PHENOLOGY ASPECTS OF SOME SUNFLOWER HYBRIDS

A. ARDELEAN[1], A. BALINT[1], Irina PETRESCU[1], C. STROIA[1]
[1]Banat's University of Agricultural Sciences and Veterinary Medicine"King Mihai I of Romania" from Timisoara, 300645, 119, Calea Aradului, Timisoara, Romania
email: cipistroia2001@yahoo.com

Abstract: *Cultivated sunflower (Helianthus annuus L.) is an unusual plant. It is distinguished from all other cultivated plants by its single stem and conspicuous, large inflorescence. A sunflower plant is influenced by both the growth stages from planting to maturity, as well as temperature, day length, nutrition and humidity. Hybrid maturity and crop area also have an effect on the length of the growing season. The study investigated the phenology of three sunflower hybrids grown in the western part of Romania. The yield of these hybrids from the morpho-phenological perspective is being sought in order to identify their adaptability to the cultivated area. To grow best, sunflowers need full sun. They grow best in fertile, moist, well-drained soil with heavy mulch. The results obtained from the measurements show that the studied hybrids behave differently from the environmental conditions encountered in the western part of Romania. In order to reach the objectives, the most important characteristics were measured which reflected the behavior of the hybrids in relation to the environmental factors, namely, the height of the plant, the length of the roots, the number of leaves, the length and width of the leaves, the diameter of the stem, the diameter of the flower buds and the diameter of the inflorescence. Those characteristics determine somewhat the use of the plant-as a source of edible oil, as food for people and animals, or as forage. Floriculturists are interested in the variability in flower color, petal structure, and petal size. Descriptive classes are proposed herein for some morphological characters to improve the uniformity of descriptions of inbred lines and cultivars. Many descriptive characters are affected by the environment, so measurements should be made of plants grown under optimum field conditions. The statistical calculation was performed in Microsoft Office Excel 2016, establishing the coefficient of variation, the standard deviation of the mean and the average of the observed variants.*

Key words: *Sunflower, morphological, Helianthus annus L.*

INTRODUCTION

Sunflower is one of the most widespread oil plants in our country. From its seeds an oil is widely distributed both in Romania and abroad.

The high demand for sunflower oil, but also the multiple uses of this plant causes many farmers to go to cultivation.

Vegetable fats (oils) have many uses in the food and food industry. Sunflower oil, having very good food qualities, is widely used either directly in human nutrition, or in the preparation of preserves and margarine, etc. The excellent edible qualities of sunflower oil are due to the high content of unsaturated fatty acids (Constantinescu, M., Sinulescu, Gh., 2014).

Sunflower (*Helianthus annuus* L.) has an important place among oil seed crops in the world market and its production increased by approximately 1.8 times during the last 20 years (Pouzet, A. and D. Delpancke. 2000). Nutrient removal by crops far exceeds than the nutrient additions through fertilizer. To this extent, the soils are becoming depleted, because much of this gap is at the expense of soil fertility (Tandon, H.L.S. 2004; Jehan Bakht et all. 2010). Application of fertilizers having nutrients like nitrogen, phosphorous and potash can increase sunflower growth and yield substantially (Kho, R.M. 2000; Prasad P.V.V. est all., 2002; De Varennes et all., 2002; Cechin, I. and T. de. F. Fumis. 2004).

The importance of improving the sunflower was an area of great interest for a well-attained objective, namely obtaining the best oils and the highest quality canteens (Constantinescu, M., Sinulescu, Gh., 2014). Abiotic and biotic factors have been and are

challenging for the field of sun flower enhancement because new genotypes of the subject and of the improvement object such as: climate change, new genotypes of parasites and pathogens, new culture technologies appear annually and periodically for which the improvement becomes a difficult mission (Madosa E., 2000).

MATERIALS AND METHODS

The observations were made in the sunflower crops in the perimeter of Vladimirescu, Arad county. The biological material consisted of sunflower hybrids created in Lovrin breeding fields, so the studied hybrids SUN13S18, SUN13OR18 and SUN14OR19 are suitable for the western part of Romania (Mouchantat AH, 1978).

The species of the genus *Helianthus* form a polyploid series having as base number 17 chromosomes. Within the genus there are diploid, tetraploid and hexaploid forms.

The division of the species according to the degree of ploidy can be done according to the type of roots. The diploid group ($2n$ = 34 chromosomes) is characterized by a fasciculated root, the tetraploid species ($2n$ = 68 chromosomes) have roots in the form of rhizomes, and the hexaploid ones ($2n$ = 102 chromosomes) are root species in the form of tubers. A large number of data are known about the variability and genetic determinism of the characters involved in breeding (Alexandru-Viorel Vranceanu, 2000).

