Scoping early sown canola in Western Australia

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Abstract

Ability to successfully establish crops early in the season is considered an advantage for most crops in the Mediterranean type of rainfed environment but review of literature suggests that it can be particularly advantageous for canola. But such early sown canola runs the risk of crop failure due to early moisture stress. We investigated crop emergence, survival and grain yield of an open pollinated canola variety Tanami seeded at 4kg/ha seed rate in April at Dryland Research Institute at Merredin after creating a gradient of moisture levels created by artificial irrigation ranging from equivalent rainfall of 5mm to 42.5mm. We found that response curve on all of the three traits namely, crop emergence, survival through dry period and grain yield, consisted of three segment; a sharply improving 'damage' regime where the level of trait is lower than timely sown crop, followed by a 'sustain' regime where level of trait is at par with the timely sown crop and finally ending in the 'advantage' regime where trait level increases above the timely sown crop in proportion to the level of irrigation. We suggest, however, that the rainfall levels corresponding to these segments of response curve can vary with location, season, soil type, fertiliser regime, pest control and cultivar.

Key Words

early sowing, canola establishment, soil moisture, dry sowing, rainfed, seasonal conditions

Introduction

Western Australian (WA) growers often desire to sow their canola crops earlier than the conventional sowing time, which occurs after the season 'breaks' (that is, once winter rainfall begins). This is largely driven by anticipated economic benefits of earlier sowing, which may occur through greater grain yield and oil percentage. However, the typical quadratic type yield response curve to time of sowing often seen with cereal yield (e.g. Sharma et al 2008) is less commonly reported in canola (Farre et al 2007, Serafin et al 2005). The other benefit of sowing canola early is to finish the whole seeding program before heavy yield penalty due to late sowing sets in.

The main risks of early sowing comprise seed (pre-emergence) and seedling (post-emergence) losses but it is also not clear how well the survived plants would yield in comparison to the timely sown crop at similar plant density. Therefore, we investigated crop emergence and crop survival of early sown canola at different soil moisture levels and compared yield level with crop emerged after proper break to the season.

Methods

An early sown canola experiment with three replications was conducted at the Merredin Research Station located at Merredin in WA. The crop was dry sown with cultivar Tanami at 4.0 kg/ha seed rate using knife points. After seeding, a blanket irrigation equivalent to 10 mm rainfall was applied with sprinklers on 21 April 2011. Next day, a gradient of moisture level was superimposed by further addition of water with T-Tape starting from 5 mm up to 42.5 mm in 2.5 mm intervals; all applied in one lot rather than split application of heavier amounts. The experimental design was not a fully randomised one; rather the irrigation treatments were set in a fixed sequence in order to minimise interference by adjoining plots. The direction of sequence, nonetheless, differed with replication. The maximum to minimum irrigation sequence ran in East to West in replication-1, West to East in replication-2 while in the third replication, maximum lied in the middle with lower amounts tapering to the ends (like a hat). The unirrigated check treatments were, as such, located towards the ends where minimum irrigation was applied.

Data were recorded on the number of plants emerged by 03 May 2011 and repeated on 25 May 2011. Biomass on 01 July and grain yield in October were recorded using quadrats covering an area50 cm long x five rows. Grain yield data were collected from the same spots that were used for plant survival. At the time of sowing, the top 10cm soil layer appeared dry, probably having less than five percent moisture, as also evidenced by the lack of any germination in the unirrigated area. Gravimetric soil water measurement done on 16 May revealed good stored moisture content beyond 20cm depth even in the unirrigated area (Figure 1).

Data were analysed using Genstat.

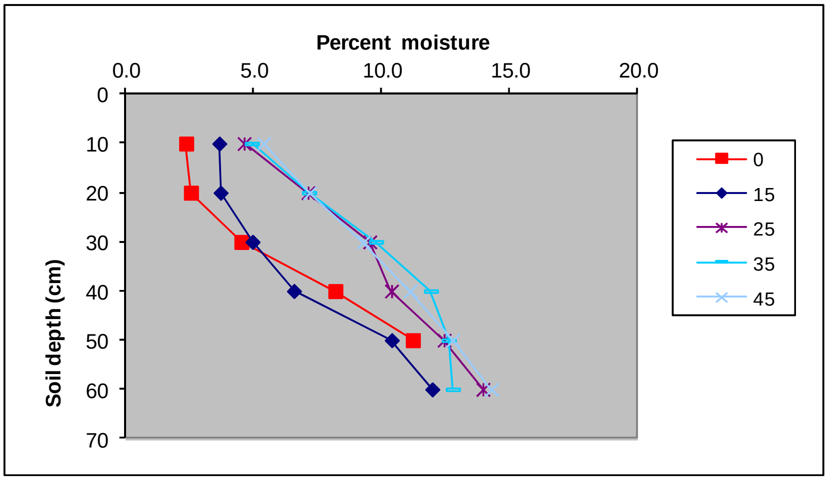

Figure 1. Soil moisture content on 16 May 2011.

Results

A total of 259 mm seasonal rainfall comprising 4, 35, 30, 52, 44, 35 and 59 mm in April to October, respectively was received at the trial site which is above average for Merredin. All of the plant emergence, plant survival, mid-season biomass and grain yield varied with initial soil moisture levels created through irrigation gradient and seemed to follow similar pattern.

