AgroLife Scientific Journal - Volume 4, Number 1, 2015
ISSN 2285-5718; ISSN CD-ROM 2285-5726; ISSN ONLINE 2286-0126; ISSN-L 2285-5718

INFLUENCE OF CROP SYSTEMS IN REDUCING OF DROUGHT EFFECT FOR SUNFLOWER PLANTS

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Abstract

Along with cereals, sunflower is species which has seen a significant expansion in plant structure on a farm (Brad, 1990). The economic advantages of this are important (Hera et al., 1989), and by creating new hybrids are always looking for the potential to be as their genetic filled in. A lot of the new hybrids have also a good resistance for drought seasons (Pârjol et al., 1971). In the paper there was a prospect of these new genetic possibilities in terms white luvicsoil of southern territory (Ionescu et al., 1983). Were experienced three times of sowing, three densities and three hybrids in recent years. The period studied included a very dry year (2012), a favorable year (2013) and a middle one (2014).
Of all the factors, the greatest influence was a time of sowing, respectively were observed large losses of grain production by delaying sowing (Bîlteanu, 1993). The time in which most hybrids produced very well was 1 to 30 April. All hybrids sown in May produced significantly negative do to drought conditions (Vrânceanu, 1974). Density had only positive influence in medium climatic environment (Holliday, 1960; Robinson et al, 1980) and less in the very favorable one. In the background of very dry, high densities (50 and 70 plants.ha^{-1}) grain yield formation disfavored. Investigated hybrids with high production potential, behaved rather differently, because their reaction for experiment factors was less obvious. Therefore, new hybrids Sandrina, Flornil and the latest F. 911 and F. 708 alongside Favorit is recommended for cultivation in southern white luvicsoil conditions.

Key words: *densities, drought, grain yields, sowing time, sunflower.*

INTRODUCTION

In the present circumstances, to promote the newest hybrids of sunflower, specified some technological elements are required (Şipoş et al., 1981). Practical goal is the best possible expression of genes optimized them (Vrînceanu, 1974). Some of these measures can be adapted since sowing. Thus, every year it aims to set spring sunflower crop as early as possible. Employment in an early period of time means consider an important number of factors, including: achieving thermal factor, soil moisture, proper timing of the first species emergency. For sunflower, the best period for sowing may undergo some variation. According to some authors, its sowing until the end of April not produce obvious differences in the formation of seed production (Bîlteanu, 1993).

Another necessary element in ensuring obtaining a successful of the crop is the density. From the results it was found that while this crop density at emergence decisive influence not produce the maximum (Şipoş et al., 1981; Ionescu et Drăghicioiu, 1989). The explanation is obvious that there is a clearing capacity of production per plant (Robinson et al., 1980), so that the whole chain of sunflower would produce about the same parameters. However, the expression of an optimal production capacity, experiments are necessary before launching new hybrid to the market.

At the same time, by sowing sunflower hybrids new aims to avoid periods of drought in the summer, including the time of sowing and density. As it is known, the earliest plants emerged, having a normal growth, fast (Duncan, 1969; Stoy, 1969), before the summer, are more resistant to drought in July and August (Pârjol et al., 1971). If for some reason seeding sunflower is made late, in May, three are a number of negative phenomena: physiology (Duncan, 1969), uneven growth (Russel, 1966), the effect of drought (Pârjol et al., 1971). The consequence is to reduce grain production. In order to observe the influence of the planting periods and densities of creating new hybrids, the experiments were conducted herein.

MATERIALS AND METHODS

Between 2012-2014 three factorial experiments were established, such as the subdivided parcel (plot), with factors:

- A, sowing time: first at the beginning of the sowing area, the second midterm, and the third at the end of sowing period,
- B, planting density: the graduations 30, 50 and 70 thousand plants.ha^{-1},
- C, hybdid: the first two years were cultivated Sandrina Favorit and Flornil, and last year Sandrina, F 911 and F 708.