During the vegetation period, observations were made on the main phenophases, resistance traits and biometric measurements of the main morphological characters. The measurements were performed in four vegetative periods, the first period comprising measurements at 10 and 20 days after sprout. The second period includes measurements made at 30 and 45 days of sprout. The third period included measurements made at 55 and 65 days after sprout. The last period, the fourth period included measurements made at 75, 85 and 110 days after sprout (Vrânceanu A., 1967).

The studied characters were the height of the plant, the length of the roots, the number of leaves, the length and width of the leaves, the diameter of the stem, the diameter of the flower bud and the diameter of the inflorescence.

The values were recorded in the tables following the statistical calculations that include the coefficient of variation, the standard deviation of the mean, and the average of the observed variants.

The statistical calculation was performed in the Office Excel 2016, using which the values for the arithmetic mean, the error of the mean, the coefficient of variation were obtained.

RESULT AND DISCUSSION

The increase in height of the sunflower hybrids during the first vegetation period.

The height of the hybrids was observed in the first vegetation period at 10 days and 35 days after sprout. The hybrid with the highest height was SUN13S18, which had dimensions that varied between 4.40 cm at 20 days and 9.15 cm at 35 days with an average value of the two observation periods of 6,78 cm.

The hybrid SUN13OR18 and SUN14OR19 at 20 days after sprout recorded similar values of plant growth in height ranging from 2.43 cm to 2.83 cm, similar values are found at 35 days from sprout respectively 8.50 cm and 7.33 cm.

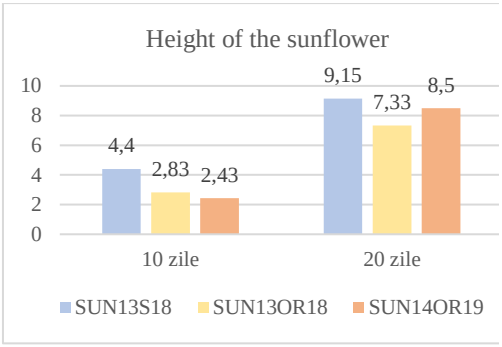

Fig.1 The increase in height of the sunflower hybrids during the first vegetation period

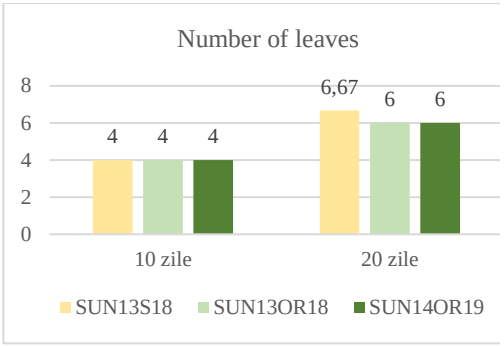

Fig 2. Number of leaves formed by sunflower hybrids during the first vegetation period

Number of leaves formed by sunflower hybrids during the first vegetation period

Number of leaf in the first period of 10 days growth from the east is similar in all three hybrids analyzed (two pairs of leaves).

At 20 days after sprout, the SUN13S18 hybrid presents in one of the three analyzed variants the incipient emergence of the fourth leaf perch thus obtaining an average of the number of leaves analyzed by 6.67.

On the other hand, the hybrid SUN13OR18 and SUN14OR19 at 35 days have the same number of pairs of leaves, namely, three fully developed pairs of leaves.

The length of the leaves formed in the sunflower hybrids during the first vegetation period.

The highest value recorded during the 10-day observation period of the leaf length character was in the SUN14OR19 hybrid with a value of 2.43 cm, and in the 20-day period the SUN13S18 hybrid recorded a value of 11.33 cm.

Similar values were observed in SUN13S18 and SUN13OR1 8 hybrids, respectively, 2.10 cm and 1.93 cm during the 10 days after sprout. The SUN14OR19 hybrid during the 20 days after sprout was observed a value of 8.07 cm.

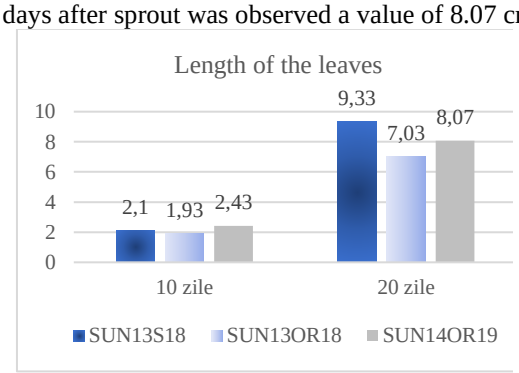

Fig 3. The length of the leaves formed in the sunflower hybrids during the first vegetation period

