1.636	1.491	1.085	0.145	0.551	0.455	0.319	0.892
EKONOM	2.264	2.231	1.653	0.033	0.611	0.645	0.051	0.896
OROLOGE	2.603	2.116	1.387	0.487	1.216	0.813	0.599	0.896
MONTECRISTO	2.409	2.051	1.408	0.358	1.001	0.711	0.504	0.904
KWS SPHERE	1.608	1.408	1.031	0.2	0.577	0.415	0.482	0.908
RULER	1.655	1.44	1.054	0.215	0.601	0.423	0.508	0.913
ELENUS	1.75	1.441	0.982	0.309	0.768	0.502	0.616	0.914
TOSCADOU	1.901	1.538	1.003	0.363	0.898	0.584	0.622	0.916
KAROQUE	2.079	1.743	1.19	0.336	0.889	0.600	0.560	0.922
EMISAR	2.484	1.935	1.314	0.549	1.17	0.672	0.817	0.924
EVIDENT	1.844	1.761	1.217	0.083	0.627	0.586	0.142	0.928
KWS MARVEL	1.786	1.592	1.161	0.194	0.625	0.464	0.418	0.929
FRENETIC	1.859	1.664	1.185	0.195	0.674	0.512	0.381	0.936
REGINA	2.548	2.061	1.312	0.487	1.236	0.797	0.611	0.940
SOLEHIO	1.652	1.425	1.038	0.227	0.614	0.411	0.552	0.942
SEMNAL	2.198	1.892	1.299	0.306	0.899	0.628	0.487	0.944
ASPEKT	1.793	1.552	1.059	0.241	0.734	0.522	0.462	0.944
LITERA	2.133	1.997	1.437	0.136	0.696	0.585	0.232	0.957
TOMCAT	1.5	1.341	0.967	0.159	0.533	0.388	0.410	0.964
LEONIDUS	2.736	2.371	1.639	0.365	1.097	0.755	0.483	0.970
SIMNIC 1619	2.638	2.113	1.335	0.525	1.303	0.802	0.655	0.970
VOINIC	2.209	1.678	1.098	0.531	1.111	0.596	0.891	0.973
ANGELICA	1.642	1.405	0.995	0.237	0.647	0.415	0.571	0.988
GERRY	1.979	1.751	1.172	0.228	0.807	0.578	0.394	1.002
URSITA	1.641	1.358	0.946	0.283	0.695	0.411	0.689	1.002
BIHARIA	2.733	2.533	1.744	0.2	0.989	0.780	0.256	1.012
TORONTO	1.714	1.416	0.855	0.298	0.859	0.552	0.540	1.016
PAJURA	2.051	2.04	1.44	0.011	0.611	0.585	0.019	1.026
KLIMA	2.934	2.356	1.517	0.578	1.417	0.817	0.707	1.027
CONSECVENT	1.731	1.524	0.986	0.207	0.745	0.522	0.397	1.031
KATARINA	2.529	2.235	1.436	0.294	1.093	0.749	0.393	1.067
BEZOSTAIA	1.283	1.217	0.792	0.066	0.491	0.393	0.168	1.081
FELIX	2.12	1.922	1.289	0.198	0.831	0.585	0.338	1.082
CHEVIGNON	1.888	1.65	1.045	0.238	0.843	0.550	0.433	1.100
ALAHAMBRA	2.155	1.795	1.16	0.36	0.995	0.555	0.649	1.144
GATINEL	2.269	1.871	1.077	0.398	1.192	0.664	0.599	1.196
IS AGILIS	3.283	2.659	1.547	0.624	1.736	0.832	0.750	1.337
AVERAGE								0.773

In contrast, the correlation between the initial water quantity and water loss after 24 hours is a strongly positive correlation (r=0.216) (>P 1%). Thus, a variety with a high initial quantity has an equally high water loss. At the opposite pole, the Izvor, Carom, Tarroca and Izalco varieties were differentiated, which, although they presented high initial quantities, had low water losses after 24 hours (Figure 2).