Variants area of 20 m^2 was in three replicates. Crop technology was that recommended by the resort. Luvic-soil form culture was in arable horizon following indices: pH 5.23, P_{AL} 17.7 mg.kg^{-1} d.w., Al^{3+} 37.2 mg.kg^{-1}, and 1.54 % total carbon (TC). During the growing season temperatures were recorded (minimum, medium and maximum), and precipitations. For every moment of sowing were calculated amounts of active degrees ($\Sigma tn>7^0C$) and hydro-climatic indices (I_{HC} = P mm/ ETP.100, where ETP = evapo-transpiration potential).

For the Albota sunflower is close to optimum climatic conditions and namely from sowing until the end of June (Figure 1). In July and August, however, rainfall not cover consumption needs, so we have registered the fenomenon of drought. Compared to multi-values in some years the phenomenon of drought can be attenuated or accentuated depending on the crop each year. In the research investigated 2012 was very dry, a favorable year 2013 and 2014 the midlle one. Accordingly new sunflower hybrids, formed different grain yield with accents between times of sowing and densities.

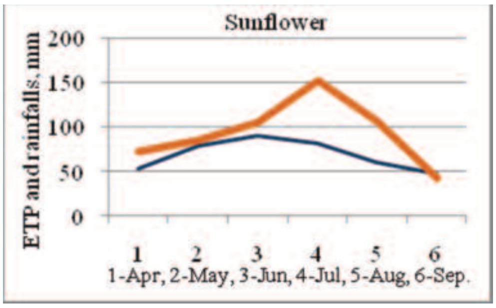

Figure 1. The ETP and precipitations evolution from sunflower vegetation, multiannual data

Photo 1. Sandrina hybrid, flowering period

RESULTS AND DISCUSSIONS

Obtaining sunflower production based on moments of sowing, density and hybrid, have had specificity expressed in each crop year. It is caused by increased variability of climatic conditions, from close to the normal influenced by drought. Thus, three different crop years were: 2012 arid, 2013 relatively normal, and 2014 middle. To observe the influence of the three factors of sunflower crop in these conditions, the results will be presented for each crop year.

Sunflower under 2012. For this year the sunflower was sown between April 5 and May 15. In experiment three times of sowing were: April 12, May 3 and May 15. Climatic elements have evolved specific, Table 1. Thermal factor of plant vegetation has been fairly consistent: 2043 $\Sigma tn > 7^0C$ at first sown and between 1823 and 1726 for the other dates. Temperature excesses occured in July, 8 days exceeded the maximum 35^{0}C and extreme media of environments was 33.2^{0}C. Was very good rainfall in May and June, followed by lack of water in July/7 mm over the entire month). The climatic conditions this year have made it clear influence of drought. Hydroclimatic index (I_{HC}) was between 66 and 63%, depending on sowing dates.

Table 1. Climatic evolution from maize vegetation, 2012 dry year

Sowing times	Month mean values					Σtn>7⁰	I_{HC}* %
	Month	Tn⁰C			P mm		
		Min.	Med.	Max.			
I 12.04	Apr.	11	19	22	15	2043	66%
	May	13	17	22	109		
	Jun.	17	22	28	110		
	Jul.	20	26	33	7		
	Aug.	17	24	32	53		
II 3.05	May	12	17	21	107	1823	64%
	Jun.	17	22	28	110		
	Jul.	20	26	33	7		
	Aug.	17	24	32	53		
III 15.05	May	13	16	20	20	1726	63%
	Jun.	17	22	28	110		
	Jul.	20	26	33	7		
	Aug.	17	24	32	53		

*Hydro-climatic index, $I_{HC} = \frac{P\ mm}{PET} \cdot 100$; ETP- evapo-transpiration potential

