SUMMARY

Key words: sunflowerl, fertilization, plant thicket, hybrids, oil

Being ranked the forth worldwide, after soy, palm oil and rape and first in Romania, sunflower is considered to be an extremely important plant for a sustainable agriculture and the assurance of the population's food safety and security.

In the last decades thorough research on climatic conditions and soil characteristics has been made in the field all over the world and in Romania. Light was shed on many theoretical and practical issues related to this important culture plant, allowing the knowledge of a genetic and biological database, along with the improvement of culture technology.

The investigations of the present doctoral thesis subscribe to this context. The thesis was drafted within the Sectoral Operational Programme for the Development of Human Resources 2007 – 2013, Major intervention field: 1.5. "Doctoral and Post-Doctoral Programmes for the Support of Research".

The investigations were carried out in ecological conditions on a cambic chernozem from the Ezareni Farm of the Iaşi Didactic Station during the agricultural years 2009 – 2012.

The purpose of the investigations was to modernize a series of technological sequences in sunflower to live up to the productive potential of the new cultivars and improve achene quality through the increase in oil content and the improvement of the fatty acids rapport.

To meet this goal, we aim at:

- quantifying the effect of different nitrogen, phosphorus and potasium doses on the achene and oil production;
- establishing the most appropriate nutrition space in new cultivars;

- the increase in the achene production, oil content and production in a several hybrids;
- the research of the effect of climatic factors in the experiment years in achieving productivity of the sunflower phytosystem;
- comparing biology, production and oil content in four hybrids, two Romanian and two foreign ones;
- the evaluation of economic efficiency according to the variants used.

To meet these objectives, a tri-factorial experience was organized in four rehearsals, disposed in subdivided parcels with the following factors:

A factor – Fertilization with five degrees: a_1 - $N_0P_0K_0$; a_2 - $N_{32}P_{24}K_{48}$; a_3 - $N_{64}P_{36}K_{72}$; a_4- $N_{96}P_{48}K_{96}$; a_5 - $N_{120}P_{60}K_{120}$;

B factor – Thicket of plants with three degrees: b_1 - 40.000 plants/ha; b_2 - 55.000 plants/ha; b_3 - 70.000 plants/ha;

C factor – Sunflower oil hybrids with four degrees: c_1 - Favorit (Romanian); c_2 - Performer (Romanian); c_3 - PR63A90 (Pioneer); c_4 - PR64A83 (Pioneer).

For the planification of experiments and their accomplishment, as well as the drafting of the doctoral thesis, the national and international literature of the field was researched with respect to the theme approached, especially the one from the last decades. We drew the following conclusions:

- Although sunflower is a great consumer of nutrients, it needs less fertilizer as compared to other culture plants mainly due to the increased capacity of absorption of the root system, approximately 60% being assimilated until calatide formation;
- The efficiency of phosphorus fertilizers was confirmed by many investigations in the country and abroad, with many changes in soil and plant;
- The reaction of sunflower to potassium is not entirely elucidated, being sometimes insignificant, otherwise decisive;
- The literature of the field shows a close connection between production, achene quality and oil and nutrition space (plants' thicket per hectare);

- The study of the behaviour of a series of sunflower cultivars in various pedoclimatic conditions in our country and abroad mentioned their eco-stability as far as the level and biological quality of the oil are concerned. The year and the settlement can cause fluctuations of the oil content by 3 – 7% within the same genotype.

The research was conducted at the Ezăreni farm of S.D. Iaşi on a cambic chernozem soil with 3.6% humus, 0.196% total nitrogen, 12.6 mg P_2O_5/100 g soil, 20.2 mg K_2O/100 g soil and 6.3 pH on a 0-20 cm depth.

The climatic conditions were different in the three years. In the agricultural year 2009-2010, the average monthly temperature was by 1.5 ^oC higher than the multiannual average and in the sunflower vegetation period (IV-VIII) by 2.36^oC; precipitation overcame the multiannual average by 39.4 mm, hence the favourable year.

In the agricultural year 2010-2011 higher temperatures than the multiannual average by 1.2 ^oC were recorded, and for the vegetation months (IV-IX) by 1.6 ^oC. The precipitations recorded were under the multiannual average by 68.6 mm, and during the vegetation period, by 53.3 mm; this year was considered less dry (LPS), as well as the vegetation period, causing higher productions and a more reduced content in oil. The very favourable distribution of precipitation according to phenophases led to the highest production in the three years.

The agricultural year 2011-2012 was considered an extremely dry one, with a difference in precipitation of 162.4 mm as compared to the multiannual average, and for the vegetation period (IV-IX) of 31.3 mm; it was recorded as a dry one, with 27.3% less precipitation than the multiannual average. The temperatures in the vegetation period were by 2.2 ^oC higher than the multiannual average. As a result, the productions were lower than in the first two years.

The results obtained in the three years with different climatic conditions are different according to plant biology, achene production, oil content and biological oil production, and within each agricultural year, according to treatments applied (the factors investigated).

During all the experimental years, phonological observations such as the following were made: sowing time, springing, blooming, maturity and measurements on plant height, number of leaves per plant, calatide diameter, achene weight on calatide, etc.

Determinations were made in four repetitions, and statistic calculus on variation analysis was performed.

After the harvest, the production brought to STAS humidity, MMB and MH were statistically calculated.

The content of achenes in biological oil was determined in the laboratory SC Ulerom Vaslui; afterwards the production of biological oil was calculated.

As expected, the higher doses of fertilizers and higher plant thickets had a positive influence on plant height and number of leaves per plant.

The achenes weight on calatide increased along with the rise in fertilizer doses up to $N_{96}P_{48}K_{96}$ and fell to $N_{120}P_{60}K_{120}$.