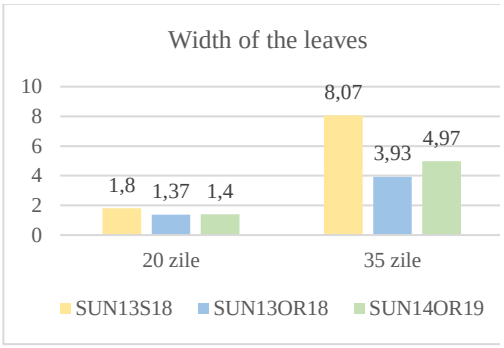

Fig 4. The width of the leaves formed on the sunflower hybrids during the first vegetation period

The width of the leaves formed on the sunflower hybrids during the first vegetation period

We have the width of the leaves after 10 days after sprout with similar sizes where no big differences were observed in the studied plants.

Noticeable differences between the analyzed variants begin to appear at 20 days after sprout. The lowest value was observed in SUN13OR18 of 3.93 cm and the highest in the hybrid SUN13S18 of 5.59 cm. The SUN14OR19 hybrid obtained an intermediate value between the other variants, respectively 4.97 cm.

The root length of the sunflower hybrids during the first vegetation period

The comparative analysis of single results we can see a long root hybrid SUN13OR18 4.00 cm after 10 days from the east, this value is similar to the hybrid SUN14OR19 where they could see a major difference, with an average of the three analyzed plants of 3.97 cm. The lowest mean value was recorded in the SUN13S18 hybrid of 2.57 cm.

After 35 days from sprout the highest value of the average root width of the three studied plants was recorded in the SUN13OR18 hybrid of 13.05 cm. Compared with the results of the first observations, 20 days after sprout, the lowest value was recorded in the SUN14OR19 hybrid of 11.77 cm and the intermediate value was observed in the SUN13S18 hybrid of 12.32 cm .

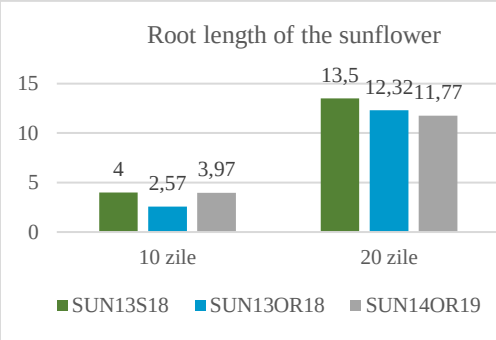

Fig 5. The root length of the sunflower hybrids during the first vegetation period

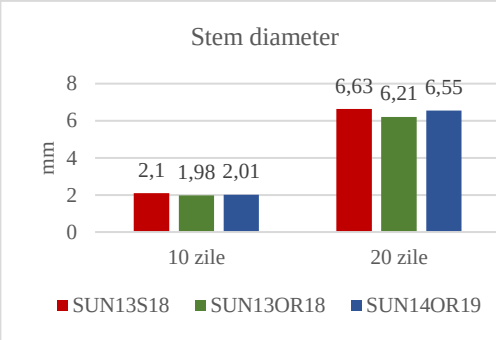

Fig 6 . Stem diameter in sunflower hybrids during the first vegetation period (mm)

Stem diameter in sunflower hybrids during the first vegetation period (mm)

The diameter of the stems has similar values at 10 and 20 days after sprout respectively, the highest value was recorded in the SUN13S18 hybrid of 2.10 mm. Also, the SUN13S18 hybrid has the highest value at 35 days after sprout, is 6.63 mm.

The increase in height of the sunflower hybrids during the second vegetation period

After a period of 30 days from sprout, the average height of the three plants analyzed recorded the highest value in the SUN13S18 hybrid of 82.33 cm. And at 45 days after sprout, as can be seen in the table, the hybrid SUN13S18 also recorded the highest value of 39.30 cm.

The values of the SUN13OR18 and SUN14OR19 hybrids did not show any notable differences, the values of the studied hybrids plants being between 30 days between 35 - 37 cm, and at 45 days the values being between 72-75 cm.

