Two families which differed significantly in relative growth rate in the field were grown in a controlled environment at 18/13°C and 13/4°C under a 12 hr photoperiod for measurement of growth and its main components. Three plants were harvested from the four replicates of each family every three days over a period between 10 and 31 DAS for measurements of leaf area and dry weight.

RESULTS AND DISCUSSION

There was considerable variation in germination response to decreasing temperature among half-sib families (Fig. 1). Differences in germination rate (Timson Index) among families increased with a decrease in temperature from 20 to 7°C. Heritability estimates for germination rate at 20, 10 and 7°C were 0.11, 0.60 and 0.66 respectively. As germination rate was not correlated with seed size, there appear to be inherent differences in tolerance to low temperature at this stage of development.

Significant differences in time to emergence from soil in winter were detected among selected half-sib families. There were also significant differences in pre-anthesis growth rate, time to anthesis and biomass dry weight among these families. Biomass dry weight at anthesis was correlated with both the duration of pre-anthesis development (Fig. 2) and relative growth rate at 40 DAS (Fig. 3). Relative growth rate and time to anthesis were not correlated (Fig. 4) and one of the earliest flowering families (HS-66) was included among a small group of lines having the highest biomass dry weights because of its high pre-anthesis growth rate.

Differences among families in growth rate in the field could reflect genetic variation in tolerance to low temperature and/or low radiation level. A significant correlation between relative growth rate and percentage electrolyte leakage at 4°C (Fig. 5) suggests that response to low temperature is the more important determinant. This view was supported by measurements of the relative growth rates of two families, differing significantly in growth rate in the field, at optimal and low temperatures under identical conditions of controlled lighting (Fig. 6). The family HS-66 (high growth rate in field) had a much higher relative growth rate at low temperature (relative to growth at optimal temperature) than the family HS-54 (low growth rate in field) immediately after emergence.

These results indicate that there is considerable scope for increasing the pre-anthesis biomass production of *B. campestris* during winter without having to delay commencement of flowering. Rapid achievement of this goal will be dependent on the efficiency of the selection procedure adopted. An efficient selection procedure will involve rapid advancement of large breeding populations. This requirement could be met with selection for increased pre-anthesis growth rate based on mass selection for rapid emergence from soil in a controlled low temperature and reduced electrolyte leakage at low temperature.

CONCLUSIONS

Seed yield improvement of Brassica campestris in the lower rainfall environment of the West Australian wheatbelt should be obtained through increasing pre-anthesis biomass production. A greater biomass production can be obtained through increasing pre-anthesis growth rate under low temperature and retaining the early flowering characteristic. This breeding objective would be achieved quite rapidly through mass selection for rapid emergence from soil at low temperature and for reduced electrolyte leakage at low temperature.

REFERENCES

RICHARDS, R.A. and THURLING, N. 1978. Variation between and within species of rapeseed (Brassica campestris and B. napus) in response to drought stress. II. Growth and development under natural drought stress. Aust. J. Agric. Res. 29: 479-490.

TIMSON, J. 1965. New method of recording germination data. Nature 207:216-217.

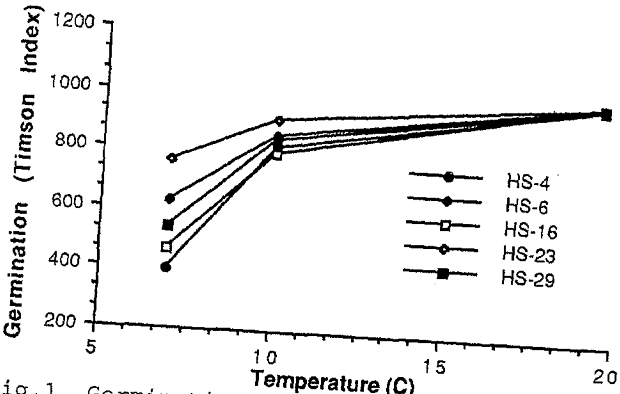

Fig.1. Germination responses of selected half-sib families to variation in temperature

