RESEARCH REGARDING WINTER WHEAT SOWING TIME UNDER CONDITIONS OF MOLDAVIAN CENTRAL PLATEAU

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ABSTRACT

Among the measures which contribute to winter wheat yield increasing, the sowing time presents a great importance. The results of the performed research emphasize that the new cultivars are more exacting to the sowing time than the older ones. The paper presents the behaviour of winter wheat as regards the yield depending on the sowing time under conditions of Moldavian Central Plateau. Ten sowing times were studied: 1 – September 15th; 2 – September 25th; 3 – October 1st; 4 – October 5th; 5 – October 10th; 6 – October 20th; 7 – October 30th; 8 – November 5th; 9 – November 10th; 10 – November 20th. Rapid cultivar (released by Research Institute for Cereals and Industrial Crops Fundulea), was sown. The greatest yields were achieved when the sowing was done during September 25th – October 10th. On an average, during the three years of research, the late sowing led to the yield losses of 27.3–55.5%.

Key words: grain yield, sowing time, winter wheat.

INTRODUCTION

Under conditions in which plant breeding put at disposal of farmers, new wheat cultivars with increased agro-productive characteristics, the agro-phytotechnical research has to establish efficient crop technologies (Bîlteanu, 1998; Hera and Sin, 1980; Pânzaru et al., 1992). The sowing time is very important and it determines a good establishment of the crop, the winter hardiness, the evolution of pests and diseases attack, all these with direct implications on quantitative and qualitative level as well as on crop economical efficiency.

The results of the performed research emphasize that the new cultivars are more exacting to the sowing time than the older ones (Bîlteanu, 1998).

The paper presents the behaviour of winter wheat as regards the yield depending on the sowing time under conditions of Moldavian Central Plateau.

MATERIALS AND METHODS

The experiment was placed at Secuieni Agricultural Research Station (1997–1999) on a typical cambic chernozem: pH = 6.6; humus – 2.5%; total N – 0.15%; P_2O_5 – 17 ppm; K_2O – 195 ppm; C : N – 11.1; Da =1.3 t/m^3; Cc = 25.6%; Co = 12% (Figure 1).

Ten sowing times were studied:

- first sowing time – September 15th;
- second sowing time – September 25th;
- third sowing time – October 1st;
- fourth sowing time – October 5th;
- fifth sowing time – October 10th;
- sixth sowing time – October 20th;
- seventh sowing time – October 30th;
- eighth sowing time – November 5th;
- ninth sowing time – November 10th;
- tenth sowing time – November 20th.

Rapid cultivar, released by R.I.C.I.C. Fundulea and registered in 1992, was sown. The experimental data were statistically pro-cessed by the ANOVA test.

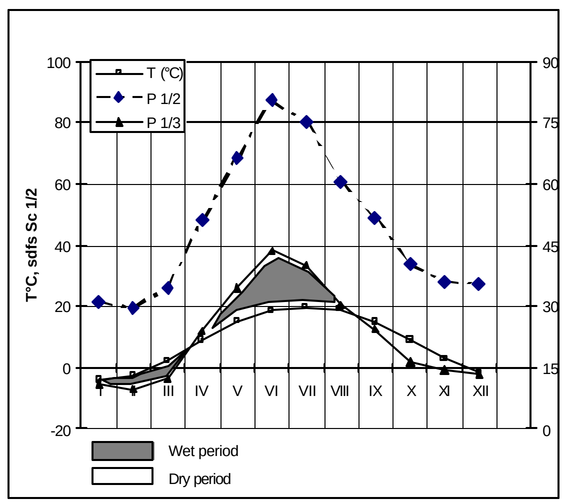

Figure 1. Climadiagram. Secuieni, Neamþ County

RESULTS AND DISCUSSION

The grain yield was influenced by the climatic conditions of the experimentation year,

[*)] Agricultural Research Station, Secuieni, Neamt County, Romania but especially by the sowing time (Table 1) and varied between 1,169 and 6,422 kg/ha.

