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DAY LENGTH INFLUENCE ON SUNFLOWER GROWTH AND DEVELOPMENT

The VNIIMK Don Experimental Station has for years studied the effect of the day length on the development, growth and other features and properties of sunflower and other oil crops tying this up with the breeding work.

The bulk of research was done into sunflower, resulting in extensive and interesting material concerning over 20 different varieties and forms of this plant of different origin and breeding pattern. These data allowed not only to broaden and deepen our knowledge of the peculiarities of sunflower growth and development, but to outline the ways of utilizing these data in breeding practice as well and to use them in distributing this crop in different geographical regions.

During our research we have found that the shortening of the day length speeds up the flowering of sunflower, and the lengthening of the day results in a retardation of this phase. On the bases of these data sunflower may be considered as the plant of the short day. Our results have also shown that early dates of flowering of plants are not uniform in all plants, but vary in different varieties from 1 to 22 days. Thus, according to this trait varietal differences are only observable by the time of flowering acceleration under conditions of a short 10-hour day compared to a natural day length.

Having thoroughly analysed the peculiarities of sunflower development in separate inter-phases and judging by the specially designed experiments we have found that the shortened light day somewhat speeds up the development of all studied varieties only in the period from the start of budding till flower-

ring. According to the character of reaction to the short day during the period from emergence to budding the studied sunflower varieties can be divided into two groups. The first, small group consists of obvious short day forms which speed up their development under conditions of short day; the second, more numerous group consists of forms neutral to day length or even long day forms which under conditions of a short day do not speed up their development and in some cases even slow it down (see Table).

Observations have also shown that the varieties of the first group start the formation of generative organs (differentiation of growth cone of stalk) under short day earlier than under natural long day, and the second group of varieties show this phenomenon to be the same under different lengths of the day.

Thus, we were the first to observe different biological groups within sunflower varieties differing not only in extent but in character and sign of photoperiodic reaction as well. We also explained the causes behind the controversy in literature concerning this problem.

Our results have also shown that when determining the reaction of sunflower varieties to the day length it is insufficient to observe only the budding, or only the flowering stages as the same varieties can be included into the group not reacting to the day length by the head formation time, and into the short day group according to the flowering time.

The light day length determines neither the length of sunflower flowering nor, in most varieties under study, the period from the end of flowering till maturity.

Our investigations have also shown for the first time that the development of many sunflower varieties under a long 18-h day and under permanent illumination is unsigni-

Table

The Length of Developmental Stages in Two Groups of Sunflower Varieties under Different Day Lengths (mean for 20 varieties)

Group of varieties	Days from seedlings to head formation		Days from head formation to flowering	
	under natural day length	under short day, 10 h	under natural day length	under short day, 10 h
First	38,2	30,2	27,3	18,8
Second	33,6	34,3	25,6	18,8

ficantly retarded. This suggests that a long day characteristic of Northern and Southern latitudes does not hamper these varieties normal development.

Sunflower studies under different conditions of day length have also allowed to find other characteristic features of this plant; some of them underlay the development of new means of obtaining early and short stalk forms serving as initial stocks for breeding for earliness.

Specifically, under certain day length variants considerable fluctuation was observed in budding time, flowering and the length of the vegetation period in certain plants within one sunflower variety. Variability in phases of development, the vegetation period and the stalk length was most pronounced in variants with a shifting day length, when the plants after emergence received artificially shortened 9-10-h day lengths with subsequent shift to a long natural day length. This was also seen when plants grew under short day length during the

entire vegetation period. Under these conditions sunflower varieties as complex populations differentiate, as it were, into their component biotypes according to their different reaction to the day length. Thus, larger possibilities are presented to select forms with certain lengths of vegetation period or stalk height. Utilizing this possibility we have specially designed experiments to "split" varieties populations and select forms firmly retaining a short vegetation period and reduced stalk lengths in further generations, especially when they after selection, were grown under short day conditions during several years. This method is however not effective for all varieties studied, owing to which if must be further studied and verified.

Our research served as a basis for further studies conducted by other specialists, and our methods of developing new early forms by means of photoperiodic treatments are used not only in breeding oil crops but other crops as well.

Different reactions of sunflower varieties to day length changes and the plants' heterogeneity in this respect are to be taken into account in sunflower seed production and in growing sunflower in new regions differing in environmental factors.

Permanent 10-h day length slows down sunflower growth processes. The longer the day, the higher is the stalk and the larger is its mass as a whole and that of its parts. On the other hand, variable day length when 10-25 short days precede longer natural days stimulates stalk growth in many sunflower varieties under study. As distinct from other oil crops (mustard, linseed, lallemantia, etc.), most sunflower varieties pass the phase of stalk maximum growth almost at the same time, irrespectively of a photoperiodic regime.

Day length reduction reduces sunflower seed yield and oil content. But under field conditions the day length effect cannot be considered in

isolation from soil moisture, temperature and other environmental factors capable to compensate the adverse influence of the photoperiodic regime.