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VARIATION OF THE GROWTH PERIOD AT SUNFLOWER HYBRIDS ACCORDING TO GROWING CONDITIONS

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Abstract

For a given sunflower hybrid, even the length of the growth period is a specific characteristic, this being determined by the genetics of the hybrid, this is influenced between some limits by the growing conditions. These limits of variation are important to be known by the farmers as they could predict the time when the plants reach a certain growing stage or the maturity.
The aim of the present paper is to identify the variation limits of the growth period of an assortment of 18 sunflower hybrids cultivated in 2018 and 2019 in five locations covering the most important regions for growing sunflower in Romania. Sunflower hybrids behave differently regarding the duration of the growth period, according to the specific growing conditions of the location and the year. The variation limits of the growth period at the sunflower hybrids studied in the five location from the most important regions for growing sunflower in Romania and in the years 2018 and 2019 were of 52-74 days for the period from emergence to beginning of flowering process (10% flowered heads) and of 101-135 days for the period from emergence to maturity.

Key words*: growth period, hybrid, limits of variation, sunflower.*

INTRODUCTION

Sunflower (*Helianthus annuus* L.) adapted during the time to various growing areas, which are characterised through different environmental conditions. This adaptation process has involved several mechanisms among which the length of the growth period is one of the most important.
Sunflower is a temperate zone crop which can perform well under various climatic and soil conditions (Qadir et al, 2007). This is a versatile crop, this being reflected in the fact that it can grow on a wide range of soils in many latitudes and are tolerant of dry conditions (Myers, 2017).
The total time required for development of a sunflower plant and the time between the various stages of development depends on the genetic background of the plant and the growing environment (Schneiter & Miller, 1981). So, the length of the growth period is given by the genetics of the hybrid and it is influenced by the environmental conditions which characterise a certain geographical location.
Early maturing varieties are ready for harvesting 90 to 120 days after planting, and late maturing varieties 120 to 160 days after planting (Fernández-Luqueño et al., 2014).
Practically, due to its adaptation to a large production area, with different climate features in light intensity, temperature and altitude, the crop cycle may vary from 80 to 130 days, depending on the cultivar and sowing date (Castro and Leite, 2018).
The time taken for a sunflower plant to develop through the growth stages from planting to maturity is affected by planting time, temperature, day length, nutrition and soil moisture; thus, temperature may vary the time taken to reach physiological maturity by as much as 25-30 days (GRDC, 2017).
Climatic variability is a major cause of inability of agricultural crops to achieve potential yield (Agele, 2003). This is an important source for the variability of the length of the growth period of the crops. Among the climatic factors,

temperature has a major influence on the growth and development processes of the plants, as well as on the length of the growth period.

Temperature affects the duration of all phenological stages (Alberio et al., 2015; GRDC, 2017; Ștefan et al., 2008). Having wide adaptability, different sunflower hybrids require different total number of cumulative degree-days or growing degree days for growth, development and maturity (Qadir et al., 2007). The increase in the average annual temperature will decrease the duration of the growth period till flowering with 4-6 days/°C and the duration of the growth period till maturity with 7-12 days/°C (Guilioni et al., 2010).

Another important factor affecting the length of the growth period is the day length, respectively the photoperiod. The flowering time, for example can be increased by up to 15 days due to day length (GRDC, 2017).

Generally, a longer growth period of a given sunflower hybrid is associated with a higher yielding capacity, this being due to the fact that the plants can produced more through photosynthetic process during a longer period of growth. But, increasing the vegetation period itself do not lead to a high productivity and in each groups of earliness there are hybrids with high and low productivity (Gontcharov & Zaharova, 2008). The longer growth period has to be put into values through optimal values of the environmental factors.

For a given sunflower hybrid, even the length of the growth period is a specific characteristic, this being determined by the genetics of the hybrid, this is influenced between some limits by the growing conditions. These limits of variation are important to be known by farmers as they could predict the time when the plants reach a certain growing stage or the maturity.

