Dry seeding- more wins than losses

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Key messages

- Dry seeding provides logistical and production benefits in cropping programs which largely outweigh any increase in production risk. For instance, simulation analysis of 100% dry seeding across a 6000ha, heavy soil-type farm in Merredin found that the area affected by frost around flowering only increased slightly (from 12.5% with no dry seeding to 15% with 100% dry seeding), whereas the area affected by heat stress decreased markedly (24% to 11%).
- The only situation where dry sown crops are at high risk is when canola (not wheat) is sown in early April into a soil with little stored moisture and an early rainfall event of less than 20mm falls. Notwithstanding, seedling survival following such a rainfall event, is still likely to be adequate to achieve yield potential if the rainfall event occurs after 20 April.
- A weed and pest free paddock is a pre-requisite when using dry seeding to lift farm profits through increased farm level yields and increased capacity to sow a larger area.

Aims

Dry seeding is a means to achieve earlier sowing for a large proportion of a cropping program under a variable season break. Large cropping programs can be consistently established with less capital investment into seeding machinery. There are two key advantages of dry seeding: i) the dry sown area enjoys the same early sowing advantage as would have been for the area sown on day-1 after opening rains; ii) Early finishing of seeding implies a reduction in the proportion of crop area suffering from terminal heat and drought.

However, there are perceived increases in frost risk and seedling mortality associated with dry seeding. There is also confusion whether dry seeding benefits are likely to be greater on light or heavy country. However, we will show in this paper that although these risks are ‘real’ the benefits from dry seeding outweigh them. Survey results have demonstrated that farmers tend to prefer to dry sow Canola (and Lupins) before dry seeding wheat. Differences in yield response to time of sowing, seed costs, crop growth reduction due to early water deficit and compensatory growth with recovering conditions later on further complicate the decision making when canola should be preferred over wheat for dry seeding.

The aim of this paper is to compile relevant information in order to provide qualifying information and develop rules of thumb around dry seeding under WA Wheatbelt conditions.

Method

Results presented in this paper are derived from a multitude of field and crop modelling experiments.

Field data comes from trials conducted at Merredin and Kellerberrin since 2011 (Table 1).

The modelling results comprised a multi-field, multi-year simulation model analysis in the APSIM framework at seven locations across the WA Wheatbelt. The locations were: Cunderdin, Dalwallinu, Katanning, Merredin, Mingenew, Mullewa and Salmon Gums. Sixteen farm management scenarios made up of a full factorial combination of two farm sizes (3 000 or 6 000 ha), two soil types (heavy and light), and four potential rates of dry seeding (0, 33, 66 and 100% of total farm area) were considered for each location.

	Seedling survival at Kellerberrin	Seedling survival at Merredin	Seedling survival at Merredin	Growth compensation later in the season after severe early water deficit at Merredin	Growth response later in the season after good start at Merredin
Year	2011	2011	2012	2013	2014
Sowing date	6-Apr	21-Apr	5-Apr	30-Apr	30-Apr
Crop	Canola	Canola	Canola	Wheat and Canola	Wheat and Canola
Sown dry or wet	Dry	Dry	Dry	Wet	Wet
Irrigation timings	April	April	April	May, July, September	June, July, September
Stored moisture at 20cm	No	No	Yes	Yes	No
Seasonal rainfall (mm)	n/a	n/a	n/a	199	239

Table 1. List of experiments presented in this paper.

Results

For sake of simplicity, results are presented according to key questions rather than experiment wise.

What is the trade-off between increased frost risk and decreased heat damage with dry seeding?

Modelling work done under dry seeding project (Fletcher et al, paper under review) shows that yield gains as a result of escape from terminal drought stress are much greater than increase in losses due to frost events. This finding is consistent throughout the Wheatbelt (Table 2).