Considering the average of 1997–1999, the yields ranged between 2,255 and 5,099 kg/ha. Yearly, the greatest yields were achieved when the winter wheat was sown during September 25th–October 10th. Thus, the yields achieved in 1997 were of 5,264–6,422 kg/ha, in 1998 of 4,908–5,095 kg/ha in 1999 of 3,733–3,970 kg/ha and of 4,635–5,099 kg/ha in accordance with 1997–1999 average.

The early sowing (September 15th) led to some yield losses as compared with the sowing time considered as control (October 1st), which were of 650 kg/ha (10.6%) in 1997; 643 kg/ha (9.5%) in 1998; 374 kg/ha (9.4%) in 1999 and 503 kg/ha (10%) considering the 1997–1999 average.

The sowing in November generated, in comparison with the same control, yield losses of 1,840–2,614 kg/ha (30.1–42.7%) in 1997; 1,259–3,926 kg/ha (24.8–87.1%) in 1998; 1,039–1,882 kg/ha (26.2–47.5%) in 1999 and 1,381–2,809 kg/ha (27.3–55.5%) during 1997–1999. The inferior limits correspond to the sowing in the first part of November, and the superior limits, to the sowing in the second decade of November.

Between the grain yield and the sowing time, represented by the number of days of delayed sowing vs. October 1st, a very strongly indirect correlation was established (Figure 2): for each late day of delayed sowing the yield decreases with 45.79 kg/ha.

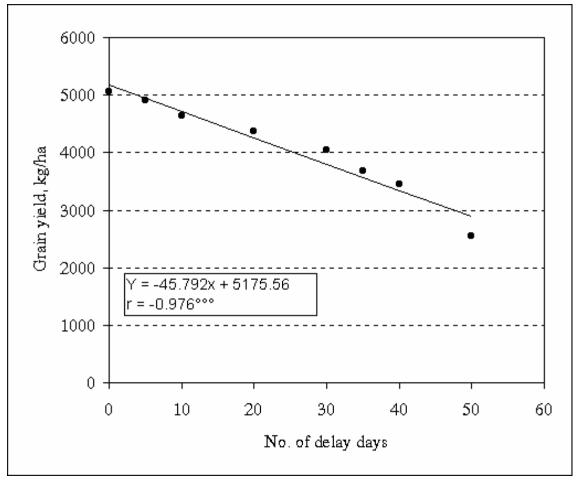

Figure 2 Correlation between number of days of delayed sowing and grain yield in Rapid winter wheat cultivar (Secuieni, 1997–1999)

Unlike the above mentioned correlation, a strong direct correlation was established between the winter wheat yield losses and the number of delay days (Figure 3).

The yield losses registered due to delayed sowing (Table 2), varied depending on the experimentation year and the number of delay days.

Thus, the yield losses, expressed in kg/ha/day, were greater under 1997 year conditions (52.4–86.4 kg/ha/day) and smaller in 1999 (12.6–37.6 kg/ha/day). Considering the average of the 1997–1999 period, the yield losses due to delayed sowing ranged between 33.2–56.1 kg/ha/day. The superior limits were specific to the greater number of delayed sowing days.

Table 2. Yield losses (kg/ha/day) in winter wheat –

Table 1. Influence of sowing time of winter wheat, Rapid cultivar, on grain yield (Secuieni, 1997–1999)

Sowing time	Grain yield, kg/ha						
	1997	1998	1999	1997–1999 average			
				kg/ha	%	diff.	signif.
15th September	5,472	4,613	3,596	4,561	90.0	-503	000
25th September	6,422	5,048	3,827	5,099	100.1	35	-
1st October	6,122	5,095	3,970	5,064	100.0	ct.1	-
5th October	5,788	5,001	3,907	4,899	96.7	-165	-
10th October	5,264	4,908	3,733	4,635	91.5	-429	00
20th October	5,022	4,563	3,541	4,376	86.4	-688	000
30th October	4,382	4,505	3,262	4,050	79.9	-1014	000
5th November	4,282	3,836	2,931	3,683	72.7	-1381	000
10th November	3,840	3,868	2,647	3,452	68.1	-1612	000
20th November	3,508	1,169	2,088	2,255	44.5	-2809	000
LSD 5%	294	316	110	231 kg/ha			
1%	397	427	148	320 kg/ha			
0.1%	529	569	198	433 kg/ha			

