THE EFFECT OF DISTANCE FROM POLLEN SOURCE ON SEED SET AND YIELD IN APETALOUS HYBRID CANOLA SEED PRODUCTION

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ABSTRACT

The benefits of hybrid seed and an apetalous characteristic in terms of increased yields have been documented in the past. In this study three lines of canola in which both features were combined, were investigated in order to determine the feasibility of seed production on male sterile lines which also lacked petals. During the season in which the trial was conducted good seed set was obtained on these lines while the number of seeds/pod and seed weight was found to be influenced by the distance of the row from the pollen source. It is believed that environment may have a large influence on seed set in the apetalous lines.

INTRODUCTION

In December 1992 to April 1993 three lines of apetalous canola were trialed at the University Farm, Cambridge Tasmania, to assess the combined effect of the apetalous characteristic and Ogura Cytoplasmic Male Sterility (CMS). Work conducted by Rao *et al.* (1991), demonstrated that apetalous lines allowed an increase in the amount of radiation entering the crop canopy during flowering, resulting in yields of up to 45% higher than the conventional cultivar 'Marnoo'. It is suggested that this characteristic combined with the increased vigour of hybrid plants would contribute to a significant increase in the F_1 generation yield. For seed production, however, the lack of both petals and anthers may pose a problem for flower opening and pollination including bee activity, hence the ratio of male to female rows and distance from the source of pollen may be even more important than in normal petalled lines.

Pinnisch and McVetty (1990), studied hybrid seed production with normal petalled summer rape possessing the Polima CMS system and found that both total seed yield and percentage hybridity declined linearly as distance from the pollen source increased

EXPERIMENTAL

The experiment was conducted with three different planting patterns with female to male row ratios of 1:1, 2:1 and 4:1 with rows being spaced 80 cm apart. Each of the four replicates contained planting patterns as main plots, containing the three lines in subplots 4 m long. The 4:1 ratio plots were harvested so that yield, and its components could be expressed in terms of increasing distance from the pollen source with a maximum of four rows or 3.2 m. Male rows were of the same genotype as the female, except that they did not carry the CMS factor.

RESULTS AND DISCUSSION

The latest flowering line was 1806, which as a result had less opportunity for contamination with pollen from other sources. The mid flowering line had a flowering time which overlapped significantly with the other lines and apart from a decrease in seeds/pod, failed to show any significant relationship with increased distance from the male row. This was attributed to the experimental design and abundance of pollen during flowering allowing cross pollination between lines, thus obscuring any relationship associated with increasing distance away from the intended pollen source. The earliest flowering line did not have seed weights recorded row by row, but this appears to be an important yield component.

TABLE 1. Yield and components of line 1806, and regression coefficient (R^2) of each component on row number (R^2 derived from individual plot results)

Row Number	Yield g/m^2	Pods/Plant	Seeds/Pod	Seed Weight mg
1	111.0	236.2	29.9	3.36
2	126.0	203.5	28.1	3.81
3	107.9	209.3	26.2	3.67
4	124.3	218.8	20.2	3.92
lsd (.05)	22.37	80.64	3.30	0.46
R^2	0.014	0.004	0.677	0.756

Table 1 shows yield and components as a function of distance from the pollen source and demonstrates the effect of distance on the yield components. The most striking feature was that the influence of distance from the pollen source could be readily seen on the number of seeds/pod and seed weight, but had little effect on yield. The major influence of distance appeared to be a reduction in the number of seeds/pod, offset by an increase in seed weight.

In the comparison of yield and components in terms of different planting patterns, 1:1, 2:1 and 4:1, (not presented), there were few significant differences. The differences were only obvious in the row by row comparison. However the earliest flowering line 1811, did show a significant increase in the numbers of seeds/pod in the 1:1 compared to 4:1 planting pattern. The more distinct difference in this component may have been the result of a reduced flowering time overlap with the other lines, however as the row by row seed weights were not available it could not be used for more detailed analysis.

The major factor affecting yield and its components as distance from the pollen source increases could be presumed to be bee activity. The greater number of seeds/pod closer to the pollen source would then be the result of the foraging patterns of the pollen vectors, in this case honey bees. Most bees forage along a row rather than crossing rows, therefore bees which finish work on a pollinator row are more likely to move to a nearby rather than a distant male sterile row (Robinson 1984).

Williams, *et al.* (1987), showed that rapeseed exposed to bees did not necessarily produce more pods, but produced up to 51% more seed immediately post-flowering, compared with plots from which bees were excluded. Therefore the major influence of greater bee activity would be to increase the number of ovules per ovary which are fertilised and develop into seeds. This would appear to be the case in this study, where the rows further away from the pollinator are less likely to be visited by bees bearing pollen. The more distant the row the more likely that the bee has deposited its pollen load on plants closer to the pollen source.

The reason that this did not correspond to a decrease in yield appeared to be due to compensatory growth in the weight of the seed. The regression of seed weight on distance from the pollinator showed a significant relationship (R^2), with seed weight increasing with increased distance from the pollen source (Table 1). When combined with a decrease in the number of seeds/pod the net effect on yield was minimal. With an increasing number of rows from the pollen source (greater than those investigated here), it would be expected that eventually the ability of the plant to compensate for decreased seed set by increasing seed weight would be exceeded, and a decline in yield would begin to become apparent.

Pinnisch and McVetty (1990), found that total seed yields ranged from the equivalent of 1500 kg/ha on rows farthest away from the pollen parent, to 3000 kg/ha on the row nearest the pollen parent. They found a significant regression relationship between total seed yield and distance from the pollen parent. However in their study they did not identify the yield components which caused this reduction in yield. This experiment was a more detailed study of the rows closer to the pollen parent, the maximum row number away from the pollen parent being four in comparison with Pinnisch and McVetty who looked at 29 rows spaced at 30 cms (total 9 m).

Considering the time of sowing, which was very late for the Tasmanian climate, the seed set on the apetalous lines compared favourably with conventional hybrid systems. However trials conducted in the 1994-95 season indicate at this stage that the apetalous lines are influenced by external factors to a greater extent than a normal petalled variety. The main effect at this stage appears to be caused by difficulty in flower opening during periods of high temperature.

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