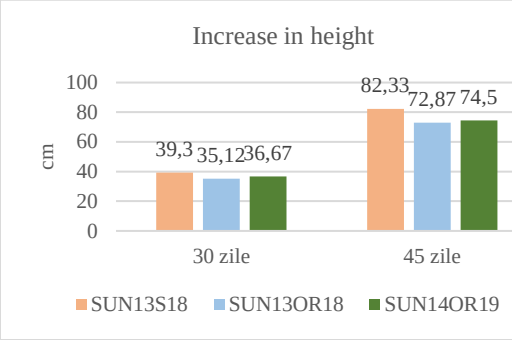

Fig 7. The increase in height of the sunflower hybrids during the second vegetation period

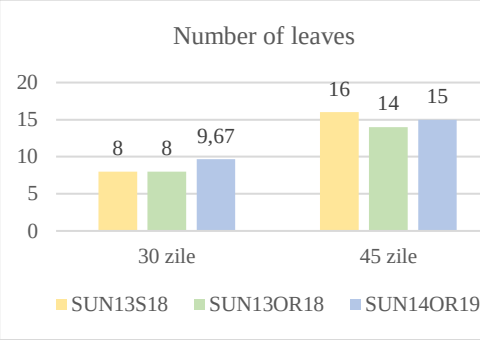

Fig 8. Number of leaves formed in sunflower hybrids during the second vegetation period

Number of leaves formed in sunflower hybrids during the second vegetation period

At 30 days after sprout, according to the observations made, the highest value of the number of leaves was recorded in the SUN14OR19 hybrid, averaging 5 pairs of leaves. The hybrid SUN13S18 and SUN13OR18 have similar values respectively 4 pairs of leaves.

After 45 days of sowing, the highest value of the number of leaves is also recorded in the hybrid SUN13S18 with a number of 7 pairs of leaves, but we notice a differentiation between the hybrid SUN13OR18 which has the lowest value and SUN14OR19 whose value average is intermediate to the values of the other variants studied.

The length of the leaves formed in the sunflower hybrids during the second vegetation period

After a period of 30 days after emergence, the maximum value of the leaf length was recorded at SUN13S18 (20.00), the intermediate value was present in the SUN14OR19 19.03 cm hybrid and finally the minimum value was recorded in the SUN13OR18 hybrid of 17,00 cm. The same ranking was maintained 45 days after the sprout, the SUN13S18 hybrid obtained 25.13, the SUN14OR19 value of 19.27 and the SUN13OR18 hybrid obtained the value of 18.55 cm.

At 4 5 days after sprout the same ranking was maintained, the hybrid SUN13S18 obtained the value 25,13, the SUN14OR19 value of 19.27 and the hybrid SUN13OR18 obtained the value of 18.55.

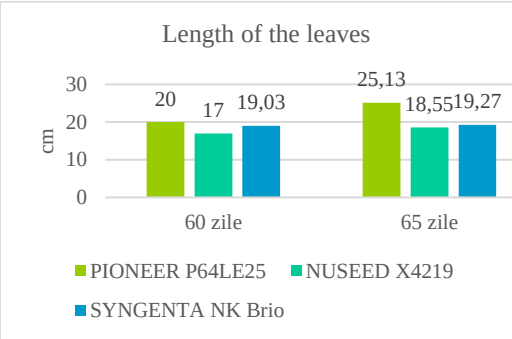

Fig.9 length of the leaves formed in the sunflower hybrids during the second vegetation period

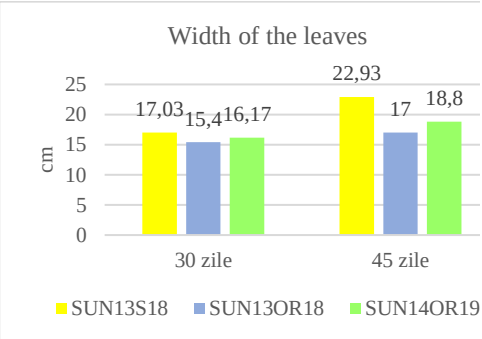

Fig. 10 The width of the leaves formed on the sunflower hybrids during the second vegetation period

The width of the leaves formed on the sunflower hybrids during the second vegetation period

The results recorded for the width of the leaves were maintained in the same order of value as those for the length, the hybrid SUN13S18 obtaining the maximum value at 30 days of 17.03 cm and at 45 days it obtained the value of 22.93. The SUN14OR19 hybrid obtained the value of 16.17 cm at 30 days after sprout and the value of 18.80 at 45 days after sprout. The hybrid SUN13OR18 recorded the value of 15.40 cm at 30 days after sprout, and at 45 days it obtained the value of 17.00 cm.

The diameter of the stems in the sunflower hybrids during the second vegetation period

In the first observation of the second vegetation period, respectively 30 days after the emergence, the values of the diameter of the stem are similar, the hybrids SUN13S18, SUN13OR18 and SUN14OR19 recorded values between 10-13 mm. In the second observation of the same vegetation period, the highest value was recorded in the SUN13S18 hybrid of 23.67 mm, the intermediate value was observed in the SUN14OR19 hybrid of 19.39 mm. The lowest observed value was recorded in the SUN13OR18 hybrid of 17.57 mm.