The aim of the present paper is to identify the variation limits of the growth period of an assortment of 18 sunflower hybrids cultivated in 2018 and 2019 in five locations covering the most important regions for growing sunflower in Romania.

MATERIALS AND METHODS

An assortment of 18 commercial sunflower hybrids was studied under rainfed conditions in two years (2018 and 2109) and in five field experiments located in the most important regions for growing sunflower in Romania.

The studied hybrids were the following: P63LL06, SY Flamenco, NK Neoma, LG55.42 CL, FD15E27, FD15CL44, LG 55.55 CLP, Paraiso 1000 CL Plus, ES Arcadia SU, P64LE25, P64LE99, MAS 85.SU, Rustica 172, Rustica 170, MAS 83.HO, Suntec HO CL, ES Poetic HO, P64HE118.

The five locations of the field experiments were the following:

- Negrești (Vaslui district), which is representative for eastern Romania; the area is characterised by haplic chernozems with neutral pH, well supplied with potassium and mid supplied with phosphorus and nitrogen.
- Cogealac (Constanța district), which is representative for south-eastern Romania; the area is characterised by chernozems with basic pH, well supplied with potassium and mid supplied with nitrogen and phosphorus.
- Mircea Vodă (Brăila district), which is representative for south-eastern Romanian Plain; the area is characterised by chernozems with neutral-basic pH, well supplied with potassium and mid supplied with phosphorus and nitrogen.
- Peciu Noi (Timiș district), which is representative for western of Romania; the area is characterised by haplic chernozems with neutral-basic pH, well supplied with potassium, mid supplied with phosphorus and poorly supplied with nitrogen.
- Șimleu Silvaniei (Sălaj district), which is representative for north-western of Romania; the area is characterised by haplic luvisols with neutral-basic pH, well supplied with potassium, mid supplied with phosphorus and poorly supplied with nitrogen.

For the five locations, the year 2018 is characterised as being warmer and dryer than 2019 (Table 1). The average temperature registered in the period April-August, which is associated with the growing period of the sunflower in Romania, in the two experimental years varied between 19.2 and 22.4ºC, while the sum of rainfall varied between 164.2 and 367.7 mm, according to location.

Table 1. Temperatures and rainfall registered in the period April-August, which is associated with the growing period of the sunflower in Romania

Location	Average temperatures (°C)		Sum of rainfall (mm)	
	2018	2019	2018	2019
Negrești	21.3	22.3	221.9	367.7
Cogealac	20.5	19.9	213.0	181.0
Mircea Vodă	20.7	19.8	164.2	216.0
Peciu Nou	22.4	20.1	292.4	296.9
Şimleu Silvaniei	21.0	19.2	265.7	327.5
Average values for the five locations	21.2	20.3	231.4	277.8

The field experiments were organised in split plots with three replications. The sowing was performed in April at 70 cm row spacing. The plant density was of 51,000 plants/hectare.

The weeds were controlled by the help of herbicides, which were applied pre-emergence (Dual Gold 960EC herbicide with 960 g/l of S-metolaclor as active substances, applied in a rate of 1.5 l/ha for controlling annual grasses and some annual broad-leaved weeds) and in vegetation in the 6 leaves stage (Select Super 120 EC herbicide with 120 g/l of Clethodim as active substances, applied in a rate of 1.5 l/ha for controlling annual and perennial monocotyledonous weeds).

Fertilization was performed with complex fertilizers containing nitrogen and phosphorus, which were of type 18:46:0, applied before seed bed preparation in a rate of 300 kg/ha. In vegetation, there was applied 150 kg/ha of ammonium nitrate.

RESULTS AND DISCUSSIONS

Duration of the period from emergence to beginning of the flowering process (10% flowered heads) at the studied sunflower hybrids in the five different locations in Romania was in average of 59 days, with limits of variations from 52 to 68 days in 2018, and it was in average of 66 days, with limits of variations from 54 to 74 days in 2019 (Table 2). These figures are according to those obtained by previous studies performed in South Romania, when the number of days from emergence to the beginning of flowering (10% flowered heads) varied between 64 and 70 days (Ion et al., 2006), even this time the minimum values are smaller.