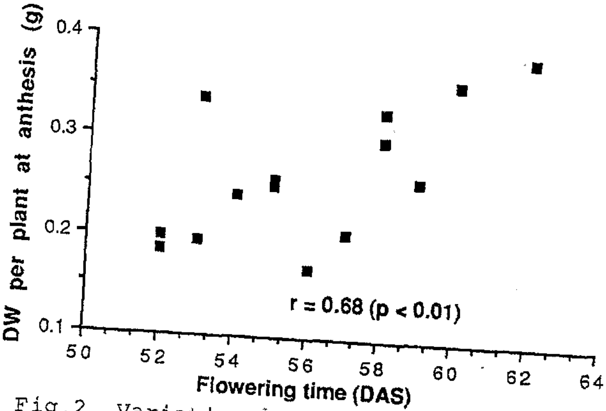

Fig.2. Variation among families in flowering time and biomass DW at anthesis.

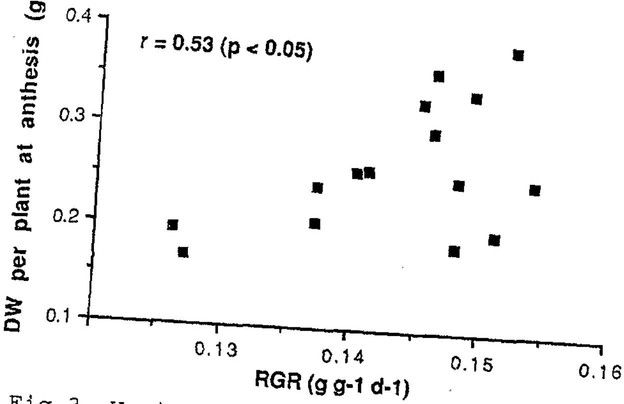

Fig.3. Variation among families in relative growth rate and biomass DW at anthesis.

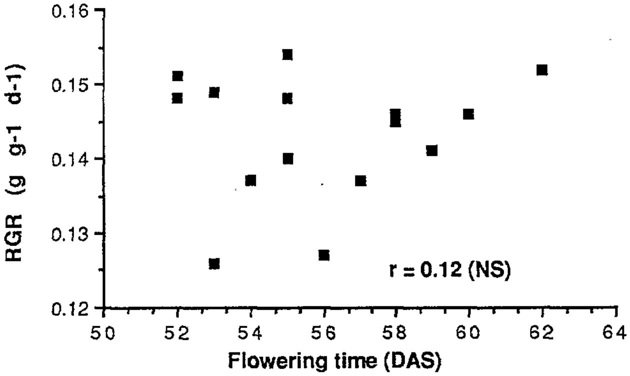

Fig.4. Variation among families in flowering time and relative growth rate.

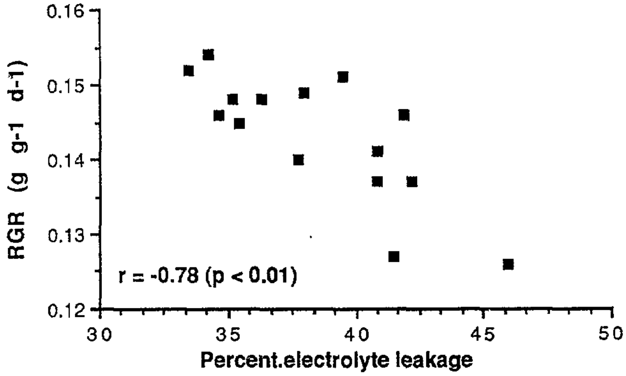

Fig.5. Variation among families in percent. electrolyte leakage and relative growth rate.

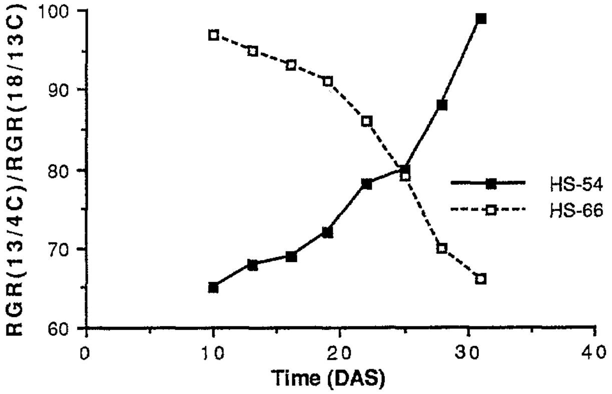

Fig.6. Growth of selected half-sib families under controlled temperatures.