Location	Soiltype	Cropping program (ha)	Percentage of cropped area affected by frost during flowering after 0% dry seeding	Percentage of cropped area affected by frost during flowering after 100% dry seeding	Percentage of cropped area affected by heat stress during grain filling after 0% dry seeding	Percentage of cropped area affected by heat stress during grain filling after 100% dry seeding
Cunderdin	Heavy	3 000	5	7	24	8
		6 000	3	5	30	18
	Light	3 000	4	6	15	5
		6 000	4	6	23	13
Dalwallinu	Heavy	3 000	0	1	20	5
		6 000	0	1	26	13
	Light	3 000	0	1	18	5
		6 000	0	1	26	13
Katanning	Heavy	3 000	4	7	5	0
		6 000	3	5	11	3
	Light	3 000	6	6	1	0
		6 000	4	5	7	1
Merredin	Heavy	3 000	17	18	16	5
		6 000	13	15	24	11
	Light	3 000	24	25	11	4
		6 000	16	19	19	9
Mingenew	Heavy	3 000	0	0	15	1
		6 000	0	0	24	9
	Light	3 000	0	0	6	0
		6 000	0	0	16	5
Mullewa	Heavy	3 000	0	0	23	7
		6 000	0	0	32	16
	Light	3 000	0	0	16	3
		6 000	0	0	28	11
Salmon Gums	Heavy	3 000	29	31	33	27
		6 000	24	28	39	33
	Light	3 000	34	33	28	20
		6 000	25	28	36	28

Table 2. Average proportion (%) of cropped area affected by frost event (Tmin<0°C) during flowering or heat stress event (Tmax>35°C) during grain filling.

Will my canola or wheat crop survive from an April dry seeding followed by a dry spell?

Experimental data with canola presented earlier (Sharma et al, Crop updates 2013) showed that seedling survival increased with increasing stored soil moisture and delayed sowing (reduced soil temperature). The cut-off point beyond which no mortality was seen among seedlings emerged from a 06April sowing was 32mm of soil moisture. These data combined with anecdotal information suggest that risk of seedling mortality of April sown canola would vary according to figure 1.

