Photoperiodic Growing Conditions As A Background For Estimation And Selection Of Fast-Ripening Sunflower Forms

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Abstract

The possibility to use artificially created short 10-hour photoperiod as a background for selection of fast-ripening biotypes within the splitting sunflower population was established by research work and it was confirmed by correlational analysis.
Sunflower ontogenesis the interphase period "three pairs of true leaves - budding beginning" is noted by high variation coefficient and that allows treating it as the basic one when estimating and choosing selection samples by fast-ripening.
Having fulfilled the work using the named methods in the system: "phytotron-field" the authors have created inbred sunflower lines with fast-ripening signs.

Introduction

The photoperiodic studies of plants show that there are ecotypes with different photo-response within the population. This testifies to the dynamic character of photoperiodic plant adaptation and demands all-round examination of specific manifestation and the mechanism of this process not only on the species level but also on the variety level.

Materials and methods

We have studied response to the photoperiodic growing conditions of the following new promising sunflower varieties: intermediate-ripening Flagman and Leader, early-ripening Berezansky, fast-ripening Kavkazets selected by VNIIMK and Siberian variety Yenisey. The experiment was fulfilled in three

large-size climate chambers, where the following conditions were automatically supported: air temperature 25-27° C, illumination of plant tops 25 - 28 Kilolux, and in each chamber a certian photocondition was provided for 10, 16, 24 hours within 24-hour cycle. The plants were grown in separate containers with 10 kg soil mixture each on the basis of the vegetation experiment method. The blossoming flowers were covered with isolators for self-pollination.

Results, discussion and conclusion

The phenological observations displayed that duration and development of plant growth changed with the change of photoperiodic conditions. The early development stages of studied varieties were faster when plants were permanently exposed to light.

But the plants under study blossomed and ripened earlier under conditions of 10- and 16-hour photoperiod. These data are confirmed by the results of correlation analysis showing that under conditions of a short day the vegetation duration is essentially influenced by the plant development speed at interphase period "three pairs of true leaves - budding beginning" and at "budding" period (correlation coefficients being 0.77 and 0.71 correspondingly).

Under permanent exposition to light the vegetation period is influenced to a greater extent ($r = 0.86$) by ripening duration phase, and due to which the vegetation period increases notably for the variety Rodnik by 9 12, Berezansky by 8-13, Flagman by 15, Leader by 9-12 days correspondingly as compared to 10 and 16 hour photoperiod.

Neutral response to day duration was observed in the varieties Yenisey and Kavkazets, their vegetation period being dependent on photoperiod: 78, 79, 80 and 81, 81 and 85 days correspondingly (table 1).

The significance of some growth and development stages for the whole vegetation period of sunflower grown under

different photoperiodic conditions can be judged according to the corresponding correlation ties (table 2).

These correlation analysis data show that interphase stage "three pairs of true leaves - budding beginning" stipulates further plant growth and development in what concerns necessary terms for vegetation completion, as under all photoperiod studies a high corresponding correlation tie is observed (0.77; 0.65; 0.74). The significance of the mentioned interphase stage for development of sunflower plants can be explained by the fact that it involves the main first organogenesis stages (3-5) of reproductive development. By the end of this period the vegetative organs and flowers in inflorescence are completely formed.

Among the photoperiods under study the short 10-hour period is most important for the plant and close correlation is observed between the stages "three pairs of true leaves - budding beginning" (0.77), "budding" (0.71), blossoming (0.35) and the whole vegetation period.

Since the interphase period "three pairs of true leaves - budding beginning" has the highest significance in plant growth and development cycle, the variation degree of this index under different photoperiod conditions is of interest for us (table 3).

Analysing data of Table 3 we see that interphase period "three pairs of true leaves - budding beginning" shows high variation coefficient again under all photoperiodic growth conditions (34.0; 40.0; 43.5 correspondingly).

So within the phenologic phases under study, the mentioned interphase period can be taken as basic in variety sample estimation for fast-ripening and other morphophysiological characters.

Ten-hour growing conditions promote appearance of different fast-ripening sunflower biotypes and this is a response of sunflower population to environmental changes or to be more

exact a manifestation of selective effect at the level of variety-population.

The investigation has resulted in selection of a fast-ripening variety Rodnik of self-pollinated line with 75-day vegetation period. Examination of this line for inheritance of fast-ripening characters in progeny was conducted under 10 and 16-hour photoperiod in climatic chamber using the method of the first experiment. The analysis of the obtained data has shown that the segregation in the second generation of the selected line is kept on the duration of interphase period "three pairs of true leaves - budding beginning" and individual sunflower plant productivity. Variation coefficient for a short day was 27 % and 23 % for the 16-hour photoperiod. Biotypes with 67 - 68 day vegetation period were selected under 10-hour photoperiod conditions.

Two-year experiments with the obtained biotypes were carried out in the field nursery. Variation coefficient of seed yield formed under natural environment conditions was 40 %. Normally individual plant productivity increases in plant with longer periods from shooting to blossoming but with a short photoperiod background there are forms producing higher seed yield in a shorter vegetation period. So as a result of the first year field tests of the chosen short day biotypes self-pollinated lines of the third generation were distinguished with the interphase period "shooting-blossoming" of 41-47 days. The fourth generation of the chosen self-pollinated lines with 45 day period from shooting to blossoming is under further investigation.

Table 1

Dependence of interphase period (days) and sunflower development duration on photoperiod

Variety	Photo-period	Shoo-tings-Three pairs of true leaves	Three pairs of leaves - budding begin-ning	Budding	Blosso-ming	Ripening	Vegeta-tion period
Yenisey	10	15	9	18	9	26	78
	16	12	7	26	10	24	79
	24	11	7	26	11	24	80
Kavka-zets	10	13	14	20	10	24	81
	16	10	10	25	11	25	81
	24	10	8	28	9	30	85
Rodnik	10	14	12	19	10	21	76
	16	11	7	27	10	22	78
	24	10	8	28	9	31	86
Bereza nsky	10	15	17	19	1	21	83
	16	13	14	24	11	26	88
	24	13	15	23	12	33	96
Flag-man	10	14	20	19	10	20	83
	16	14	18	24	10	26	92
	24	12	19	22	11	34	98
Leader	10	16	21	23	12	19	91
	16	14	17	26	8	23	88
	24	12	18	26	10	34	100

Correlation ties between interphase period duration and vegetation period of sunflower grown under different photoperiodic coditions

Plant growth and development stages	Photoperiod, hours		
	10	16	24
Shoots - three pairs of true leaves	0.25	0.61 +	0.26
Three pairs of leaves - budding beginning	0.77 +	0.65 +	0.74 +
Budding	0.71 +	0.10	-0.15
Blossoming	0.35 +	0.01	0.09
Ripening	-0.13	0.52 +	0.86 +

Note: + tie is 5% significant

Table 3

Variation coefficient (%) of interphase period duration of sunflower under different photoperiodic growth conditions

Plant growth and development stages	Photoperiod, hours		
	10	16	24
Shoots - three pairs of true leaves	10.5	17.4	14.8
Three pairs of leaves - budding beginning	34.0	40.0	43.5
Budding	14.5	9.03	11.1
Blossoming	17.4	15.9	24.9
Ripening	17.9	17.8	20.3