Table 2. Sunflower grain yields obtained in 2012, dry year conditions

Sowing time	Grain yields, t.ha^{-1}			Media
	Dens. 30	50	70	
	t.ha^{-1}	t.ha^{-1}	t.ha^{-1}	
Sandrina				
I, 12.04.2012	2.306	2.413	2.380	2.366
II, 3.05.2012	1.643	1.346	1.213	1.401
III, 15.05.2012	0.983	0.923	0.446	0.784
Media	1.644	1.561	1.346	1.517
Favorit				
I, 12.04.2012	2.213	2.040	2.136	2.130
II, 3.05.2012	1.370	1.300	1.280	1.316
III, 15.05.2012	0.846	0.883	0.473	0.734
Media	1.476	1.408	1.296	1.393
Flornil				
I, 12.04.2012	2.200	2.243	2.467	2.303
II, 3.05.2012	1.273	1.233	1.233	1.246
III, 15.05.2012	1.007	0.753	0.573	0.778
Media	1.493	1.410	1.424	1.442
	Time, A	Density, B	Hybrid, C	A.B.C
LSD 5 %	0.144	0.216	0.097	1.059
LSD 1 %	0.239	0.302	0.130	1.486
LSD 0,1 %	0.448	0.427	0.170	2.128

Sunflower yields obtained fell from one sowing moment to another, very evident, Table 2. The maximum yield was obtained for Sandrina hybrid, first sowing and density of 50,000 plants.ha^{-1} - 2.413 t.ha^{-1}. The second moment production levels fell to an average of 1.401 t.ha^{-1}, while the third sowing production was formed under 1.000 t.ha^{-1}. In this hybrid can say that in a typical year of drought, only sowing at the earliest time they could avoid large losses of production. Favorit hybrid produced most first time and density of 30,000 plants.ha^{-1}, with 2.213 t.ha^{-1} grain yield. Lowest production was obtained at 70,000 plants.ha^{-1} in the third sowing time (15 May), with 0.473 kg.ha^{-1} grain. Flornil hybrid produced under the same conditions comparable between 2.467 and 0.573 kg.ha^{-1} grains respectively.

Sunflower in 2013. The range created conditions for sowing sunflower this year was between 10 April and 10 May. Data from the experiment were: 18 April, 24 April and 8 May. In terms of climate plants have received moderate temperatures close to requirements and with peak rainfall of 119 mm in June. Σtn > 7⁰C above 1800⁰C were to the first two dates, and 1619⁰C in the last sowing, Table 3. Hydroclimatic indices were located more than 50%, although rain between 8 and 20 mm fell relatively uniform at decadal intervals.

Formed grain production showed very good values for the first two periods and i.e. over 3.000 t.ha^{-1}

Third sowing period produced between 2.033 $t.ha^{-1}$ (Flornil, 70,000 $plants.ha^{-1}$) and 2.867 $t.ha^{-1}$ (Sandrina, 30,000 $plants.ha^{-1}$), Table 4. Physiologically, only hybrids sown a delay time suffered by a lack of water in August and even September (the third moment has extended vegetation in September).

Tabel 3. Climatic evolution from maize vegetation, 2013 normal year

Sowing time	Month mean values					$\Sigma tn>7^0$	I_{HC}* %
	Month	Tn^0C			P mm		
		Min.	Med.	Max.			
I 18.04	Apr.	10	21	24	0	1845	50%
	May	13	19	25	52		
	Jun.	16	20	25	119		
	Jul.	16	21	27	35		
	Aug.	18	25	32	28		
II 24.04	May	12	19	29	52	1815	51%
	Jun.	16	20	25	119		
	Jul.	16	21	27	35		
	Aug.	18	25	32	32		
III 8.05	May	12	18	24	36	1619	52%
	Jun.	16	20	25	119		
	Jul.	16	21	27	35		
	Aug.	18	25	32	32		
	Sep.	11	19	22	0		

$*I_{HC} = \frac{P\ mm}{ETP} \cdot 100$ (Stângă, 1983); ETP- evapo-transpiration potential