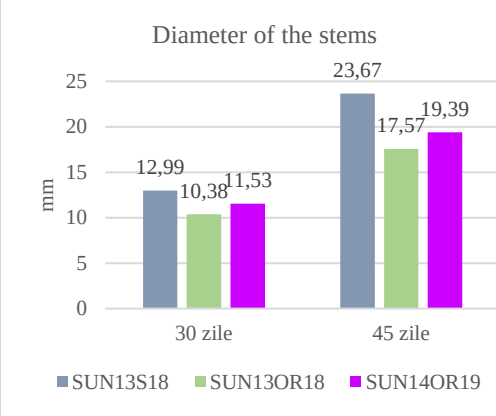

Fig. 11 The diameter of the stems in the sunflower hybrids during the second vegetation period

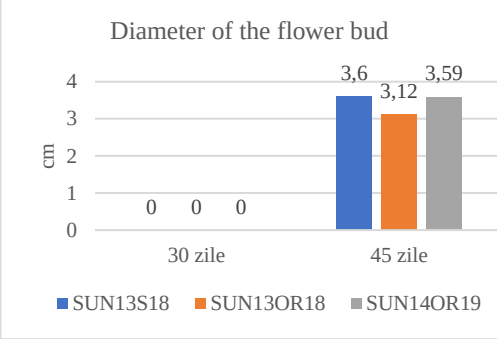

Fig. 12 The diameter of the flower bud in sunflower hybrids during the second vegetation period

The diameter of the flower bud in sunflower hybrids during the second vegetation period

At 45 days after sprout, the incipient phase of the flower bud can be observed where the largest diameter value was recorded in the SUN13S18 hybrid of 3.60 cm. And the SUN13OR18 hybrid obtained a value of 3.12 cm, representing the smallest value obtained.

The increase in height of the sunflower hybrids during the third vegetation period

During the third observation period, there were significantly higher values and a faster growth compared to the previous periods, thus registering the maximum value at 55 days from sprout to the SUN13S18 hybrid of 121.33 cm. The mean value was observed in the SUN14OR19 hybrid of 118.83. And the lowest value recorded at 80 days after sprout was at the SUN13OR18 hybrid of 106.71 cm.

At 65 days after sprout, there is also a differentiation of the height of the studied hybrids. The highest height was noted in the SUN13S18 hybrid with a value of 137.50 cm. Hybrid SUN14OR19 was recorded value of 135.96 cm, and hybrid SUN13OR18 was observed the smallest single value of 132.93 cm.

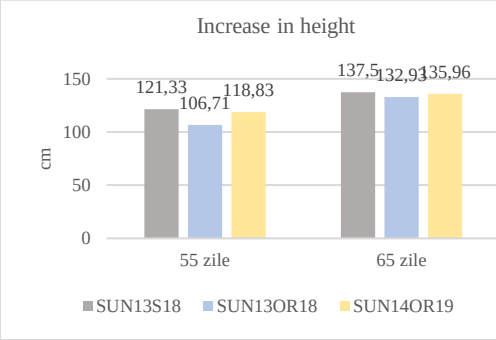

Fig. 13 The increase in height of the sunflower hybrids during the third vegetation period

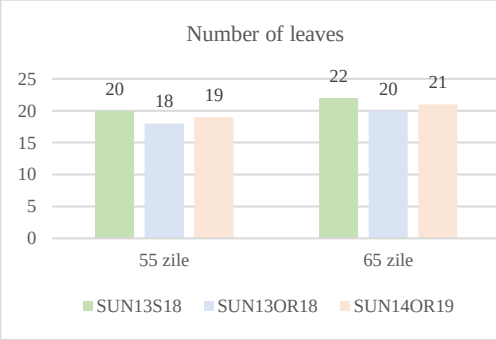

Fig. 14 The number of leaves in the sunflower hybrids during the third vegetation period

The number of leaves in the sunflower hybrids during the third vegetation period

In the first observation made 55 days after the sprout there was an exponential increase in the number of leaves compared to the previous period, thus, the highest value recorded was in the hybrid SUN13S18 with no number of 16 pairs of leaves, and the one lower value was recorded in the SUN13OR18 hybrid with 14 pairs of leaves.

The second observation from the third vegetation period remains the same, thus, the hybrid SUN13S18 has the highest value of 18 pairs of leaves, compared to hybrids SUN14OR19 and SUN13OR18, which have values between 16-17 pairs of leaves.

