The ability of rapeseed to recover from simulated hail damage to seedling plants.

Jane R. King, Department of Plant Science, University of Alberta. Edmonton, Canada.

Hail is the single most important cause of crop loss in Western Canada. In an average year five million dollars is paid out by crop insurance companies to compensate for hail related crop losses to rapeseed. Knowledge of the crops ability to recover from different types of damage is essential if accurate crop loss estimates are to be made following hail damage. The type of damage occurring and the plants ability to recover will vary with the severity and timing of the damage. When a field of rapeseed is hailed at the seedling stage two types of injury are observed: 1) The growing stem is broke off at ground level kiling the plant and resulting in a thinning of the stand 2) One or both of the cotyledon leaves may be entirely removed from the plant (McGregor 1980). In this study the effect of removing one or both cotyledon leaves was studied.

Method

In all tests the treatments were the removal of one or both cotyledon leaves from seedling plants. The leaves were removed by cutting at the base of the lamina at a time when both of the cotyledon leaves were fully expanded but before the emergence of the first true leaf. Undamaged plants acted as controls.

1980 Greenhouse Saskatoon: Seeds were sown in plots containing a modified Cornell mixture, with two replicates for each treatment for each of the two cultivars Torch (B. campestris) and Tower (B. napus). Each replicate consisted of seventy five seedlings. Seedling survivial was recorded fourteen days after damage.

1980 Field Saskatoon: Seeds were planted at a 1-2 cm depth with a double disc press drill. There were five replicates of a row of fifty seedlings for each cultivar, Torch and Tower. Survival was recorded after fourteen days.

1981 Field Edmonton: This was a repeat of the 1980 field experiment with six replicates for the cultivars Candle (B. campestris) and Altex (B. napus). Survival, days to first flower, days to maturity, and yield were all recorded.

1982 Field Edmonton: In 1982 the treatments were applied to 1 m^2 plots bounded on each side by two guard rows of undamaged plants. There were six replicates. Altex and Candle were the cultivars used. Survival days to first flower and yield were recorded.

Results

In the greenhouse test (1980) survival was 98% or greater for all treatments with no significant difference between treatments. In the 1981 field test there was also no significant difference between the survival rate of the treated and untreated plants (Table 1). In 1980 and 1982 field tests (both years of low soil moisture) cotyledon removal did affect seedling survival. In each of these years removal of both cotyledon leaves significantly reduced the seedling survival rate of both species. In 1980 survival after removal of both cotyledon leaves was only 38% of the undamaged plants for B. campestris Torch and 80% for B. napus Tower. In 1982 both the species showed a survival rate of approximately 66%. In 1982 removal of one cotyledon leaf from B. napus Altex also resulted in a significant reduction in survival to 85% of the control.

The number of days to first flower (when at least 50% of the plants in one replicate had at least one flower fully open) was recorded in 1981 and 1982. Removal of both cotyledon leaves caused a significant increase in the number of days to first flower for both species in both years (Table 2). For B. campestris the delay was three to four days, for B. napus six to seven days. Removal of one cotyledon leaf also delayed flowering by one or two days but this was not significant except for B. napus Altex in 1981.

Days to maturity was recorded in 1981. Removal of both cotyledon leaves delayed maturity by one or two days but this delay was not statistically significant (Table 3).

There were no significant differences between yields obtained from damaged or undamaged plants of B. campestris in either 1981 or 1982 (Table 4). Removal of both cotyledon leaves from B. napus seedlings significantly reduced the yields by approximately 40% in both years. In 1982 there was also a significnat loss of yield of 17% following the removal of one cotyledon leaf from B. napus.

Table 1. Percent Survival in Field (Expressed as a percentage of surviving undamaged plants).

	B. campestris			B. napus		
	1980	1981	1982	1980	1981	1982
[1]1	[2]a 100	98	a 88	a 100	96	b 85
2	b 38	96	b 67	b 80	90	c 66
0	a 100	100	a 100	a 100	100	a 100

Table 2. Days to First Flower.

	B. campestris		B. napus	
	1981	1982	1981	1982
1	a 46	a 42	b 50	a 51
2	b 48	b 45	c 55	b 55
0	a 45	a 41	a 48	a 49

Table 3. Days to Maturity.

	1981	
	B. campestris	B. napus
1	123	129
2	125	131
0	123	130

[1] Number of cotyledon leaves removed.

[2] Figures in the same column followed by the same letter are not significantly different SNK's test $p \leq 0.05$.

Table 4. Yield (g).

	B. campestris		B. napus	
	1981	1982	1981	1982
1	[1]156	[2]227	[3]a211	b264
2	162	216	b131	c189
0	168	208	a214	a319

[1] 1981 yield based on survivors from fifty plants
[2] 1982 yield g/m^2
[3] Figures in the same column followed by the same letter are not significnatly different from one another SNK's test $p \leq 0.05$

Conclusions

Although removal of both cotyledon leaves at the seedling stage of development may result in a reduction of the plant stand by 40% or more, in B. campestris this did not result in a significant loss of yield. For the B. napus crop however damage of this kind resulted in a significant loss of yield of approximately 40%. Although days to first flower were significantly increased by removing both cotyledon leaves this did not appear to significantly affect the maturity date.

Previously crop insurance adjusters have considered a seedling with both its cotyledon leaves removed to be a loss to the crop and the removal of one cotyledon leaf to be a partial loss. These tests have shown that even under adverse conditions such as the dry spring of 1982 the majority of such damaged seedlings will survive and make a significant contribution to crop yield. Once again the rapeseed crop has demonstrated its remarkable plasticity and ability to recover from damage.

This study was initiated under support from the Canadian Crop Hail Association and the All Risk Crop Insurance Association of Alberta, Saskatchewan and Manitoba.

McGregor, P.I. 1980. The nature of hail injury to rapeseed. Can. J. Plant Sci. 60: 1441-1449.