The effect of sowing date and rate on seed coat discolouration due to frost in field peas in the southern Mallee of Victoria.

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Abstract

Frost occurring during the reproductive period of field peas can cause downgrading through seed coat discolouration and yield loss. During 2001, a field trial was conducted to determine the optimum sowing date (9 May, 17 June and 11 July) and sowing rate (15, 35, 55, 75 and 110 plants/m²) of 4 field pea cultivars (Dundale, Parafield, Snowpeak and Kaspa) at Birchip in the southern Mallee of Victoria. During September and October, several significant frosts occurred which resulted in discolouration of the seed coat of grain at harvest. Discolouration was scored on a 1 - 9 scale where 1 = no grain with discoloured seed coats and 9 = all grain with discoloured seed coats. May and June sown plots that were in midflowering and podding during the frost periods had up to 60% of grain discoloured and suffered yield losses of up to 35%. In contrast plots sown in July were at an early flowering stage during the frost periods and almost no discolouration of seed coats was observed. Later sowing is an option to prevent frost damage in peas, but this will carry a yield penalty in 3 out of 5 years.

Key Words

field pea, frost, sowing rate, sowing time, seed coat discolouration

Introduction

In the southern Mallee of Victoria, frosts occurring during the reproductive growth period of field peas can cause significant yield loss and seed coat discolouration (brown staining). Severe frosts (e.g. less than 0°C ambient air temperature for several hours) can result in complete crop failure, particularly if they occur during the mid to late pod fill phase. Discolouration will potentially result in losses of up to \$40/t with downgrading from a human consumption grade to a feed grade (K. Panagiotopoulus, pers. comm.).

During 2001 several frost events occurred during the flowering and pod filling phase of field peas grown in an experiment comparing the effect of sowing rate and sowing date on several cultivars at Birchip in the southern Mallee of Victoria. These frosts resulted in discolouration of the seed coat, without total crop failure. The paper reports on the interaction between sowing date, sowing rate and cultivar on the frost damage, as determined from scores of seed coat discolouration, and grain yield.

Methods

In 2001, a field trial was conducted to determine the optimum sowing date (9 May, 17 June and 11 July) and sowing rate (15, 35, 55, 75 and 110 plants/m²) of 4 field pea cultivars (Dundale, Parafield, Snowpeak and Kaspa) at Birchip in the southern Mallee of Victoria. The experiment was replicated 3 times in a randomised split-plot design with sowing date as the whole plot and cultivar and sowing rate in subplots. Plots (12m long with 8 rows at 19.5cm spacing) were sown with 80kg/ha of 'grain legume super'. Weeds, insects and fungal diseases were controlled by the application of appropriate herbicides, insecticides and fungicides at relevant stages of crop growth.

Measurements and statistical analyses

Weather conditions (rainfall, air temperature, soil temperature and humidity) were recorded daily by an automatic weather station. A mild frost was classified as any ambient air temperature (at 1.5m height in a

screen) between 0° C and 2° C and a severe frost as temperatures less than 0° C (Rodriguez, pers comm.). Flowering (50% of plants with 1 fully opened flower; stage 203) and maturity (when 95% of pods on plants had turned brown; stage 302) dates were recorded (1). At harvest the seed coat discolouration was scored on a 1 - 9 scale (1 = no grain with discoloured seed coats 9 = all grain with discoloured seed coats) and grain yield determined. To test for significant differences a three-way analysis of variance between cultivar, sowing date and sowing rate was conducted. Correlation between discolouration and grain yield was calculated using linear regression, from which the relative yield loss was calculated.

Results

Five mild frosts and 2 severe frosts occurred during the reproductive phase of the field peas grown in the experiment at Birchip in 2001 (Figure 1). During the most severe event (20 October) there were 5 consecutive hours when ambient air temperatures were below 2°C.

Flowering began in mid September for Snowpeak and late September for Dundale, Parafield and Kaspa sown in May and June (Table 1). Plots sown in July began flowering in late September/early October for all cultivars except Kaspa, which began in mid October (Table 1). Flowering time was not significantly affected by sowing rate (P > 0.05) although there was a trend for flowering to commence 2-3 days earlier at higher sowing rates. The period between flowering and maturity ranged between 40 to 50 days.

May and June sown plots of peas that were flowering and had pods at mid stages of filling when frosts occurred had up to 60% of grain with discoloured seed coats (Fig. 2). In contrast all plots sown in July, except two, were at an earlier flowering and pod development phase when frost periods occurred and had no discolouration of the seed coat. Increasing sowing rates had no significant effect on seed coat discolouration scores. Seed coat discolouration scores negatively correlated with grain yield for both May (r = 0.81, P < 0.05) and June (r = 0.95, P < 0.05) sown plots. It was estimated that in plots with scores of 7 there was a 35% yield loss relative to plots scoring 1 at the same sowing date (data not shown).

Conclusion

The best strategy to avoid grain discolouration by frost in peas in this environment and season was to sow later. However, this practice would result in reduced grain yields compared with early sowing in seasons without frosts occurring after the end of September (3 in 5 years; Bureau of Meterology). Further research over several environments and seasons is necessary to confirm findings of the preliminary observations presented here.

Figure 1: Minimum recorded temperatures from 21 September 2001 to 20 November 2001 at Birchip. Open circles (*) indicate ambient air temperatures > $0^{\circ}C - < 2^{\circ}C$ (mild frost) and crosses (x) indicate temperatures < $0^{\circ}C$ (severe frost).



Table 1: Flowering and maturity dates for field pea cultivars grown at Birchip (days from flowering to maturity is indicated in brackets).

Sowing date	Dundale	Parafield	Kaspa	Snowpeak
May 10	27 Sept - 10 Nov	22 Sept - 8 Nov	28 Sept - 8 Nov	14 Sept - 5 Nov
	(44)	(47)	(41)	(52)
June 16	27 Sept - 9 Nov	24 Sept - 8 Nov	29 Sept - 8 Nov	17 Sept - 4 Nov
	(43)	(45)	(40)	(48)
July 11	4 Oct - 19 Nov	4 Oct - 18 Nov	14 Oct - 19 Nov	29 Sept - 15 Nov
	(46)	(45)	(36)	(47)

Figure 2: The effect of sowing time on the proportion of grain with discoloured seed coats at harvest (1 = no grain discoloured and 9 = all grain discoloured) in 4 field pea cultivars grown at Birchip in 2001. Bar represents l.s.d. value (P = 0.05).



Acknowledgments

This research was supported by the Grains Research and Development Corporation. We thank Tony Leonforte and Rob Norton for review of the manuscript.

References

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