Leaf lengths in sunflower hybrids during the third vegetation period

The length of the leaves from 50-65 has a much faster growth rate than the first vegetation period. Figure 14 shows similar values between the SUN13OR18 hybrid with a value of 23.27 cm and the SUN14OR19 hybrid with a value of 24.53 cm. And the highest value was registered on the SUN13S18 hybrid of 16.22 cm. After 65 days the maximum value was registered in the SUN13S18 hybrid of 30.06 cm. The mean value was observed in the SUN14OR19 hybrid of 28.44 cm, and the smallest recorded value was noted in the SUN13OR18 hybrid of 27.25 cm long width of leaves on sunflower hybrids during the third vegetation period.

The same growth rate observed at the leaf length is also present at the leaf width character, where during the 50-65 days period a much more rapid growth is observed. The maximum value is recorded in the SUN13S18 hybrid, where at 55 days the value of 24.53 cm was observed and at 65 days the value of 30.44 cm.

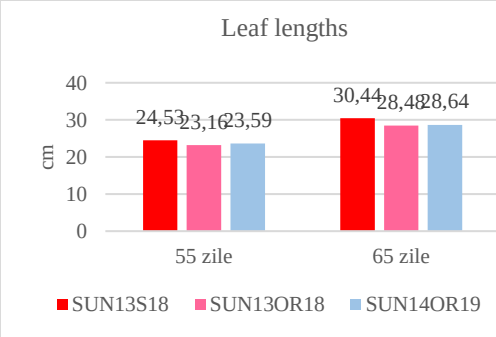

Fig.15 Leaf lengths in sunflower hybrids during the third vegetation period

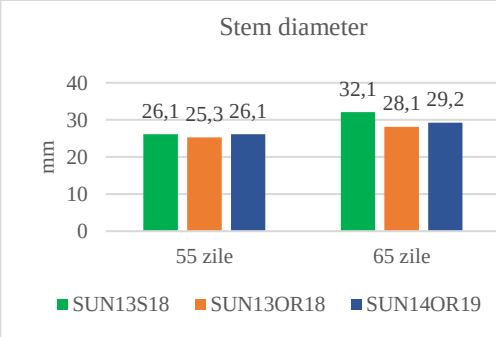

Fig. 16 Stem diameter in sunflower hybrids in the 3rd vegetation period (mm)

Stem diameter in sunflower hybrids in the 3rd vegetation period (mm)

At 55 days after sprout, observations were made on the diameter of the stem, where similar values between 25 - 26 mm were recorded.

Differences between the studied variants were observed at 65 days after sprout, the highest value was recorded in the SUN13S18 hybrid of 32.10 mm, and the lowest value was recorded in the SUN13OR18 hybrid of 28.10 mm. The intermediate value was observed in the SUN14OR19 hybrid of 29.20 mm.

Diameter of the flower bud in the sunflower hybrids during the third vegetation period (cm)

The values of the diameter of the floral bud, in the observations from 55 days after sprout are between 4-5 cm. And at 65 days the values are between 5-7 cm. The highest value was registered the SUN13S18 hybrid with 7.16 cm.

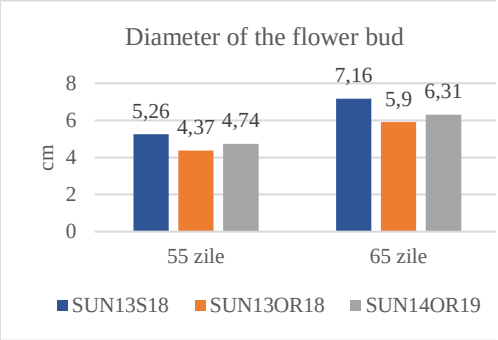

Fig. 17 Diameter of the flower bud in the sunflower hybrids during the third vegetation period (cm)

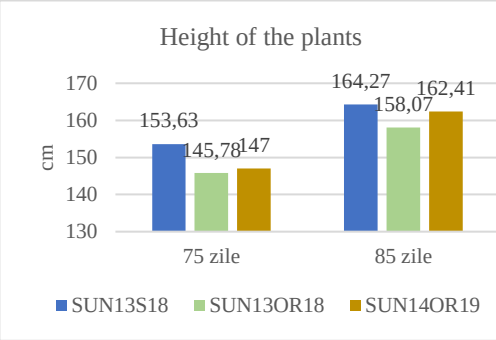

Fig.18 The height of the plants in the sunflower hybrids during the fourth vegetation period

The height of the plants in the sunflower hybrids during the fourth vegetation period

During the growing season IV, the maximum value was Obtained held in hybrid SUN13 S18 160 cm. The smallest recorded value is observed in the SUN13OR18 hybrid with a size of 158.0 7 cm, and the intermediate value is recorded in the SUN14OR19 hybrid with the size of 162.41 cm.

Number of leaves in sunflower hybrids during the fourth vegetation period

By comparing the three variants, small differences are presented both at 75 days and at 85 days after sprout on the number of leaves for all observed hybrids. In the last observation phase of the IV period of development it was observed that the hybrid SUN13S18 has 13 pairs of leaves, the hybrids SUN13OR18 and SUN14OR19 have a number of leaves of 12 pairs.