Tabel 4. Maize grain yields obtained from 2013, normal year conditions

Sowing time	Grain yields, $t.ha^{-1}$			Media
	Dens. 30	50	70	
	$t.ha^{-1}$	$t.ha^{-1}$	$t.ha^{-1}$	
Sandrina				
I, 18.04.2013	3.500	3.433	3.467	3.467
II, 24.04.2013	3.300	3.367	3.267	3.311
III, 8.05.2013	2.867	2.600	2.533	2.667
Media	3.222	3.133	3.089	3.148
Favorit				
I, 18.04.2013	2.567	3.233	3.300	3.033
II, 24.04.2013	2.667	3.533	3.467	3.222
III, 8.05.2013	2.533	2.800	2.267	2.533
Media	2.589	3.189	3.011	2.929
Flornil				
I, 18.04.2013	3.267	3.533	3.433	3.411
II, 24.04.2013	3.367	3.467	3.500	3.444
III, 8.05.2013	2.600	2.567	2.033	2.400
Media	3.078	3.189	2.988	3.085
	Time, A	Density, B	Hybrid, C	A.B.C
LSD 5 %	0.261	0.100	0.311	0.689
LSD 1 %	0.433	0.141	0.416	0.945
LSD 0.1 %	0.808	0.199	0.547	1.313

Sunflower in terms of 2014. This year sowing sunflower occurred in two ranges:one early April 1-5 and second late from 20 to 31 May. Climatic conditions have induced this phenomenon, especially by the rains that have fallen in large amounts from April to July, constantly- Table 5. In experiment the first sown was in April 4th and the following two moments on 23 May and 29 May. At first sowing rains fallen negatively influenced plant growing up, after about 30 days. Under these conditions the density of emerged plants was reduced by about 5%. Overall, plants vegetation sown of three times, with background excessively wet climate, the vegetation was extended until October (first decade). Temperatures have evolved close to normal, without excesses. $\Sigma tn > 7^0C$ was different: 1937^0C in the first sowing, 1619^0C in the second and 1490^0C in the last sowing. Hydro-climatic index exceeded 100% the first time and stood at over 90% in the other two times. Production of sunflower formed under these conditions was very good and namely the first two planting dates. Their level often exceeded 3.000 $t.ha^{-1}$, Table 6. The highest yields in all three hybrids were obtained from 30,000 $plants.ha^{-1}$ density. The lowest yields were formed on the third moment of sowing and the density of 70,000 $plants.ha^{-1}$.

Tabel 5. Climatic evolution from maize vegetation, 2014 medium year

Sowing time	Month mean values					$\Sigma tn > 7^0$	I_{HC}* %
	Month	Tn^0C			P mm		
		Min.	Med.	Max.			
I 4.04	Apr.	11	14	18	180	1937	132%
	May	12	17	22	158		
	Jun.	15	19	24	115		
	Jul.	18	23	28	138		
	Aug.	17	23	30	43		
	Sep.	12	17	23	88		
	0ct.	11	14	18	8		
II 23.05	May	15	18	26	0	1619	94%
	Jun.	15	19	24	115		
	Jul.	18	23	28	138		
	Aug.	17	23	30	43		
	Sep.	12	17	23	88		
	Oct.	11	15	18	13		
III 29.05	Jun.	15	20	24	107	1490	97%
	Jul.	18	23	28	138		
	Aug.	17	23	30	43		
	Sep.	12	17	23	88		
	Oct.	11	13	18	66		