Rapid cultivar (Secuieni, 1997–1999)

No of delay days	Yield losses, kg/ha/day			
	1997	1998	1999	1997–1999
5	68	18.8	12.6	33.1
10	86.4	18.7	23.7	42.9
20	55.3	26.6	21.4	34.4
30	58.2	19.6	23.6	33.9
35	52.7	35.97	29.6	39.4
40	57.2	30.6	33.0	40.2
50	52.4	78.5	37.6	56.1

Analysing the productivity elements of the crop (Table 3), it has been ascertained that they were influenced by the sowing time as well as by the climatical conditions of each year. So, the number of harvested plants/m^2 has decreased, according to the delayed sowing, up to 17.1% in 1998 and 17.6% in 1999 and was not influenced by the sowing time in 1997, when the beginning of fall was droughty and the previous sowing emerged poorly.

The correlation between the number of delay days and the number of harvested plants/m^2 during 1997-1999 is represented in figure 4 and it is statistically assured as distinctly significant.

The number of spikes/m^2 was superior to the experiment average for sown times in interval September 25th–October 10th with 3.8–17.7% in 1997; with 7.3–14.3% in 1998 and with 15.0–34.5% in 1999. The sowing in November determined the reduction of the number of spikes/m^2 compared with sowing at 1st October with 35.2 in 1997, 44.1% in 1998 and 50.5% in 1999.

In the case of sowing in the second decade of November, the spike number/m^2 is smaller than the plant number/m^2 at emergence, showing that the productive tilling ability had subunitary values. Among the crop productivity elements, the most influenced by the sowing time was the spike number/m^2, which also registered the highest variation coefficients: 14.83% in 1997, 16.16% in 1998 and 29.32% in 1999 (Table 3).

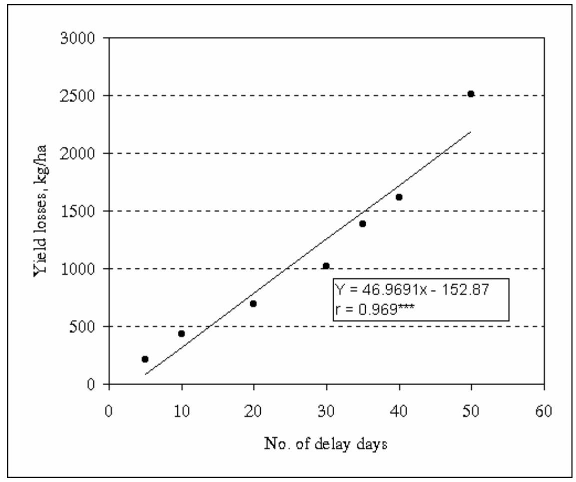

Figure 3. Correlation between no of delay days and yield losses in Rapid winter wheat cultivar (Secuieni, 1997–1999)

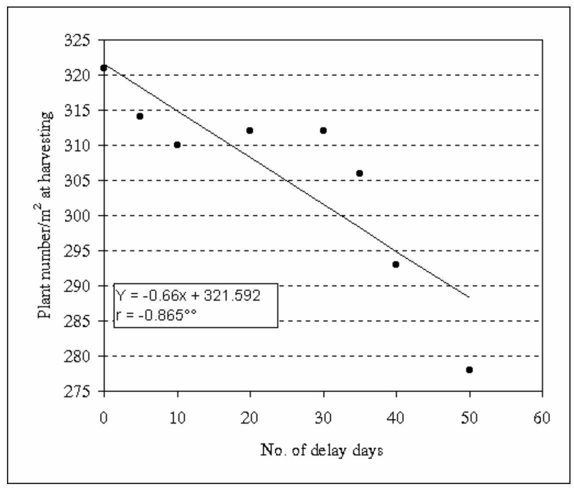

Figure 4. Correlation between no of delay days and no of harvested plants in Rapid winter wheat cultivar (Secuieni, 1997–1999)

The individual productivity elements of wheat plants were influenced by the climatic conditions of experimentation year, but especially by the sowing time (Table 4). Generally, the yield was determined by the grain weight/plant, as result of the number of fertile tillers/plant. TKW had a small variation (s%=2.6–6.6) depending on the experimentation year and sowing time, registering a diminution vs. experiment mean values with 5.2–12.9% and 6.7–12.2% in comparison with the values registered at control (October 1st).

