THE REACTION OF THE EARLY FLOWERING GENE efr UNDER SHORT-DAY CONDITIONS IN THE PHYTOTRON

Gottschalk, W.
Institute of Genetics, University of Bonn, Federal Republic of Germai

Recombinant R 46C is homozygous for genes efr for earliness and bif-1 for dichotomous stem bifurcation. The plants form their first flowers at the axil of the 4th to 6th foliage leaf and enter their flowering period about 10 days earlier than the mother variety 'Dippes Gelbe Viktoria' under field conditions in West Germany. R 46C was crossed with other mutants and recombinants and a large number of different recombinant types is now available homozygous for efr and other distinct mutant genes or gene groups of our collection. Eighteen of these recombinant types were grown in a phytotron under the following conditions:

Photoperiod:	from	6:00 p.m.	to	6:00 a.m. darkness
	"	6:00 a.m.	"	6:30 a.m."dawn"
	"	6:30 a.m.	"	5:30 p.m. full light (30,000 lux)
	"	5:30 p.m.	"	6:00 p.m."dawn"
Thermoperiod:	"	6:00 a.m.	"	10:00 a.m. rising from 15 to 25°C
	"	10:00 a.m.	"	4:00 p.m. constantly 25°C
	"	4:00 p.m.	"	9:00 p.m. decreasing to 15°C
	"	9:00 p.m.	"	6:00 a.m. constantly 15°C
Humidity:	60%			

Under these conditions, the plants of the initial line began flowering 46 days after sowing; the flowering period was 8 days. With regard to the reaction of gene efr, two different criteria have to be considered: the induction of flowering and the formation of fully developed flowers. Gene efr shows a pleiotropic action as follows:

- -Formation of floral buds at very low positions of the stem (=induction of flowering).
- -Many of these early buds, however, are not developed into flowers; they abort.
- -Some of the lowest flowers, which develop fully, show certain anomalies in flower morphology.

Thus, early flower induction many plants of recombinant R 46C as well as of most of the recombinants derived from it is not advantageous because of the negative aspects of the pleiotropic pattern. One of the aims of our phytotron investigations was to test whether these negative aspects can be reduced or even eliminated by specific environmental conditions or by transferring gene efr into specific genotypic backgrounds.

Floral induction occurred in all the genotypes homozygous for efr tested during the normal stage of ontogenetic development, i.e. in the axil of the 4th to 6th foliage leaf. This indicates that the other mutant genes, combined wifh efr, do not influence this physiological behavior. With regard to actual flowering, however, the recombinants cultivated behaved very differently from each other. In the plants of R 46C, the first fully opened flowers appeared 3S days after sowing; this was 11 days earlier than in the initial line. The

flowering period lasted 11 days which was somewhat longer than the initial line. Three other recombinants, in which efr is combined with genes for waxlessness and short internodes, showed the same behavior, indicating that the genes involved do not influence the reaction of gene efr with regard to this part of its pleiotropic pattern. Some mutant genes, however, influence gene efr positively. Five recombinant types tested flowered two days and another three types flowered even four to five days earlier than R 46C as follows:

-RR 1041: slightly reduced internode length (short I), stem bifurcated, sometimes weakly fasciated, early: 30 days

- R 869: very long internodes, slightly reduced chlorophyll content, very weakly fasciated, early: 30 days

- R 864: very long internodes, non-fasciated, early: 31 days

In the field, these genotypes are linearly fasciated, but their stem is either not fasciated or only slightly fasciated under the phytotron conditions mentioned above.

The opposite effect, i.e. flowering three to four days later than R46C, was observed in four out of the 18 genotypes tested. Two genotypes flowered extremely late:

-RR 1033: very long internodes, very weakly fasciated, bifurcated, early flower induction: 56 days

- R 871: short internodes (short I), bifurcated, early flower induction: 66 days

In R 871, only a few plants began flowering at 66 days; most of them either failed to flower at all or flowered later in the two short-day trials in which they were observed. Thus, these two genotypes are genetically early due to the presence of gene efr, but in reality they are extremely late. They are not only much later than their parental genotype R 46C but also considerably later than the mother variety which begins flowering 46 days after sowing.

Of particular interest, however, are two recombinant types which even 13 weeks after sowing did not have flowers or normally developed floral buds:

-R 20D long internodes, stem repeatedly bifurcated, early flower induction

-R 20E very short internodes (short II), stem bifurcation, early flower induction

Flower induction under the influence of gene efr took place in these two genotypes, but the other mutant genes involved suppressed the development of the minute floral buds into flowers thus influencing the pleiotropic action of efr negatively. The recombinants R 20D and R 20E were selected in the F_2 of cross 489C x 46C. They differ from each other only with regard to their internode lengths whereas both are homozygous for genes efr and bif-1. Thus, it can be assumed that gene bif-1 for stem bifurcation is responsible for the suppression of the action of gene efr in these recombinants.

The experiment shows the gene efr for earliness is highly influenced both by other mutant genes of the genome and by specific environmental factors.