The differences between maximum and minimum values registered by the studied hybrids according to the specific growing conditions of the location was in average of 10 days, with limits of variation from 7 to 14 days in 2018, and it was of 14 days, with limits of variation from 11 to 19 days in 2019. The higher variation registered in 2019 is confirmed by the value of the coefficient of variation (CV) which was in average of 7.64 in 2019 compared to 5.92 in 2018 (Table 2).

Duration of the period from emergence to maturity at the studied sunflower hybrids in the five different locations in Romania was in average of 116 days, with limits of variations from 101 to 130 days in 2018, and it was in average of 122 days, with limits of variations from 110 to 135 days in 2019 (Table 3). These figures are according to those mentioned by Vrânceanu (2000), respectively the growth period at the sunflower hybrids is of 115-136 days.

The differences between maximum and minimum values registered by the studied hybrids according to the specific growing conditions of the location was in average of 21 days, with limits of variation from 16 to 27 days in 2018, and it was of 22 days, with limits of variation from 18 to 25 days in 2019. Differences between maximum and minimum values registered by the studied hybrids in 2018 and 2019 are quite similar, this being shown also by the coefficient of variation (CV) which was in average of 6.59 in 2018 and 6.31 in 2019 (Table 3).

It has to be notices that the differences between maximum and minimum values registered by the studied hybrids according to the specific growing conditions of the location are much higher, up to double for the duration of the period from emergence to maturity compared to the duration of the period from emergence to beginning of the flowering process. This means that the differences between maximum and minimum values registered for the duration of the period from emergence to beginning of the flowering process are amplified as time goes on to the maturity leading to higher differences for the duration of the period from emergence to maturity.

Table 2. Duration of the period from emergence to beginning of the flowering process at different sunflower hybrids cultivated in five different locations in Romania in 2018 and 2019

Sunflower hybrid	Period from emergence to beginning of flowering (days)									
	2018					2019				
	Minimum	Average	Maximum	Difference (Max.-Min.)	CV* (%)	Minimum	Average	Maximum	Difference (Max.-Min.)	CV* (%)
P63LL06	53	*57*	64	11	6.76	56	*65*	73	17	9.31
SY Flamenco	55	*58*	62	7	4.40	58	*66*	73	15	7.55
NK Neoma	54	*58*	62	8	6.03	56	*64*	71	15	8.09
LG55.42 CL	54	*58*	62	8	5.14	57	*64*	70	13	6.86
FD15E27	53	*59*	64	11	6.58	56	*65*	72	16	8.57
FD15CL44	54	*59*	65	11	6.35	60	*67*	74	14	8.11
LG 55.55 CLP	52	*56*	60	8	5.42	54	*62*	68	14	8.35
Paraiso 1000 CL Plus	55	*60*	64	9	4.89	60	*67*	71	11	6.27
ES Arcadia SU	53	*56*	61	8	5.44	54	*63*	73	19	9.80
P64LE25	54	*58*	63	9	6.63	57	*66*	72	15	7.93
P64LE99	55	*59*	68	13	8.15	58	*67*	72	14	7.57
MAS 85.SU	55	*59*	64	9	5.42	60	*67*	73	13	6.88
Rustica172	54	*60*	65	11	6.11	60	*68*	73	13	7.50
Rustica170	54	*62*	68	14	7.52	60	*67*	72	12	6.87
MAS 83.HO	55	*60*	64	9	5.48	61	*68*	73	12	6.58
Suntec HO CL	56	*60*	63	7	4.28	60	*67*	73	13	6.74
ES Poetic HO	55	*59*	64	9	5.39	57	*64*	70	13	6.99
P64HE118	52	*57*	61	9	6.56	56	*64*	69	13	7.51
Minimum	**52**	**56**	**60**	**7**	**4.28**	**54**	**61**	**68**	**11**	**6.27**
Average	***54***	***59***	***64***	***10***	***5.92***	***58***	***66***	***72***	***14***	***7.64***
Maximum	**56**	**62**	**68**	**14**	**8.15**	**61**	**68**	**74**	**19**	**9.80**

*CV = coefficient of variation.

