RESEARCHES ON OPTIMIZING THE CULTURE TECHNOLOGY IN SUNFLOWER

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ABSTRACT

The approached issues covered research objectives aimed at optimizing the culture technology in order to achieve maximum and constant sunflower yield, in the soil and climate conditions of southern Romania, also pursuing the economic efficiency and environment protection. Research were performed in the experimental field Systems of Sustainable Agriculture and Crops Fertilization (SSA-CF) not irrigated version, in the framework of NARDI Fundulea, pursuing the following parameters: hybrids, fertilization and plants density

The experimental diagram is three factorial type of form 3 x 3 x 2, managed according to the subdivided parcels method, in three repetitions.The total testing area was of 11,760m^2. In order to organize the experiment it was used biological material consisting of three sunflower hybrids. Crop management was performed in optimal conditions of technology specific to the culture area, the studied genotypes consisting of: Performer (test check – semi-late hybrid), Barolo RO (semi-late hybrid), and PR64A89 (semi-late hybrid).

INTRODUCTION

Experimental field is in the East of Romanian Plain area, on the Mostistea river side, along the border between Vlasiei Plain and South Baragan Plain. As geographical position is approximately 44 ° 30 ' North latitude and 24 ° 10' East longitude, on the territory of the Fundulea town, Călăraşi County, 34 km East of Bucharest. Fundulea groundwater depth is about 14 m and an average elevation of 56 m. The area of vegetation is at the crossing between the steppe and forest steppe. The climate is predominantly continental, with an annual average temperature of 10°C. The coldest month is January, with an average temperature of minus 3°C, and an absolute minimum of minus 26°C. The hottest month is July, having the average temperature of 22°C and 41 ° C maximum absolute temperature.

Annual precipitation averages 571mm, out of which 72% during the growing season, especially in May and June (Partal, E., Zaharia, G.V., 2008).

During the summer is only 35% of the total annual rainfall, having torrential character. The frequency of dry years is over 40%. They are common drought periods, of 10-14 days, in May-June, and of about 30 days or longer at the beginning of spring and especially at the beginning of fall. The duration of sunshine is of 2,165 hours multiannual average (Partal, E., Zaharia, G.V., 2008).

The research objectives aimed at optimizing culture technology in order to achieve maximum and constant sunflower yield, in the soil and climate conditions of southern Romania, also following the economic efficiency and environmental protection.

Due to its high oil content in seeds commonly exceeding 48-50% of the dry substance, sunflower is a typical oleaginous plant, whose economic value derives 80% of its edible oil (Bîlteanu, Gh., 2003).

MATERIAL AND METHODS

Research were performed in the experimental field of Systems of Sustainable Agriculture and Crops Fertilization (SSA-CF) not irrigated version, from NARDI Fundulea,

pursuing the influence of density and fertilization on the harvest quality of three sunflower hybrids (a1 – Performer; a2 – KWS Barolo RO; a3 – PR64A89).

Concerning the plant density they were used two variants, c1 of 50,000 plants/ha, and c2 of 60,000 plants/ha.

An important influence factor was the soil. Experimental conditions in the area are characterized by the transition from steppe to forest steppe that mostly allows the formation of cambic chernozem soil category. Humidity higher than in the steppe led to a proliferation of the clay formation. So, a large part of the clay content from the A level migrated towards the limit between levels A and B.

Humus content is higher in the first 15 cm due to the former beds of leaves and gradually decreases towards depth (Partal, E., Zaharia, G.V., 2008).

Total nitrogen content (N_t) is generally high (0.18 – 0.13 %), as well as the total phosphorus (0.018%). Usually the cambic chernozem, cultivated longer, it is found a significant decrease in humus and nitrogen content of the arable layer. The level A extends to a depth of 45 cm, being followed by the level AB and B.

Since the bulk of sunflower roots develop to depths of 70 cm, only these levels have a direct influence on crop (Tabără, V., 2009).

» Ap (0-18 cm): clayey-dusty loam of very dark brown-gray color in the dry state; moist and friable in the wet state; rough in the dry state; moderated compact; gaps and frequent fine pores; frequent thin roots; straight smooth transition.

» Aph: (18-30 cm): clayey-dusty loam; same color as the previous chernozem; compacted; deconstructed (substantial); right wet, with scrap of fine roots; flat straight cross.

» Am (30-45 cm): clayey-dusty loam of very dark brown-gray color in wet state and dark gray in wet state; moist; medium sub-angular grains and polyhedral structure, well developed; friable in the wet state; rough in the dry state; loose; infrequent gaps; frequent fine pores; frequent fine roots; gradual, curled transition.

» AB: (45-62 cm): clayey loam (clay clayey-dusty- dusty clay) very dark brown gray in wet state and brown in dry state; damp; medium sub-angular polyhedral structure, well developed; friable in the wet state; rough in the dry state; rare gaps; frequent fine, medium pores,; frequent thin roots; gradual, curled transition.