The number of fertile tillers/plant registered a diminution depending on the sowing time, in comparison with the experiment mean values, with 22.3–35.1% and 32.6–46.3% vs the control.

The grain number/plant decreased with 21.1–63.7%, as compared with the experiment mean values and with 29.0–67.2% as compared with control time (October 1st).

The grain weight/plant decreased depending on the sowing time, with 25.2–69.2% as compared with the experiment average and 36.2–72.2% as compared with control time.

Strong correlations have been established (Figures 5–8) between the productivity elements and the number of delay days.

Table 3. Formation of the main productivity elements of winter wheat crop, Rapid cultivar (Secuieni, 1997–1999)

Sowing time	1997			1998			1999		
	No. of emerged pl./m²	No. of harvested pl./m²	No. of spikes/m²	No. of emerged pl./m²	No. of harvested pl./m²	No. of spikes/m²	No. of emerged pl./m²	No. of harvested pl./m²	No. of spikes/m²
1. 15th September	436	287	545	460	342	548	400	324	640
2. 25th September	444	275	550	468	357	588	396	346	692
3. 1st October	476	267	525	432	356	568	408	340	697
4. 5th October	448	258	500	468	348	576	416	335	650
5. 10th October	452	265	485	452	340	552	424	326	596
6. 20th October	460	285	470	450	337	548	404	316	455
7. 30th October	496	295	440	448	312	511	359	325	422
8. 5th November	495	291	435	456	310	488	375	317	374
9. 10th November	480	264	380	376	314	446	339	300	345
10. 20th November	400	258	340	362	295	317	295	280	308
Mean values	458	274	467	437	331	514	381	321	518
Variation coeff.	6.41	5.16	14.83	6.49	7.03	16.16	10.55	5.44	29.32
LSD 5%	18	19	18	18	18	18	18	18	18
1%	25	26	25	25	24	25	25	25	25
0.1%	34	36	34	34	33	34	34	34	34

Table 4. The individual productivity of winter wheat plants. Rapid cultivar (Secuieni, 1997–1999)

Sowing time	1997				1998				1999			
	Number of fertile tillers/plant	Grain number/plant	Grain weight/plant	TKW	Number of fertile tillers/plant	Grain number/plant	Grain weight/plant	TKW	Number of fertile tillers/plant	Grain number/plant	Grain weight/plant	TKW
1. 15th September	1.89	42.5	1.90	44.8	1.60	30.8	1.35	43.7	1.97	31.9	1.11	34.7
2. 25th September	2.00	51.5	2.33	45.3	1.64	31.5	1.41	44.8	2.00	32.0	1.10	34.5
3. 1st October	1.96	51.8	2.29	44.3	1.59	32.8	1.43	43.5	2.05	33.1	1.16	35.3
4. 5th October	1.94	50.5	2.24	44.4	1.65	31.7	1.43	45.2	1.94	32.8	1.16	35.5
5. 10th October	1.83	45.3	1.98	43.8	1.62	32.1	1.44	44.9	1.83	33.1	1.14	34.6
6. 20th October	1.65	40.5	1.76	43.5	1.62	30.8	1.35	43.9	1.44	34.4	1.12	32.6
7. 30th October	1.48	34.2	1.48	43.2	1.63	32.5	1.44	44.4	1.30	30.5	1.00	32.8
8. 5th November	1.49	34.3	1.47	42.8	1.57	27.5	1.23	44.9	1.18	28.7	0.92	32.2
9. 10th November	1.44	33.9	1.45	42.8	1.42	26.8	1.23	45.8	1.15	27.1	0.88	32.5
10. 20th November	1.32	32.9	1.36	41.3	1.07	10.4	0.39	38.2	1.10	23.5	0.74	31.7
Mean (x)	170	42.7	1.82	43.6	1.54	28.7	1.27	43.9	1.59	30.7	1.03	33.6
Variation coefficient (%)	14.54	18.5	22.4	2.60	12.4	23.3	25.2	6.23	26.5	11.26	16.07	6.6
LSD 5%	0.11	3.95	0.27	2.90	0.10	0.98	0.09	1.08	0.16	2.30	0.16	4.46
1%	0.16	5.42	0.36	3.97	0.14	1.34	0.12	1.48	0.22	3.15	0.2	6.11
0,1%	0.21	7.38	0.50	5.4	0.19	1.83	0.17	2.02	0.29	4.21	0.31	8.32
Diminution vs. x%	22.3	21.1	25.2	5.27	35.1	63.7	69.29	12.9	30.8	23.4	28.1	5.6
Diminution vs. control	32.6	36.4	40.6	6.77	35.1	67.2	72.7	12.2	46.3	29.0	36.2	10.2