Table 3. Duration of the period from emergence to maturity at different sunflower hybrids cultivated in five different locations in Romania in 2018 and 2019

Sunflower hybrid	Period from emergence to maturity (days)									
	2018					2019				
	Minimum	Average	Maximum	Difference (Max.-Min.)	CV* (%)	Minimum	Average	Maximum	Difference (Max.-Min.)	CV* (%)
P63LL06	104	*115*	129	25	7.56	110	*122*	130	20	5.90
SY Flamenco	101	*115*	128	27	8.16	111	*120*	131	20	6.03
NK Neoma	106	*116*	127	21	6.49	110	*122*	133	23	6.53
LG55.42 CL	109	*115*	125	16	5.07	110	*120*	132	22	6.00
FD15E27	109	*118*	128	19	5.35	111	*122*	132	21	6.30
FD15CL44	104	*116*	130	26	7.92	114	*124*	132	18	5.75
LG 55.55 CLP	104	*115*	123	19	6.11	110	*121*	135	25	7.01
Paraiso 1000 CL Plus	109	*117*	128	19	5.92	114	*125*	135	21	6.10
ES Arcadia SU	105	*114*	125	20	6.25	110	*122*	132	22	6.41
P64LE25	103	*116*	129	26	7.83	110	*121*	132	22	6.02
P64LE99	107	*117*	130	23	7.17	111	*123*	133	22	6.93
MAS 85.SU	105	*116*	127	22	6.85	111	*122*	133	22	6.33
Rustica172	109	*117*	126	17	5.16	110	*121*	131	21	6.09
Rustica170	106	*116*	126	20	6.49	111	*124*	133	22	7.03
MAS 83.HO	105	*117*	130	25	7.70	113	*124*	135	22	6.03
Suntec HO CL	108	*117*	126	18	5.30	110	*123*	133	23	7.29
ES Poetic HO	104	*114*	125	21	6.35	110	*121*	133	23	6.35
P64HE118	107	*116*	129	22	6.96	111	*121*	131	20	5.53
Minimum	**101**	**114**	**123**	**16**	**5.07**	**110**	**120**	**130**	**18**	**5.53**
Average	***106***	***116***	***127***	***21***	***6.59***	***111***	***122***	***133***	***22***	***6.31***
Maximum	**109**	**118**	**130**	**27**	**8.16**	**114**	**125**	**135**	**25**	**7.29**

*CV = coefficient of variation.

The duration of the period from emergence to beginning of the flowering process and the duration of the period from emergence to maturity, as well as the variation of these periods according to the specific growing conditions are important to be known by sunflower growers. In this respect, Gontcharov & Zaharova (2008) concluded that seed yield is mainly determined by duration of the period from emergence to flowering (VE-R5.1), and oil content is mainly determined by duration of the period from beginning of flowering to maturity (R5.1-R8).

CONCLUSIONS

Sunflower hybrids behave differently regarding the duration of the growth period, according to specific growing conditions of the location and the year.

The variation limits of the growth period at the sunflower hybrids studied in the five location from the most important regions for growing sunflower in Romania and in the years 2018 and 2019 were of 52-74 days for the period from emergence to beginning of flowering process (10% flowered heads) and of 101-135 days for the period from emergence to maturity.

The differences between maximum and minimum values of the duration of the growth period registered by the studied hybrids according to the specific growing conditions of the study location and year was of 7-19 days for the period from emergence to beginning of flowering process and of 16-27 for the period from emergence to maturity.

The variation of the duration of the period from emergence to maturity is much more important than the variation of the duration of the period from emergence to beginning of flowering process.

For all the studied sunflower hybrids no matter the location and year the coefficient of variation for the growth period was less than 10%.

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