» Bv_1(62-82 cm): clayey loam (clay clayey-dusty); dark brown in wet state and brown in dry state; damp; medium sub-angular polyhedral structure, well developed; brittle-hard in the wet state; rough in the dry state; infrequent gaps, fine, frequent pores; thin, scarce roots; gradual transition, curled.

Concerning the porosity, the ratio pores filled with water / pores filled with air, it is very favorable, being ranged between 0.9 and 1.1 on the depth from 30 to 130 cm. In the layer of 0-30 cm prevails the water, while below 130 cm the substrate is little altered and the aeration is higher.

The soil penetration resistance is lower in the plowed layer (28 kgf/cm²) and below this depth increases to 37 kgf/cm².

The main physical, hydrological and chemical properties of the soil are given in Table 1.

The highest content of humus of 3.0% is found in the layer of 0-30 cm and falls suddenly to 2.4% in Am. Next, along the profile, amount of humus gradually decreases. The soil reaction is slightly acid at the surface, then neutral, and then gradually moves to slightly alkaline with the maximum pH value of 8.2, due to the presence of large amounts of calcium carbonate. The total cation exchange capacity has high values and shows a very good representation of the complex soil absorption (clay + humus). Soil nutrient supply is very good.

Soil structure is glomerular, in the layer A shows in higher proportion stable aggregates. In the layer B aggregates begin to grow, the structure evolving towards shaped nut or prismatic structure. The ability of the capillary is 39%. Good permeability in layer A becomes poor in layer B due to the clay texture.

The experimental diagram is three factorial type, 3 x 3 x 2, ordered in three repetitions by the method of subdivided parcels. The experimental results were statistical processed using the variance analysis method (Gologan, I., Dornescu, A., 1981).

The experiment was located on uniform land in terms of fertility and landscape, on a chernozem soil, specific for the experimental area. The previous crop was wheat in all experimentation years.

The total experimental area was of 11,760 m^2. The total surface for the experimental plot was 168 m^2, and harvested area of 112 m^2.

In order to organize the experiment it was used biologic material consisting of 3 sunflower hybrids. Plants cultivation was performed in optimum technological conditions, specific to the cultivation area, the studied genotypes comprising three hybrids: *Performer* (control – semi-late hybrid), *Barolo RO* (semi-late hybrid), and *PR64A89* (semi-late hybrid).

RESEARCH RESULTS

A longside soil peculiarities, climatic features of the agricultural year 2012 directly influenced the results of experiments.

Evolution of climatic data was recorded throughout the agricultural year 2012. Distribution of rainfall and temperature evolution have been analyzed in stages meeting the requirements of sunflower crops (i.e. the active growing season, accumulation and maturity), for better correlation with agrophytotechnical issues watched in experiments. The agricultural year 2012 showed the following characteristics:

- rainfall in the winter was satisfactory, following the average (Table 2);
- winter months were colder than the annual average by 1.6 respectively 6.4ºC (Table 3);
- snow greatly reduced the impact of frost, so direct frost damages were relatively low;
- rainfall balance was unbalanced in March and April, when the rains were below the multiannual average with a difference of minus 13.0 – 26.8 mm per month (Table 2);
- water deficit increased in June and July, reaching a maximum in August;

Table1:

Main physical, hydric, and chemical properties of cambic chernozem soil from Fundulea (by Dumitru Elisabeta, 1997)

Properties / Depth (cm)	Layers								
	Ap	Aph	Am	A/B	Bv1	Bv2	Bv3	CnK1	CnK2
	0-18	18-30	30-45	45-62	62-82	82-112	112-140	149-170	170-200
Coarse sand (2-0.2 mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fine sand (0.2-0.02 mm)	28.1	28.0	26.2	28.1	29.8	29.7	32.2	34.5	39.7
Dust (0.02-0.002 mm)	33.1	34.2	33.8	32.1	32.5	35.0	35.0	33.2	29.8
Clay (<0.002 mm)	38.8	37.8	40.0	39.8	37.7	35.3	32.8	32.3	31.0
Physical clay (< 0.01 mm)	53.8	52.8	55.5	53.6	52.4	51.3	49.7	46.8	44.6
Texture	LL	LL	LL	LA	LA	LA	LA	LA	LA
Bulk density g/cm3	1.19	1.40	1.41	1.44	1.44	1.44	1.44	1.32	1.36
Total porosity %	56	48	48	46	46	46	46	51	49
Aeration porosity %	18	12	13	10	11	11	11	15	15
Degree of compaction %	-9	6	7	11	10	9	9	-1	2