Among the productivity indices of sink ability, the most influenced by the sowing time and climatic conditions of the experimentation year (expressed by the decreasing of minimum values registered as compared with the experiment average) were: grain weight/plant (24.8%), grain weight/spike (21.4%), grain weight/m^2 (20.35%), TKW (16.6%), grain number/plant (14.8%) and productive tilling ability (12.8%) (Table 5).

Table 5. Difference between the mean value of the productivity elements, of storage ability and assimilates involving and minimum values registered depending on the sowing time in Rapid winter wheat cultivar (Secuieni, 1997–1999)

Specification	Period average	Registered minimum value	Diminution vs. average	
			absolute	relative
Plant number/m^2 at emergence	428.6	381	47.6	11.1
Plant number/m^2 in early spring	376.3	362	14.3	3.8
Plant number/m^2 at harvesting	308.6	274	34.6	11.2
Tillering coefficient	2.41	2.21	0.20	8.2
Spike number/m^2 at harvesting	499.6	467	32.66	6.5
Number of fertile tillers/plant	1.66	1.54	0.07	4.3
Productive tillering	1.17	1.02	0.15	12.8
Spikelet number/spike	13.37	12.7	0.67	5.0
Grain number/spike	20.8	18.2	2.60	12.5
Grain number/plant	33.7	28.7	5.0	14.8
Grain number/m^2	10322	9611	711	6.8
Grain weight/m^2 (g)	420.6	335	85.6	20.35
Grain weight/spike (g)	0.84	0.66	0.18	21.4
Grain weight/plant (g)	1.37	1.03	0.34	24.8
TKW (g)	40.3	33.6	6.7	16.6

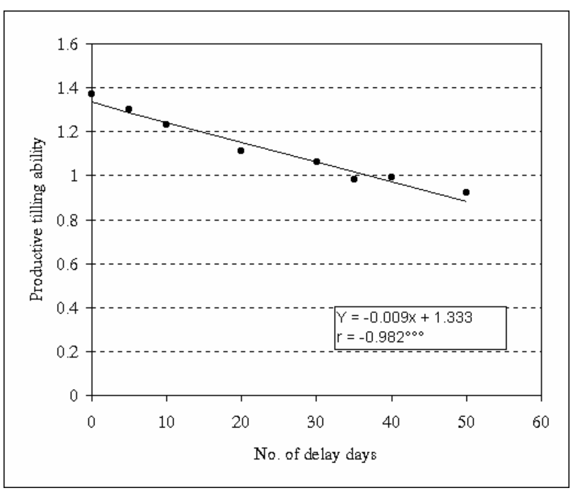

Figure 5. Correlation between no. of delay days and productive tilling ability in Rapid winter wheat cultivar (Secuieni, 1997–1999)

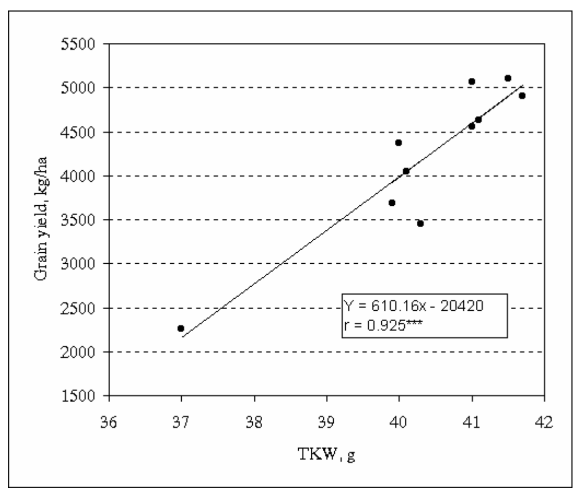

Figure 6. Correlation between TKW and grain yield in Rapid winter wheat cultivar (Secuieni, 1997–1999)