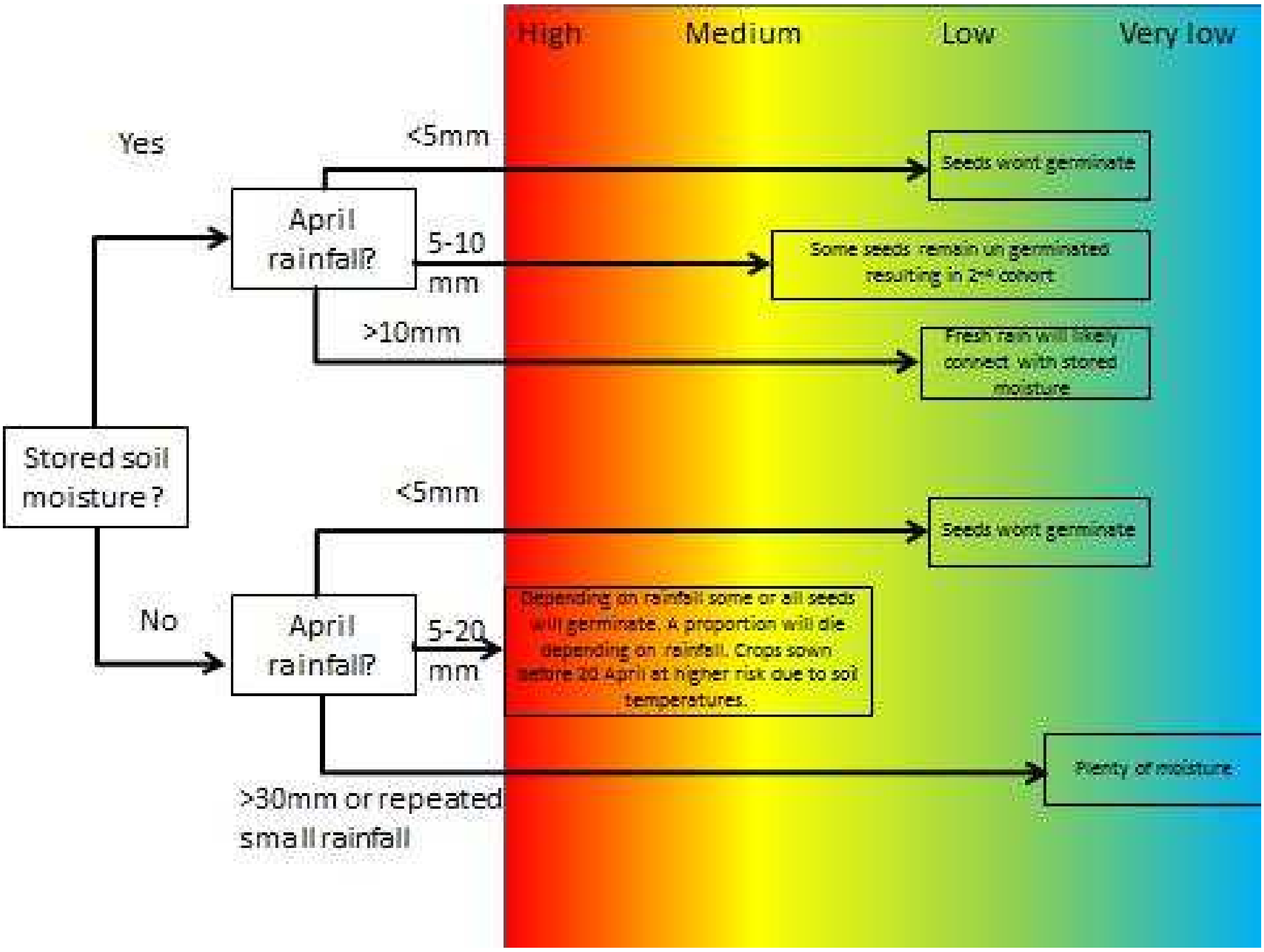

Figure 1. Risk scenarios for seedling mortality.

Unlike canola, the data produced by Dr Bob French clearly demonstrates that once germinated, it is hard to kill a wheat plant. The plants will develop a bit slowly but that would only help crops to compensate for early water deficit (discussed later).

Hence, the only time when dry sown crops are at high risk is when canola (not wheat) is sown in early April on a soil with little stored moisture and a rainfall event smaller than 20mm falls. Such falls after 20 April will probably still leave enough plant population for achieving yield potential under most situations.

Effect of early water deficit on early established crops

Experiments at Merredin in 2013 showed that early water deficit was highly detrimental to plant growth and yield of both wheat and canola. A severe deficit following good and uniform germination reduced grain yield of both crops by about 40 percent. Irrigation equivalent to 15mm rainfall applied in May (to a crop sown 30 April in moist soil) resulted in an extra 400kg/ha of canola and about 1000kg/ha of wheat. This level of response is much higher than the 300kg/ha wheat calculated assuming 20 kg/ha/mm rainfall in a French & Shultz equation but we believe it would be equally applicable to both dry and wet sown crop.

Analysis of historical climate data (Abrecht D, unpublished) suggests that exposure to water deficit during crop establishment is commonplace in both dry and wet sown crops in low rainfall regions of Western Australia; the severity and duration of exposure depends primarily on the timing and amount of rain falling after crop emergence and secondly on the moderating influence of stored soil water. The influence of crop and variety choice and crop agronomy on compensation for and recovery from exposure to early water deficit is a critical unknown for producers seeking earlier crop establishment.

Potential for response to winter and spring rains

Inferences in this subsection are drawn from the 2013 and 2014 field trials at Merredin where irrigation was applied to supplement crop water supply in June (around tillering), July (stem elongation) and September (grain formation). Years 2013 and 2014 were contrasting seasons. The 2013 season started with a low yield potential due to early water deficit while we struggled to obtain an early water deficit treatment in 2014 due to good rainfall in April and May.

The trials differed in the opportunity for crop recovery and compensation. In 2013, canola showed a positive response to both the June (52%) and September irrigations (30%) despite there being ample spring rainfall. Wheat showed significant yield compensation with September (27%) but not June irrigation.

In 2014 moisture conditions early in the season were excellent and we did not expect a large yield response; wheat still produced a significant biomass and yield response with both June and July irrigations. Average yield in the nil, 20mm June irrigation and 20mm July irrigation was 2046, 2346, 2591 kg/ha which equates to an efficiency of 16% and 28% from the same amount (20mm) but in different months. This is in line with the rainfall pattern of the year. The month of June received less rain but was preceded and followed by good rains whereas July was preceded and followed by less rain (May 54mm, June 23mm, July 49mm, and Aug 14mm). The September irrigation which was superimposed on the nil, June and July irrigation blocks produced similar effect in all blocks. Yield increased by about 30% in the 10mm treatment and further response was almost flat (Fig 2). This suggests that perhaps there is a limit to which spring rains can produce benefit and the realisation of this benefit seems to be contingent upon the yield potential set early in the season. This inference is further supported by the 2013 results when maximum response to September irrigation was 27%. Hence, irrespective of whether seeding is done in dry or wet soil, it is paramount that yield potential is well set for the paddock and the season. Should there be good spring rains, an otherwise 2t/ha crop can become 2.6t/ha.