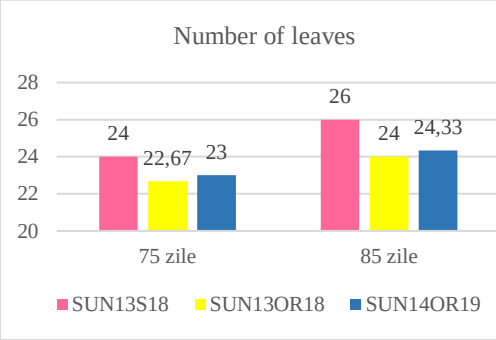

Fig. 19 Number of leaves in sunflower hybrids during the fourth vegetation period

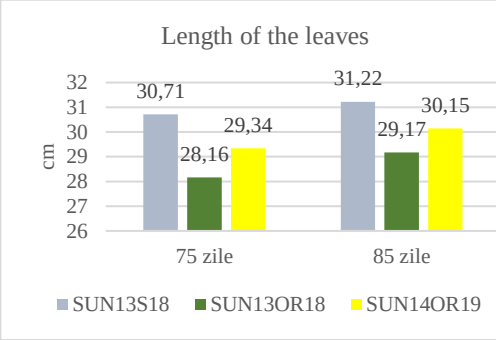

Fig.20 The length of the leaves in the sunflower hybrids during the fourth vegetation period

The length of the leaves in the sunflower hybrids during the fourth vegetation period

The result of the two observation stages does not show significant differences.
The increase in the length of the leaves in the fourth period of observations decreased significantly compared to the previous periods. By comparing the values we cannot observe significant differences. The range of values is between 28-31 cm at 75 days and 29-32 cm at 85 days.

Leaf width in sunflower hybrids during the fourth vegetation period

The same can be said about the width of the leaves, the differences are not significant by comparing the period IV with the previous periods. The values being between 29-31 cm for 75 days and a range of 30-32 cm for 85 days.

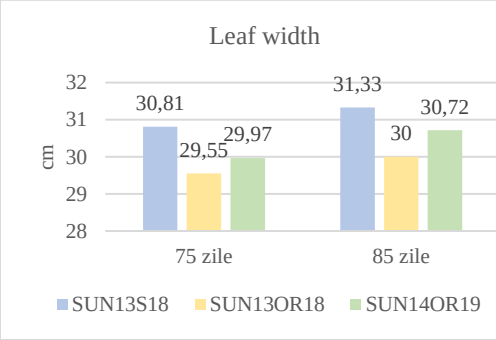

Fig.21 Leaf width in sunflower hybrids during the fourth vegetation period

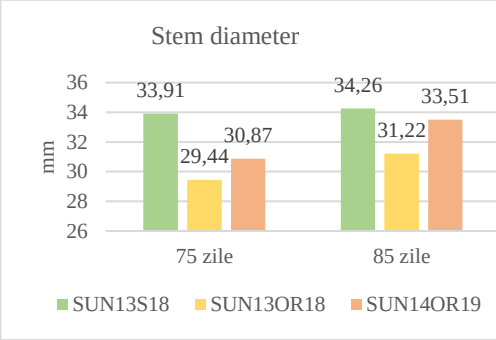

Fig. 22 Stem diameter in sunflower hybrids during the fourth vegetation period (mm)

Stem diameter in sunflower hybrids during the fourth vegetation period (mm)

In the two observation stages of period IV, the maximum values for the SUN13S18 hybrid of 33.91mm were recorded at 75 days and at 85 days the value of 31.10 mm.
The hybrid SUN13OR18 and SUN14OR19 obtained close values in the two observation stages, at 75 days the values being between 29-31 mm and at 85 days a range of values between 31-34 mm for all the analyzed plants.

The diameter of the inflorescence in the sunflower hybrids in the fourth period (cm)

A significant increase in the diameter of the inflorescence can be observed in all 3 hybrids analyzed for the two stages analyzed during the IV development period.

In table 3.24 the minimum value at 75 days can be observed in the SUN13OR18 hybrid (6.73cm) and at 85 days it can be observed in the SUN14OR19 (9.71cm) hybrid. The highest value for both periods was in the SUN13S18 hybrid with values between 7-11 cm.