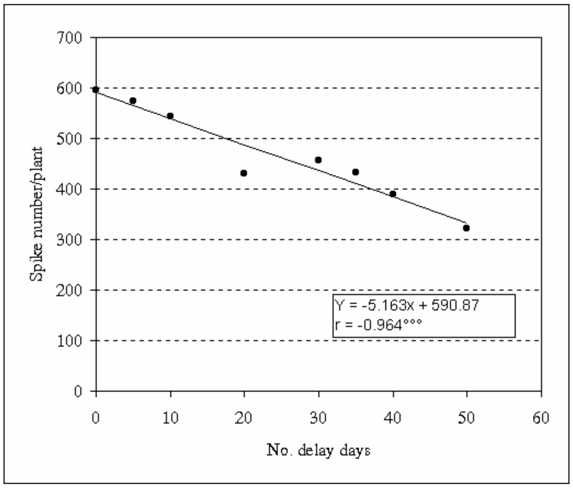

Figure 7. Correlation between no. of delay days and spike number/m² in Rapid winter wheat cultivar (Secuieni, 1997–1999)

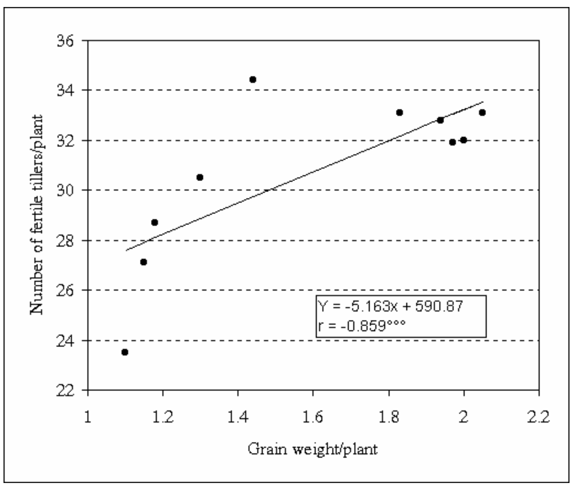

Figure 8 Correlation between the number of fertile tillers/plant and grain weight/plant in Rapid winter wheat cultivar (Secuieni, 1997–1999)

CONCLUSIONS

The optimum sowing time under conditions of Moldavian Central Plateau has been situated between September 25th and October 10th.

Sown in due time, Rapid winter wheat cultivar, released at R.I.C.I.C. Fundulea, achieved yields of 3,970–6,422 kg/ha.

The cultivar proved to be sensitive to the deviations from the above mentioned sowing time. The sowing after October 10th significantly reduces the yield with 688–2,809 kg/ha (13.6–55.5%).

The productivity elements of both crop and plant were significantly influenced by the sowing time. They were properly expressed by the optimum sowing time and had significant diminutions as sowing was delayed.

Yield differentiation depending on the sowing time has been determined by spike number/m² (s% = 14.83–29.32%), number of fertile tillers/plant (s% = 12.4–26.5%), grain weight/plant (s% = 16.07–25.2%) and grain number/plant (s% = 11.26–23.3%).

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Table 1. The content of protein factions in sunflower plants grown under optimal conditions of cultivation, at the stage of cotyledon development (Mg/g d.m.)

Genotype	Albumins		Globulins		Glutelins	
	Mg/g d.m.)	%	Mg/g d.m.)	%	Mg/g d.m.)	%
SW-501 ASC	102.7±2.9	56	72.1±0.4	32	8.4±0.5	12
RW-637 Rf	118.0±2.2	58	66.1±1.2	39	18.4±2.5	3
F_1	135.0±1.4	49	130.1±0.7	47	9.6±0.7	4

Table 2. The modification of protein content under the action of stress factors at the stage of cotyledon development (mg/g d.m.)