Wilting coefficient %	11.9	10.9	11.9	10.8	10.3	9.4	8.8	9.0	8.5
Field capacity %	32	26	25	25	24	24	24	27	25
Hydraulic conductivity mm/h	21.1	15.6	16.1	12.2	10.4	17.8	12.2	20.0	7.8
pH (in water)	6.3	6.5	6.8	7.2	7.2	7.2	7.4	8.1	8.2
Humus %	3.0	3.0	2.4	2.1	1.5	1.2	0.9	0.8	0.6
C:N	11.4	11.8	10.8	10.1	-	-	-	-	-
N_t %	0.18	0.17	0.15	0.14	-	-	-	-	-
P_2O_5 total %	0.08	0.07	0.06	0.04	-	-	-	-	-
P_2O_5 movable ppm	28	14	3	3	-	-	-	-	-
K movable ppm	98	87	108	108	-	-	-	-	-

Table 2:

Monthly evolution of rainfall recorded in 2012

Month / Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Amount
2012	73.5	42.2	4.8	35.1	159	20.7	2.0	43.8	49.1	30.8	9.4	87.9	558.8
Average (40 years)	30.0	32.1	31.6	48.1	67.7	86.3	63.1	50.5	51.0	40.1	44.0	44.0	588.5

Table 3:

Monthly evolution of the temperatures recorded in 2012 (^oC)

Month / Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average
2012	-1.4	-7.3	5.5	14.2	18.0	23.3	27.3	27.8	22.0	13.9	6.8	-1.9	
Average (40 years)	-3.0	-0.9	4.4	11.2	16.5	20.2	22.1	21.1	17.5	11.1	5.0	-0.4	11.6

- lack of rainfall in the June-August period was associated with high temperatures, which led to heat and drought phenomena;
- average monthly temperatures for the year 2012 placed themselves over the average of 40 years annual values (Table 3);
- highest positive temperatures were recorded in June, July and August 2012;
- heat together with the plants physiological consumption led to the intensification of sunflower stage evolution, so they registered leafage depreciation or yellowing phenomena, and drying in the basal, small capitulate, and raising of the sterile plant percent.

» Field observations and measurements:

- determination of production (kg/ha) obtained by extrapolating the experimental plot harvest;
- taking pictures of plots in various stages of culture;
- sampling for laboratory tests;
- reading the daily weather data throughout the vegetation (average temperature, precipitation, relative air humidity, and wind speed).

» Laboratory determination:

- removing impurities from the seed samples;

- 1000GrainWeight, determined from harvested seed per plot;
- Hectoliter mass (HM), weighing average of two samples per plot;
- oil content etc.

Hectoliter mass (HM) is listed as a factor quality assessment, so a high hectoliter mass indicates a seed of high quality and it is the ratio between mass in kilograms and volume in hectoliters, determined for any kind of grain by measuring with a device and a method consistent with the national provisions (Muntean, L.S., 1997).

1000GrainWeight is a very significant productivity element because it depends on the size of the embryo, the amount of germination, and emergence reserve substances.

1000GrainWeight is closely related to yield because varieties having large grains may have a greater yielding capability (Muntean, L.S., 1997).

CONCLUSIONS

Primary processing data was accomplished in September 2012, following the weighing of crops from each variant. It consisted in the removal of studied repetitions, achieving average per variation, then reduction of losses and impurities and reporting at the surface unit. Variance analysis emphasizes which of the factors or combinations is more significant in statistical terms, to which will be added the practical or scientific significance of those factors.

Data processing was performed following the laboratory analysis of the sunflower seeds, yielded as samples of 750g. After removing the impurities they were set the 1000GrainWeight, HM, and seeds oil content.

During the agricultural year 2012 it was registered the drought phenomenon, due to poor distribution of rainfall together with high thermal conditions throughout the growing season which led to the development of lower 1000GrainWeight values.

The highest HM and 1000GrainWeight values were registered at the variant fertilized with manure (20 t/ha) and a density of 50,000 plants/ha.

The most favorable values were obtained from the hybrids PR64A89 and Performer, where HM was of 38 kg/100 l, respectively of 37 kg/100 l, 1000GrainWeight of 54.7 g, respectively of 55.5 g.

From the analysis of these data, we can conclude that, in terms of a year with uneven distribution of rainfall in time and space, a variant yielded the best values of quality indicators is that fertilized with manure (20 t/ha) where it was used the hybrid PR64A89.

The influence of environmental factors and culture conditions is strongly felt concerning the quality level of sunflower yield, namely in the accumulation of oil in the seeds. Below is shown a range of data on quality indexes of sunflower crops, considered as the average of the first year of the experiment.

Sunflower is one of the most important oil producing crop. Hybrids currently contain in fruits (achenes) between 43 and 53% oil.

Oil content in 2012 ranged between 36.8% and 43.9% and according to our laboratory data is considered poorer in terms of quality. The highest oil contents registered the hybrids PR64A89, Performer, and then Barolo RO, but the variation is low (0.2 – 8.2%), depending on the studied technological variant and evolution of culture climatic conditions in 2012.

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