The variability of the characters was quite pronounced. The limits of variation were as follows: for spike length between 7.1 cm for the Musik variety and 12.8 cm for the Yhalamus variety; for the number of

spikelets/spike from 14.5 for the SY Olen variety to 26.8 for the Tomcat variety; for spike density from 15.66 for the Promitor variety to 26.17 for the Cordial variety; in the number of grains/spike from 28 grains/sp. in Emisar to 74 grains/spike in Tarroca; in the weight of grains/spike from 1.14 g/spike in Emisar to 3.10 g/spike in Tarroca; in the mass of 1000 grains from 29.83 g in the Kapitol variety to 53.56 g in the Ingenio variety and in the harvest index of the spike from 0.41 in Emisar to 1.27 in the KWS Peplum variety.

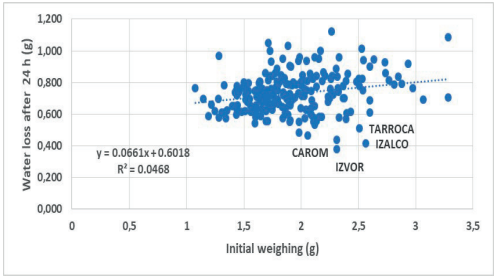

Figure 2. Relationship between initial weight and water loss after 24 hours

In general, long spikes are lax. The correlation, although strong (r=-0.233) (>P 1%) is negative in the sense that varieties that presented long spikes recorded low yields. The only variety that stood out as having high production – 9220 kg/ha at a spike length of approximately 10 cm was Lazuli. The variability of spike length explains 5% of the variability of production for the studied variety, in terms of the coefficient of determination (Figure 3).

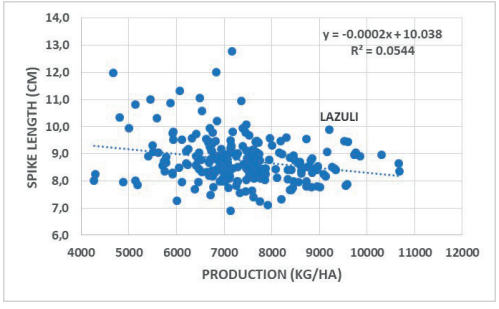

Figure 3. Production - ear length relationship

The correlation between production and the harvest index of the ears is a strong correlation (r=0.208) (>P 1%) (Figure 4).

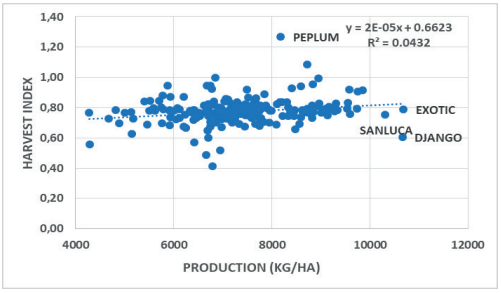

Figure 4. Production - harvest index relationship

CONCLUSIONS

The results showed that the dynamics of water loss differed greatly between varieties, the coefficient of variability being quite high (18.1%) but still average.

The highest initial water content was recorded by the varieties Exsal, Lemmy, Agilis, Klima, Tika Taka, Unic, all above the average values (1.930 g).

In the first 4 hours, on average, the lowest water losses were suffered by the varieties Pajura, Ekonom, Izvor, Tarroca, Papillon, Thalamus, Dacic, Evident, Litera, Biharia, Bezostaia, Foxil Gruia, Capo and Nikifor, all with values below 0.3 g. Most of these varieties are Romanian varieties, much better adapted to the conditions in the area.

Regarding water loss after another 20 hours, on average, the Izvor varieties (confirmed result), Izalco and Carom stood out, with very low losses, below 0.5 g.

The results are confirmed by the fact that the Carom wheat variety, the newest creation of the University of Craiova, was obtained through the improvement process under the conditions of Caracal, where the testing was done. Also, the correlation between the initial amount of water and the water loss after 24 hours, which is a strongly positive correlation, highlighted as deviations the Izvor, Carom, Tarroca and Izalco varieties, which, although they presented high initial amounts, had low water losses after 24 hours.

In addition, based on the results, the varieties Absint, Tarroca, Solveig, Atuan, Pibrac, Cazimir, Mobile, Novic and Palmeo stood out with water losses in 24 hours above the average of all varieties reduced by 25%.

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