According to thicket, achene height on calatide decreased from 40.000 pl/ha to 70.000 pl/ha. However, the greater number of calatide in the surface unit increased the production per hectare.

Between hybrids, differences in all measurements have been obtained according to their genetic inheritance. The greatest achene weight per plant was obtained in the PR64A83 hybrid corresponding to the highest productions in this hybrid.

In the first two years of experiment, the analysis of the effect of each factor considered, as well as the interaction between factors highlighted different productions, greater than in 2010-2011. Thus, the influence of fertilization is shown in the accomplishment of the highest achene production in the $N_{96}P_{48}K_{96}$ variant of 3762.43 kg/ha in 2010 and 4212.61 kg/ha in 2011, with significant differences as compared to the control variant ($N_0P_0K_0$).

Plant thicket influenced achene production in the two years, as a maximum production of 3745.8 kg/ha in 2010 and 4519.5 kg/ha in 2011 was obtained from 70.000 pl/ha, with significant differences as compared to the 40.000 pl/ha thicket.

Sunflower hybrids behaved differently in the two years as in 2010 the most productive proved to be PR64A83, with a production of 3609.04 kg/ha and in 2011, the PR63A90 hybrid with 4057.92 kg/ha; the differences are significant as compared to the control hybrid Favorit.

The interaction between the three factors investigated highlights more appropriately the relations between factors in the increase or decrease of production, being a method often used in scientific research today.

In 2010, the highest achene production was obtained in the $N_{64}P_{36}K_{72}$ x 70.000 pl/ha x PR64A83 interaction with 4546 kg/ha, and in 2012 in the $N_{96}P_{48}K_{96}$ x 70.000 pl/ha x Performer interaction, with a production of 5794 kg/ha. These examples illustrate the production capacity of the Romanian hybrid Performer which is as good as the foreign hybrids.

Oil content in achenes was higher in 2010 than 2011.

As compared to 51.13% oil in 2010 and 48.10% in 2011 at $N_0P_0K_0$, in the $N_{120}P_{60}K_{120}$ fertilization, the content was of 50.87% in 2010 and 47.44% in 2011. The higher plant thicket determined a higher content in oil than the lower thicket (40.000 pl/ha).

The highest oil content was recorded in the PR64A90 hybrid, with 51.06% in 2010 and in 2011, the content was of 47.90% in the same hybrid.

The interaction between factors, $N_{96}P_{48}K_{96}$ x 70.000 pl/ha x PR64A83 with 52.86% oil in 2010 was of 49.9% in 2011.

The year 2011-2012 was a dry one and this had a negative impact on plants and achene production.

In spite of the fact that it was a dry year, sunflower plants used soil nutrients well, determining production outputs. As in the previous years, the highest production was obtained from $N_{96}P_{48}K_{96}$ fertilization and 2466 kg/ha were obtained, by 751 kg/ha higher than in the $N_0P_0K_0$ variant. The maximum fertilizer dose ($N_{120}P_{60}K_{120}$) determined a production minus of 5.72% of the precedent variant.

When compared to the normal years from a climatic viewpoint, in this dry agricultural year the plant thicket of 40.000 pl/ha recorded a lower production than the 70.000 pl/ha which was only of 7.66%. Unlike the 70.000 pl/ha thicket, the 40.000 pl/ha one used the soil water reserve better.

Out of the hybrids, PR64A83 was the most successful, overcoming the production output of the control hybrid by 20.84% (Favorit).

Romanian hybrids – Favorit and Performer were outrun by Pioneer's by 12.38% at the achene production.

The $N_{120}P_{60}K_{120}$ x 40.000 pl/ha x PR64A83 interaction achieved the higher achene production, of 2874 kg/ha, followed by the $N_{120}P_{60}K_{120}$ x 55.000 pl/ha x Performer with an average production of 2833kg/ha.

We did not reach any conclusions on the oil content in achenes for 2012 as the analyses have not been carried out.

It is a fact that in any activity carried out in agriculture, great benefits are intended at lower production costs.

For the calculation of economic efficiency of the results obtained, expenses per surface unit were mentioned, out of which fertilizer expenses were the highest, then the value of the production obtained was calculated, the cost per achene kilo, the gross profit and the gross profit rate.

Analyzing economic efficiency from the viewpoint of gross profit and gross profit rate we may conclude that:

- the gross profit in 2010 increases from the $N_0P_0K_0$ (1317.4 lei/ha) variant to the $N_{64}P_{36}K_{72}$ (1432.1 lei/ha) variant, then dropping to 812.2 lei /ha in the $N_{120}P_{60}K_{120}$ variant;
- the highest rate of the gross profit of 78.45% was obtained in the unfertilized variant (with low production and expenses) and the highest rate of the gross profit of $N_{32}P_{24}K_{48}$ variant with 57.93%;
- in 70.000 pl/ha the maximum profit of 1407.6 lei/ha and the profit rate of 50.57% was obtained;
- the PR64A83 hybrid determined a maximum gross profit of 1543.1 lei/ha and the profit rate of 56.07%.

In 2011, due to more favourable ecological conditions, production was higher and economic efficiency better.

The highest gross profit was obtained in the $N_{32}P_{24}K_{48}$ variant with 3229.4 lei/ha and a profit rate of 128.91% between fertilizer variants.

In the 70.000 pl/ha thicket, the highest profit, of 4139.8 lei/ha was obtained and the profit rate of 141.67%.

Out of the hybrids, PR63A90 was the most successful one, with a gross profit of 3522.4 lei/ha and a profit rate of 121.92%.

Based on the analysis of the data obtained and presented in the doctoral thesis, the complexity of the investigations can be noted and the originality of research interventions with three factors in four rehearsals and three years with different climate, reaching conclusions and making important proposals, both theoretical and widely applicative.