Researched parameter	Genotype	Control	NaCl (0.5%)	Na_2SO_4 (0.7%)
Albumins	SW-501 ASC	102.7±2.9	128.5±1.5*	159.5±2.8*
	RW-637 Rf	118.0±2.2	164.8±1.0*	176.9±0.7*
	F_1	135.0±1.4	143.3±2.1	171.4±2.0*
Globulins	SW-501 ASC	72.1±0.4	35.1±0.6*	52.5±0.5*
	RW-637 Rf	66.1±1.2	45.0±0.5*	61.6±1.4
	F_1	130.1±0.7	33.9±0.6*	62.3±0.6*

* - Significant for P<0.05

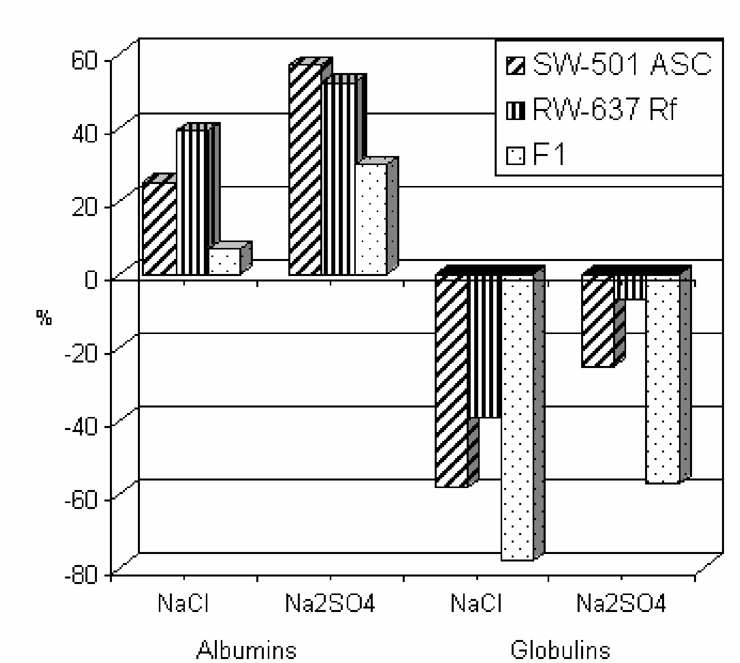

Figure 1. The effect (%) of stress action on the proteins content at the stage of cotyledon development

Table 3. The modification of protein content under the action of stress factors at the stage of cotyledon development (mg/g d.m.)

Researched parameter	Genotype	Control	NaCl (0.5%)	Na_2SO_4 (0.7%)
Albumins	SW-501 ASC	160.4±4.9	1217.2±1.2*	145.4±2.3
	RW-637 Rf	186.4±5.5	138.8±2.8*	164.1±3.3*
	F_1	165.7±5.1	100.4±1.4*	84.8±2.4*
Globulins	SW-501 ASC	95.4±3.3	45.1±2.1*	62.5±1.9*
	RW-637 Rf	110.3±2.9	60.7±1.4*	68.0±2.7*
	F_1	77.4±2.0	33.0±0.8*	57.1±1.5*