Plant numbers in the low moisture treatments (20 mm or less) were low (Table 1). Plant mortality was statistically significant but appeared practically less important because all treatments retained more than 80% plants, which according to most agronomy consultants in the area were enough to produce seasonal yield potential in the low rainfall zones of WA. The plant population survived by 25 May were less than 50 plants/m^2 in irrigation levels less than 25mm, between 50-60 plants/m^2 in irrigation levels between 30-45mm and more than 60 plants/m^2 in the higher levels. Mean plant density of the unirrigated area that germinated after the break was 80 plants/m^2.

Table 1. Plant population after five weeks from sowing (first irrigation)

	Equivalent rainfall (mm)														
	15.0	17.5	20.0	22.5	25.0	27.5	30.0	32.5	35.0	37.5	40.0	42.5	45.0	47.5	50.0
Number of plants/m^2	25	37	36	47	47	51	59	48	52	49	62	55	52	62	70

Difference in soil moisture measured just before the opening rains to the season were apparent for the irrigation treatments largely in the 10-40 cm layer compared with topsoil (Figure 1). Plant dry matter measured 70 days after irrigation varied from about 50 g/m^2 to about 150 g/m^2 in contrast to about 27 g/m^2 for that part of the same crop that was not irrigated but germinated eventually after the break. The unirrigated area yielded (0.97 t/ha) about two third of the highest irrigated treatment (1.44 t/ha) but was greater than the irrigation levels up to 25mm. This shows that despite a perceivably adequate plant population, which is as low as <10 plants/m^2 in that area (Geoff Fosbery, ConsultAg, pers. comm.), and a greater mid-season biomass, yield may not always be high enough to encourage early sowing.

In fact, the results of all the three traits in the irrigated treatments followed similar pattern and revealed a response curve consisting of a sharply improving ‘damage’ regime where the level of trait is lower than timely sown crop, followed by a ‘sustain’ regime where level of the trait is at par with the timely sown crop and finally ending in the ‘advantage’ regime where the grain yield level increases above the timely sown crop in proportion to the level of irrigation (Figure 2). It is surprising to notice the advantage phase not appearing until irrigation level was about 50mm. This result seems to have been influenced by factors: i) there was plenty of stored soil moisture resulting from 77 mm pre-sowing rainfall, ii) cultivar used might not be the ideal variety for early sowing, iii) water availability may not compensate for damage to plant metabolic process due to high temperature prevailed in April and, iv) nutrition and crop protection requirements are different for crops emerging at different times.

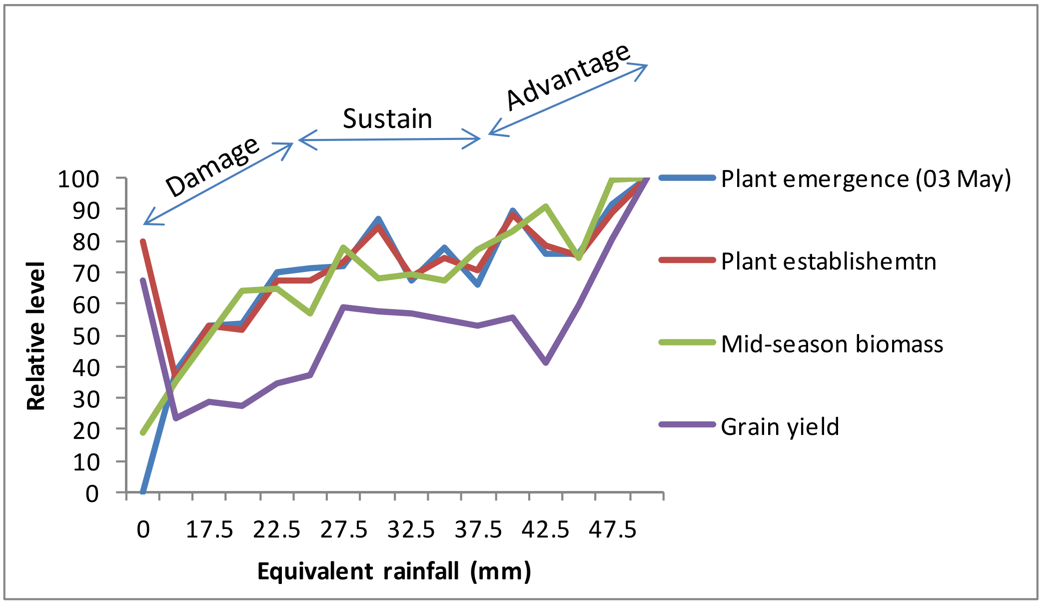

Figure 2. Relative level of four traits in a canola crop sown on a gradient of moisture created by irrigation. Timely emerged (unirrigated) crop from the same sowing yielded in the 'sustain' region of suggested response curve. Lsd (5%) on relative scale for grain yield is 28.2.

Conclusion

Canola farmers often desire and tempt to avail early sown opportunity coming with false break to the season. Our results show that response to starting moisture level is not linear and rather follows a three regime curve for all of the plant establishment, plant growth and grain yield. Yield advantage is seen only in the later part of the curve when during the experimental season, it coincided with irrigation above 47.5 mm.

Our results also show that it is not just the availability or the depth to which moisture is available at the time of seeding; it is important that there is i) sufficient moisture in the seedbed (0-10cm) to achieve good plant numbers and ii) then to sustain them (10-20cm). Because moisture at depth assists early sown canola, it is prudent to not only maximize seed and seedling available water but also to conserve more summer rain.

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