*$I_{HC} = \frac{P\ mm}{ETP}\ 100$; ETP- evapo-transpiration potential

Tabel 6. Sunflower grain yields obtained from 2014 medium year conditions

Sowing time	Grain yields, $t.ha^{-1}$			Media
	Dens. 30	50	70	
	$t.ha^{-1}$	$t.ha^{-1}$	$t.ha^{-1}$	
Sandrina				
I, 4.04.2014	3.550	3.475	3.200	3.408
II, 23.05.2014	3.350	3.250	2.775	3.125
III, 29.05.2014	2.500	2.400	1.625	2.175
Media	3.133	3.042	2.533	2.903
F. 911				
I, 4.04.2014	3.525	3.300	2.850	3.225
II, 23.05.2014	3.300	3.375	2.975	3.217
III, 29.05.2014	2.325	2.000	1.925	2.083
Media	3.050	2.892	2.583	2.842
F. 708				
I, 4.04.2014	3.225	3.150	2.875	3.083
II, 23.05.2014	3.175	3.175	2.750	3.033
III, 29.05.2014	2.450	2.475	1.800	2.242
Media	2.950	2.933	2.475	2.786
	Time, A	Density, B	Hybrid, C	A.B.C
LSD 5 %	0.136	0.148	0.110	0.354
LSD 1 %	0.410	0.202	0.147	0.483
LSD 0.1 %	0.660	0.276	0.192	0.658

Statistical analysis of grain productions. Three years of sunflower culture showed high variability. Hybrids sowing at differing times and in several densities expressed within good and bad. Variance analysis of experiments in the three years highlights the special influences, Table 7. Statistical calculation demonstrates that planting dates A-factor, had the highest influence in all three years. In terms of density (B factor) only two years have highlighted significant influence and namely in the last two years. Hybrid (C factor) had obvious influence in the first and in the last year. Of interactions, only the moment and hybrid of last year had obvious influence.

CONCLUSIONS

Among the factors studied, sowing moments had the greatest influence in the formation of new hybrids. For the area, the time in which the terms are planting varies during April and May. New hybrids produced betwee 2.500 $t.ha^{-1}$ to early sowing in dry conditions, 3.500 $t.ha^{-1}$ in normal and middle years. Production biggest losses occured in the first year when hybrids were sown on 3 May. Summer drought has formed a production of 470- 570 $kg.ha^{-1}$ grain.
Densities had obvious influence on sunflower production during last two years. In all three hybrids climatic environment formed the largest grain production to 30,000 $plants.ha^{-1}$.

New hybrids grown significantly distinguished themselves in the first and third years. With high yield potential, all hybrids have used fairly experienced the full spectrum of climate which benefited the studied period.

Interactions between factors, only one of planting dates and hybrids had meaning. This acquires practical imporance that farmers will sow new hybrids at a time as early as possible.

Table 7. The analysis of Anova test, yield grains of sunflower

Variability cause	Sq sum			LG	Variance, S^2			F test		
	2012	2013	2014		2012	2013	2014	2012	2013	2014
Repetitions	0.099	0.110	0.156	2						
Factor A	31.101	10.999	24.972	2	15.55	5.499	12.49	420***	46***	223***
Error A	0.148	0.476	0.335	4	0.037	0.119	0.056			
Big plots	*31.348*	*11.585*	*25.463*	*8*						
Factor B	0.451	0.604	5.431	2	0.226	0.302	2.715	1.70	10.8**	39***
AxB	0.774	1.411	0.199	4	0.019	0.353	0.050	0.15	1.17	0.72
Error B	1.594	0.333	1.241	12	0.133	0.028	0.069			
Middle plots	*2.819*	*2.348*	*6.872*	*18*						
Factor C	0.209	0.683	0.245	2	0.105	0.342	0.122	3.39*	1.06	2.25*
AxC	0.183	0.863	0.746	4	0.046	0.216	0.187	1.48	0.67	3.43*
BxC	0.159	1.370	0.172	4	0.040	0.343	0.043	1.28	1.07	0.79
AxBxC	0.055	0.378	0.652	8	0.007	0.047	0.082	0.22	0.15	1.50
Error C	1.106	11.584	2.935	36	0.031	0.322	0.054			
Small plots	*1.712*	*14.878*	*4.750*	*54*						
Total experiment	*35.879*	*28.811*	*37.085*	*80*						

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