* - Significant for $P<0.05$

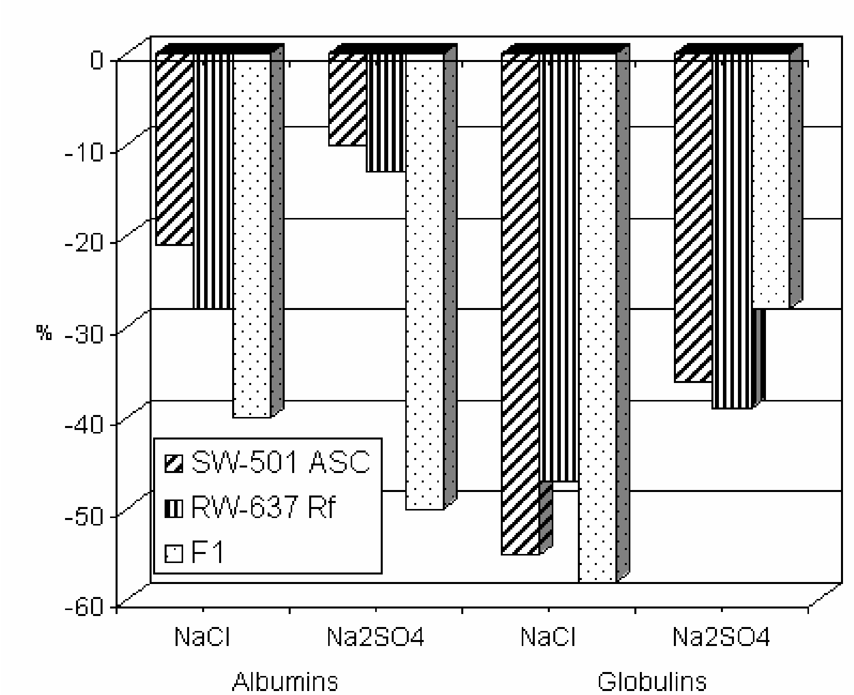

Figure 2. The effect (%) of stress action on the proteins content of sunflower at the stage of development of two leawes at the control plants and at the stage of cotyledon development at plants grown under conditions of salinity.

Table 4. The modification of protein content under the action of stress factors at the stage of cotyledon development (mg/g d.m.)

Researched parameter	Genotype	Control	NaCl (0.5%)	Na_2SO_4 (0.7%)
Albumins	SW-501 ASC	160.4±4.9	142.9±3.3*	170.6±0.2
	RW-637 Rf	186.4±5.5	168.8±0.6*	177.7±1.3
	F_1	165.7±5.1	134.0±1.7*	162.8±0.7
Globulins	SW-501 ASC	95.4±3.3	49.1±0.4*	34.3±0.2*
	RW-637 Rf	110.3±2.9	45.8±2.4*	35.2±0.4
	F_1	77.4±2.0	37.7±1.0*	57.1±0.7*

* - Significant for $P<0.05$

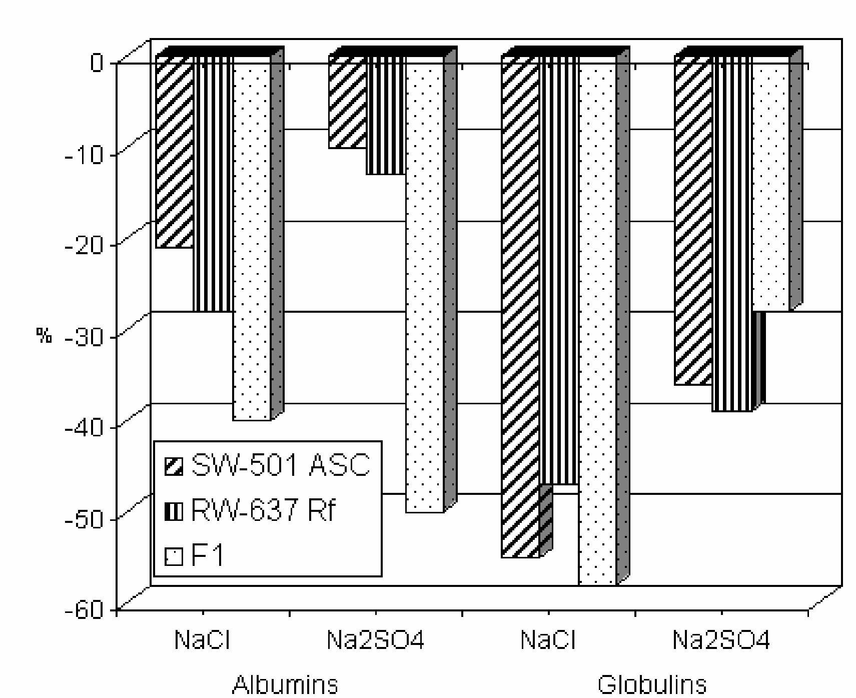

Figure 3. The effect (%) of stress action on the proteins content of sunflower at the stage of development of two leawes.