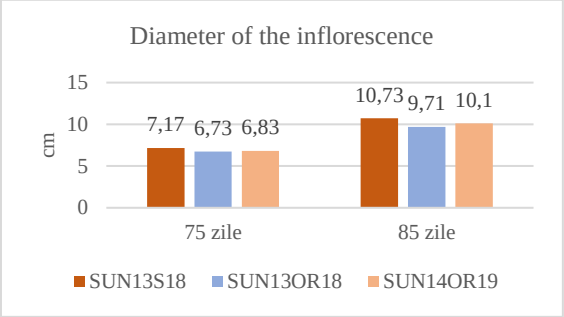

Fig. 23 The diameter of the inflorescence in the sunflower hybrids in the fourth period (cm)

The diameter of the inflorescence in the sunflower hybrids in the fourth period (cm) at 110 days

After 110 days after sprout, the diameter of the inflorescence registered a maximum value in the SUN13S18 hybrid of 15.27 cm, and the intermediate value was recorded in the SUN14OR19 hybrid of 14.60 cm. The smallest value was recorded in the 14.36 cm SUN13OR18 hybrid, as can be seen in the table below.

CONCLUSIONS

The increase of the height of the stalk was slow at all the variations observed at the beginning of the vegetation period, after the first development period, there is an increase of the growth rate until the beginning of the flowering, following a significant decrease of the height increase at the end of the height.

The highest leaf number was reported in the SUN13S18 hybrid compared to the other studied hybrids reaching 26 leaves

The length and width of the leaves recorded in the periods I –II a length between 1.95 cm - 25.13 cm and a width between 1.37 cm and 22.93 cm.

Following the observations, we can conclude a value approximation between the length and the width of the leaves for the plants analyzed in periods III-IV.

The diameter of the stem had the highest value in period I of 9.15 mm and in period II the highest value was 23.67 mm, observing an acceleration of the increase of the diameter of the stem in period III and IV.

The appearance of the flower bud was recorded 45 days in the second stage of period II. The size of the button indicates an intense growth throughout the III vegetation period until the formation of the inflorescence. It is present 45 days after sprout with a maximum size of 3.60 cm. The beginning of flowering was recorded at 65-70 days, all the plants were registered as flowering after 75 days in the first stage of the IV period of vegetation.

BIBLOGRAPHY

ALEXANDRU-VIOREL VRANCEANU, 2000, Floarea-soarelui hibrida, Editura Ceres, Bucuresti.

CANER. JACK F. (ED.). 1978. Sunflower Science and Technology. Agronomy 19. 1978 by the American Society of Agronomy. Crop Science Society of America. and Soil Science Society of America. 677 South Segoe Road. Madison. WI 53711 USA.

CECHIN, I. AND T. DE. F. FUMIS. 2004. Effect of nitrogen supply on growth and photosynthesis of sunflower plants in the greenhouse. *Plant Sci.*, 166: 1379-1385.

CONSTANTINESCU, M., SINULESCU, GH., 2014, Cultura plantelor pentru ulei, Editura MAST, Bucuresti.

DE VARENNES, A., J.P. MELO-ABREU AND M.E. FERREIRA. 2002. Predicting the concentration and uptake of nitrogen, phosphorus and potassium by field grown green beans under non-limiting conditions. *Eur. J. Agron.*, 17: 63-72.

JEHAN BAKHT*, MOHAMMAD SHAFI, MOHAMMAD YOUSAF AND HAMID ULLAH SHAH,Physiology, phenology and yield of Sunflower (autumn) as affected by npk fertilizer and hybrids,2010

KHO, R.M. 2000. On crop production and the balance of available resources. *Agric. Ecosystem. Environ.*, 80: 71-85.

LILIANA PANAITESCU, 2009, Fitotehnie - Plante oleaginoase - Plante textile, Editura Universitara, Bucuresti.

MADOSA E., 2000, Ameliorarea Plantelor Agricole, Ed. Marineasa, Timișoara

MOUCHANTAT AH. *Technologia cultura floarea soarelui in codetii de irigare*. Teza de doctorate A. Bucuresti Romania 1978 :149P

POUZET, A. AND D. DELPANCKE. 2000. Evolution comparee de la production et de la competitive te du tournesol dans differentes aires de production proc. *15th International conference, Toulouse, France Tome 1: AI*-9.

PRASAD P.V.V., V. SATYANARAYAMA, V.R.K. MURTHY AND K.J. BOOTE. 2002. Maximizing yields in riceground cropping sequence through integrated nutrient management. *Field Crop Res.*, 75: 9-21.

SADRAS, V.O. 2006. The N:P stiochiometry of cereal, grain legume and oilseed crops. *Field Crop Res.*, 95: 13-29.

TANDON, H.L.S. 2004. Fertilizers in India. Agriculture. *Farming Outlook*. 4(2): 17-22.

VRANCEANU A., 1967, Aspecte Noi Privind Cultura Florii-Soarelui, Ed.Agro-Silvică, București.