ABSTRACT

As sunflower is one of the world's most important oil plants and the most important plant cultivated to this purpose in our country, it has been the subject of study for many researchers in Romania and abroad. The total research carried out resulted in the elucidation of many theoretical and applicative aspects of this important crop, enabling knowledge of the genetic basis necessary for generating increasingly efficient hybrids, improving at the same time the agricultural technology.

Like any crop, the spectacular progresses in the last decades impose the in-depth continuation of research and their setting in different climatic, especially microclimatic, areas in order to obtain, under given pedoclimatic conditions, the highest, quantitatively and qualitatively, yields possible. It is in this context that the present research was developed under the pedoclimatic conditions of S.C. Agrofruct Plugari S.A., Iasi County with the aim of establishing for sunflower – a plant cultivated, for consumption and seed yield, with great results in this unit – a few technological links through fertilization, with five gradations (N_0P_0, $N_{32}P_{32}$, $N_{64}P_{64}$, $N_{96}P_{96}$ and $N_{96}P_{96}K_{96}$), hybrid, with three gradations (Heliasol Ro, Huracan and Tellia) and sowing density, with three gradations (30 000 plants/ha, 50 000 plants/ha and 70 000 plants/ha). In order to obtain conclusive results, the experimentation developed over a period of three years (2006 – 2008), the climatic conditions varying from very favorable (2006) and favorable (2008) to less favorable (2007).

For the elaboration of the paper and the interpretation of the results, I consulted the bibliography referring to the subject under investigation, resorting to the latest results, from 2007-2008, as well as to papers from the second half of the last century, some of which constitute pioneering work, others with monographic character, necessary for knowing the physiological, genetical of technological aspects of the sunflower.

The developed research included the specification of the reaction of the three hybrids, under the conditions of the abovementioned technological factors, to the development of the main phenological phases, the determination of the main biometrical measurements during vegetation (the plant height, the number of leaves, the foliar area) and at the end of the vegetation (the head diameter, the number and the weight of achenes per head, the 1 000-achenes weight and the hectoliter mass), the achene yield and the oil yield, as well as the economical

efficiency of different technological measures experimented. The research was developed respecting all the norms of technological and experimental technique. The control species was the Heliasol Ro hybrid, unfertilized, sowed at 50 000 plants/ha.

The observations made during the three years of experimentation emphasized the pronounced influence of meteorological fluctuations upon the manifestation and duration of the main phenological phases and the lack of influence of the technological variables on the abovementioned elements. The period from sowing to emergence represented 5-15% of the vegetation period, from emergence to butonization it took 19-50%, from butonization to blossoming 16-33%, and the period from blossoming to maturation corresponded to 20-45% of the biological cycle.

The number of leaves per plant varied, within each genotype, under the environmental conditions, that is, the climatic fluctuations and the technology that was applied. Thus, the Heliasol Ro hybrid had, over the entire period of experimentation, an average of 19.0 active leaves at the end of their emergence (varying between 16 and 24 because of the annual meteorological conditions, fertilization and density), the Huracan hybrid had 20.4 leaves, with limits, determined by the same factors, between 17 and 25, and the Tellia hybrid was characterized by a total of 17.2 leaves, varying between 14 and 22.

The foliar area of a plant was influenced by the meteorological conditions in the years the determinations took place, by the genotype of the hybrids that were cultivated and by the entire technology that was applied. The smallest foliar area, in all the years, was achieved in the unfertilized variants, cultivated at the maximum density, as a result of the reduced nutrition space and the competition between the plants. Among the hybrids, the average of all the fertilizations, densities and the years of experimentation puts on the first place the Huracan hybrid, with 3 690.3 cm^2, followed by Heliasol Ro, with 3 449.4 cm^2 and Tellia, with 3 315.1 cm^2. In general, the foliar area of a plant decreased with the increase of density, increased with the enhancement of fertilizer dosages and varied under the influence of meteorological fluctuations in the three years of experimentation. The index of the foliar area varied – like the foliar area –determined, in general, by the favorability of the agricultural year and by the experimented factors, by fertilization, sowing density and hybrid, respectively.

The average values of the plant height stress, within great limits, the variation of their size from 125 cm, the average in 2007 of the hybrid Heliasol Ro, to 171 cm, the average value noted for the Huracan hybrid in 2006, as a result of the influence of the experimented factors and the different meteorological conditions during the period when the research were carried out. The annual average values of each experimented technological factor indicated a variation of the plant height between 135 cm in 2007 and 158 cm in 2006, variations that directly reflect the

influence of the climatic fluctuations. The increased dosages of fertilizers indicate a growth tendency of the plant height which is not backed up statistically.