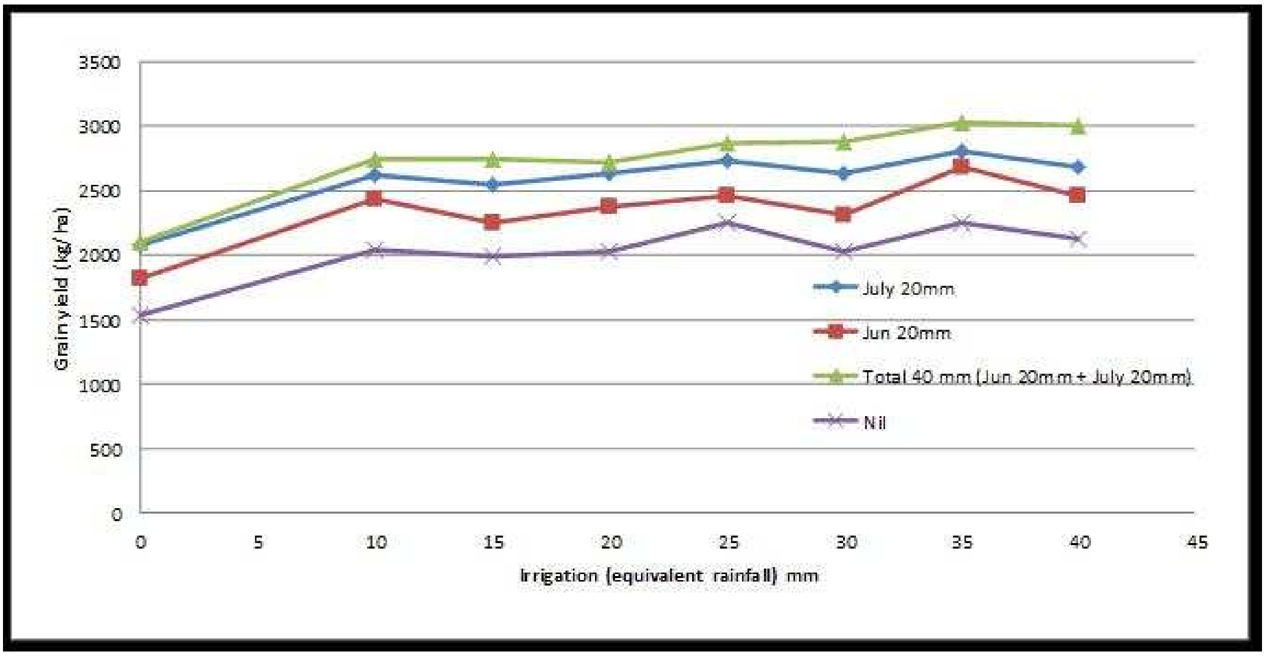

Figure 2. Grain yield of wheat in irrigation gradients superimposed in September over blocks that received different amounts in June and July at Merredin in 2014.

Interestingly, the wheat yield effect of July irrigation was significant (28%) in 2014 in contrast to no response in 2013. As stated above, the early months of the two years were contrasting. It appears that the adverse effect of early water deficit in 2013 was so severe that the crop had lost its potential to respond to July irrigation. Tillering had been so badly affected and the spike size was already so small that improved floret maintenance (as a benefit from July irrigation) could add only little; whereas in 2014, both tillering and spike numbers were good and there were opportunities to protect the florets using additional water in June and July. Hence, mid-season rains are valuable to wheat as long as early growth has not been hampered too much whereas canola remains flexible throughout. Given that wheat varieties with vernalisation requirement develop slowly under early sown conditions and reach the terminal spikelet stage a bit later in the season, it allows the plant to stay in the response phase for a bit longer. Hence, using data from these trials and anecdotal information, it may be suggested that wheat varieties with a vernalisation component could be better suited to dry seeding conditions when early water deficits are expected. Variety information for vernalisation component is available from the wheat agronomy group (contact: Brenda Shackley).

Conclusion

Actual risks associated with dry seeding are smaller than perceived.

The chances of seedling mortality are medium-high only when a false break happens on canola crops (not wheat) sown dry in early April on a soil with no stored moisture.

Both wheat and canola have the ability to compensate for poor growth due to early water deficit. While canola can respond to favourable conditions anytime, careful choice of variety (with some vernalisation component) is required for wheat.

Key words

Dry sowing, dry seeding, water deficit, rainfed

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