

Inheritance of a Correlated Day-length Response in Spring Wheat

IN the course of genetic and physiological studies of developmental processes leading to flowering in spring wheats a major gene conditioning a positive response to vernalization was detected in the variety 'Insignia 49' (ref. 1). Further investigations have now led to the recognition of a second gene governing the photoperiodic response of the Canadian variety 'Selkirk'.

The work was based on two varieties—'Triple Dirk', a back-cross derivative of the Australian variety 'Dirk 48', and 'Selkirk'. I have found (in unpublished work) that 'Triple Dirk' is not responsive to vernalization, and although no tests have yet been undertaken, it seems likely that 'Selkirk' would be unresponsive as are so many Canadian varieties.

When grown at Wagga Wagga (latitude 35° 5' S) during the long days of summer (day-length 13.5–14.5 h) 'Triple Dirk' and 'Selkirk' are comparable in maturity. Sown on December 26, 1963, the two varieties came into ear in 52 days. When sown in the greenhouse in the autumn and grown throughout the cooler short days of winter (day-length 10.5–11.5 h), flowering of both is delayed, with 'Selkirk' much more sensitive than 'Triple Dirk'. Sown on April 15, 1964, the number of days to ear emergence for 'Triple Dirk' and 'Selkirk' was 94 and 132 respectively.

An F_1 and F_2 of the cross 'Selkirk' × 'Triple Dirk' and the F_1 of the back-cross ('Selkirk' × 'Triple Dirk') ×

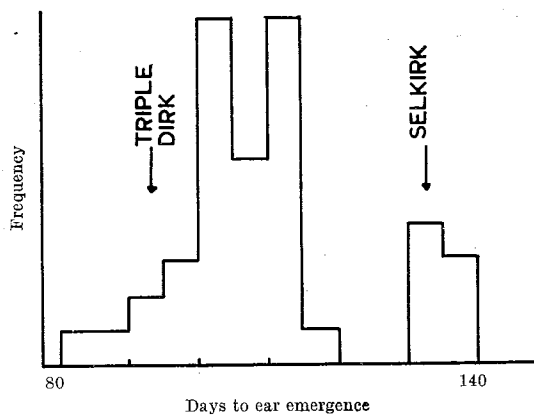


Fig. 1. Distribution of F_2 segregates from the cross ('Selkirk' × 'Triple Dirk') with respect to days from sowing to ear emergence

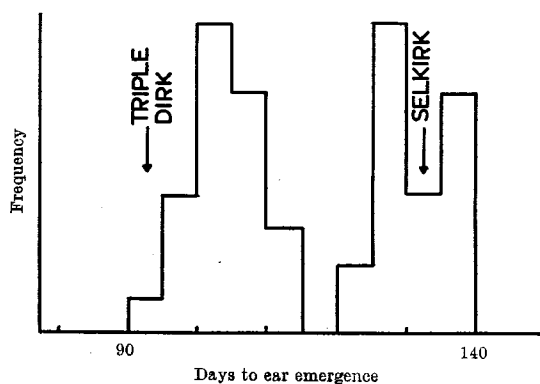


Fig. 2. Distribution of segregates from the back-cross ('Selkirk' \times 'Triple Dirk') \times 'Selkirk' with respect to days from sowing to ear emergence

'Selkirk' sown at the same time showed: (a) almost complete dominance of earliness; (b) an F_2 ratio of 34 early : 7 late, (c) an F_1 back-cross ratio of 23 early : 22 late. The two segregations fit 3 : 1 and 1 : 1 ratios with P values > 0.2 and > 0.8 respectively. The distribution of the segregating populations is set out in Figs. 1 and 2.

It is of interest to report a complete association of maturity with the number of leaves on the primary tillers at ear emergence and also with the number of spikelets on the same primary tillers. The relevant data for the parents, the F_1 and the two segregating populations are set out in Table 1.

The early and late classes of both segregating populations were separated by gaps of 13 days for the F_2 and 11 days for the F_1 back-cross. There was no inter-class overlap with respect to the leaf number and spikelet number classes.

As far as the writer is aware this is the first occasion in which a clearly defined monohybrid segregation governing a correlated response to short days has been reported in *Triticum*. This finding is significant in both its basic and applied aspects. The presence of a single gene pair conditioning the behaviour of wheat varieties to short days would suggest the operation of a simple physiological process leading to ear initiation. Similarly, the simple mode of inheritance makes possible a much greater degree of control by the plant breeder in fashioning varieties adapted to specific day-length environments. Maturity control may now be achieved through the use of specific major genes operative through either a vernalization or a day-length control mechanism.

Just as the spikelet number on the primary ear of a given variety may vary with the day-length to which the

Table 1. CORRELATED BEHAVIOUR OF TIME TO EAR EMERGENCE AND NUMBER OF LEAVES AND SPIKELETS ON PRIMARY TILLERS

	Range in number of days to ear emergence	Range in number of leaves on primary tillers	Range in number of spikelets on ears of primary tillers
'Selkirk'	130-134	9-10	25-27
'Triple Dirk'	92-97	7-8	16-17
'Selkirk' × 'Triple Dirk', F1	93-96	7-8	16-18
'Selkirk' × 'Triple Dirk', F2			
early segregates	85-120	7-8	17-22
'Selkirk' × 'Triple Dirk', F2			
late segregates	131-138	9-10	23-27
('Selkirk × 'Triple Dirk') ¹ ×			
'Selkirk' F1 early segregates	93-112	7-8	17-22
('Selkirk' × 'Triple Dirk') ¹ ×			
'Selkirk' F1 late segregates	125-138	9-10	23-27

plants are exposed prior to ear initiation, so too is it under genetic control in a segregating population such as that described herein. Furthermore, the association of spikelet numbers with maturity differences has many implications in wheat improvement programmes as well as in agronomic practice.

Unpublished investigations by me suggest that additional genes may be involved in other crosses between sensitive and less sensitive varieties.

A. T. PUGSLEY

Agricultural Research Institute,
New South Wales Department of Agriculture,
Wagga Wagga,
Australia.

¹ Pugsley, A. T., *Austral. J. Agric. Res.*, **14**, 622 (1963).