The head diameter varied, in size, within great limits, the extreme values being 14.6 cm in 2007 at the maximum density (70 000 plants/ha) and 22.3 cm in 2008, at the minimum density (30 000 plants/ha). In relation to the fertilization levels, it has been noted the enhancement of the head diameter concomitant to the enhancement of dosages of fertilizers. In relation to the hybrid, head diameter was practically equal for Heliasol Ro and Tellia and distinctively inferior for Huracan. A decrease in head diameter was noted from the smallest density of plants/ha to the maximum density.

The calculation of the size of the yield components was carried out in order to establish the effect determined by each element involved in the achene yield, but also in order to specify the influence that the experimented technological measured exerted on the size of the respective quantitative characters. The average number of achenes increased progressively, from the unfertilized variant (531 achenes per head) to the maximum fertilization (1 136 achenes per head), all the disparities registered in comparison to the unfertilized control are very significant. The genetic structure of the hybrids influenced the achievement of a different average number of achenes per head, the Huracan hybrid was very significantly inferior to control, Heliasol Ro, and Tellia was statistically equal to the latter. The experimented densities have strongly contributed to the diversification of the average number of achenes obtained per head. As compared to control (50 000 plants/ha), the other two densities were significantly different in regard to the number of achenes per head, with a positive disparity for the density of 30 000 plants/ha and a negative one for the density of 70 000 plants/ha.

The weight of achenes per head presented average values, over the entire period of experimentation, between 57.2 g (an average obtained at the density of 70 000 plants/ha) and 84.0 g (the average for the density of 30 000 plants/ha) the fertilization caused a continuous enhancement of the weight of the achenes per head, the increased deliveries presenting different degrees of statistical backing up. The weight of the achenes per head, as the average for the entire period of experimentation was significantly inferior for Huracan compared to Heliasol Ro, while for Tellia there was no significant disparity compared to control. The sowing density factor influenced the average values of the discussed variable, achieving, compared to control (50 000 plants/ha), very significant weight disparities, positive at minimum density and negative at maximum density.

The differentiations caused by the year of experimentation with regard to the 1 000-achenes weight come from the annual averages of this indicator, ranging between 56.0 g in 2006 and 40.4 in 2007. These average values were also determined, besides the genotype of each

hybrid, by the technological measures that were applied. The average of all the experimenting years and of the verified treatments ranks the hybrids used in relation to the1 000-achenes weight, in the following decreasing order: Huracan (48.8 g), Heliasol Ro (47.6 g) and Tellia (46.5 g). The fertilization, by ensuring a satisfying nutrition, caused the enhancement of the 1 000-achenes weight with the increased fertilizer dosages, but the achieved enhancement is not significant. The disparities noted between the average values of the 1 000-achenes weight between the hybrids have not been backed up statistically, but only within the same hybrid, in relation to the year of experimentation. Although the fertilization contributed to the enhancement of the 1 000-achenes weight, the disparities caused by this factor have not been significant.

Concerning the hectoliter mass, the calculations carried out in the three years of experimentation have emphasized annual average values of this indicator between 39.8 kg/hl in 2007, the least favorable year for this crop, and 42.1 kg/hl in 2006, the noted disparities are not statistically backed up. Similarly, the discrepancies caused by the factors I studied – fertilization, hybrids or sowing densities – range within the limits of error, the achieved values being practically equal.

The achene yield and the oil yield represent the final aim of breeding sunflower and constitute a synthesis of the different yield components working together, influenced by pedoclimatic factors and technological variables.

In 2006, a year favorable to sunflower, the interaction between the Tellia hybrid x $N_{96}P_{96}K_{96}$ x 50 000 plants/ha achieved the highest achene yield (3 680 kg/ha), followed by the interaction Heliasol Ro x $N_{96}P_{96}$ x 50 000 plants/ha (3 650 kg/ha) and the interaction Tellia x $N_{96}P_{96}$ x 50 000 plants/ha (3 640 kg/ha).

The year 2007 was unfavorable to all plants, including sunflower, and the highest achene yield achieved was of 1 570 kg/ha for the interaction of the factors Tellia x $N_{64}P_{64}$ x 50 000 plants/ha, followed by the interaction Tellia x $N_{96}P_{96}$ x 50 000 plants/ha, with 1 540 kg/ha.

The year 2008 was favorable to sunflower – the highest achenes yield was obtained for the interaction Tellia x $N_{96}P_{96}K_{96}$ x 50 000 plants/ha with 3 710 kg/ha, followed by the interaction Tellia x $N_{96}P_{96}$ x 50 000 plants/ha, with 3 660 kg/ha.

The interactions between the factors researched during the three years of experimentation emphasize the influence of the climatic factors on the sunflower yield, in the favorable years the yields obtained exceeded 3 700 kg/ha.

The average achene yield during the period of experimentation varied within great limits as a result of the experimented technological variables and the climatic conditions. Thus, the minimum average achene yield over the three years was of 2 087 kg/ha (88.8% compared to control), corresponding to the Huracan hybrid, unfertilized and sowed at a density of 70 000

plants/ha, and the maximum yield was 2 953 kg/ha (125.7%), corresponding to the Tellia hybrid, fertilized with the maximum dosages of fertilizers, at the density 50 000 plants/ha. This great amplitude of variation of the average yields from the entire vegetation period, approximately 900 kg/ha, shows the importance and the necessity of the use of agri-fitotechnical measures verified experimentally in order to obtain high yields and as constant as possible. In the case of the majority of the tested variants, yield increases were significant compared to control. From these data results the need of adequate fertilization of the sunflower, together with the adequate density, for each hybrid of the plants per unit area.

The fertilization has contributed significantly to the increase of achene yield which took place progressively, concomitant to the enhancement of the fertilizer dosages. The average yield increases achieved as a result of the use of increasing dosages of fertilizers ranged between 121 kg/ha (5.2%) for the fertilized variant $N_{32}P_{32}$, significant compared to the unfertilized control sample and 379 kg/ha (16.3%), very significant compared to control, in the case of use of maximum dosages of fertilizers. Adding potassium to the dosages of $N_{96}P_{96}$ did not contribute to the increase of the yield, a fact that may also be explained by the good supply of this nutritional element in the soil.

The Tellia hybrid, through its genetically higher yield potential, had a positive, significant influence on the achenes yield, underlining the importance of the use of the most productive hybrid for each area, implicitly for S.C. Agrofruct Plugari S.A.

The density of the plants per unit area had a decisive role in achieving the yields, the density of 50 000 plants/ha ensuring the highest yield. The extreme densities contributed to the significant decrease of the yield, backed up statistically, at the minimum density (deficit of 154 kg/ha) and very significant at the maximum density (255 kg/ha). The average yields over the three years of experimentation show, as the factor that contributes to the enhancement of sunflower achene yield, the optimal density of 50 000 plants/ha.

The joint effect fertilization x hybrids upon the yield emphasizes the progressive yield enhancement for the three experimented hybrids, concomitant to increasing dosages of fertilizers, the most accentuated beneficial effect is manifested in the case of the Tellia hybrid. The interaction fertilization x sowing density was best outlined at the density of 50 000 plants/ha. The combined action of sowing density and of hybrids on the yield shows that the extreme densities have negatively influenced the yield of the hybrids. Among the hybrids, Heliasol Ro and Huracan did not react to the variation of density, while Tellia has reacted positively, the increase of the yield of 257 kg/ha is distinctly significant compared to control.

The oil concentration varied within great limits, caused by the meteorological conditions of the agricultural years and by the technological factors experimented. In 2006, very favorable

to the sunflower crop, the oil concentration was low, at best it did not exceed 49.9%, while in 2007, the least favorable year for the sunflower crop, when the achene yields were small, the oil concentration was high, reaching at best 54.8%.

The oil yield/ha determined by the achene yields and the oil concentration ranged between 837.0 kg/ha (79.2%) for the Tellia hybrid fertilized with $N_{32}P_{32}$, sowed at the density of 70 000 plants/ha and 1 305.6 kg/ha (123.5% compared to control) for the Heliasol Ro at the same level of fertilization, sowed at 50 000 plants/ha. The fertilization, with the highest dosages of azote and phosphorus, had a positive effect, distinctly significant upon the oil yield. The Tellia hybrid and the extreme densities had a slightly negative influence upon the oil yield/ha, which is not backed up statistically.

The highest economic efficiency was observed at the dosages of $N_{64}P_{64}$ and $N_{96}P_{96}$ at a density of 50 000 plants/ha, as well as for the Tellia hybrid.

Based on the results obtained during the period of experimentation, proposals have been made for the improvement of sunflower breeding technology at S.C. Agrofruct Plugari S.A., Iasi County, meant to increase the sunflower yield within this unit.