

# INTER-ROW SURFACE COVER TO REDUCE EVAPORATION AND INCREASE LIGHT INTERCEPTION BY WHEAT

James Nuttall, Audrey Delahunty, Garry O'Leary, Alexander Clancy, Ashley Wallace (Agriculture Victoria)

## TAKE HOME MESSAGES

- Protecting the crop inter-row using a PVC cover significantly increased wheat yield by 10 per cent in 2019 and 50 per cent in 2018, demonstrating the benefit of water conservation and/or concentration of water shed to the crop row over two growing seasons.
- The colour of the PVC cover modified the light available to the crop and canopy temperature, where a highly reflective inter-row surface increased biomass at flowering.
- In the future, optimal formulations of coloured spray-on polymers, which protect the crop inter-row from evaporation and reflect light, may provide industry with a management option that increases yield stability and provide large relative yield benefits particularly in dry seasons.

## BACKGROUND

Managing the inter-row regions of crops by manipulating the surface albedo (reflectance of light or radiation from a surface) and protecting against evaporative losses from soil may improve yield stability of crops. Within rain-fed cropping environments, where rainfall during the growing season is low and unreliable, water storage and conservation within the soil for crop use is vital for buffering dry periods (O'Leary and Connor 1997). If an economic method of using polymers or other cover material for protecting against evaporative losses within crops could be applied, this would increase the proportion of water used by the crop compared with evaporative losses, thus increasing yield potential.

The surface albedo and corresponding reflective properties of soil within the inter-row region of crops are likely to influence soil and canopy temperature and the amount of reflected photosynthetically active radiation (PAR) intercepted by the crop. For example, dark coloured soils will absorb more radiation and may increase canopy temperature and stress on the crop particularly during flowering and grain filling, whereas, light coloured soils will correspond with a cooler canopy and potentially greater PAR, thus limiting the plant stress associated with increased canopy temperature. If these principles can be demonstrated, then management practices that manipulate albedo, such as canopy shape and surface cover may also provide yield benefit.

To determine the impact of inter-row evaporative water loss and inter-row albedo on crop yield, we tested the concept of protecting the inter-row region of wheat crops from evaporative loss using polyvinyl chloride (PVC) half-pipe painted either yellow, grey or unpainted (white). We also tested an alginate-based spray-on polymer (clear in colour once dried) and a 6t/ha stubble mat on wheat growth.

## AIM

To test the benefit of reducing inter-row evaporative losses in-crop and manipulating inter-row albedo on wheat growth using PVC covers of three different colours, compared with the effectiveness of possible management options such as a spray-on polymer and stubble mats.

## PADDOCK DETAILS

Location:	Kalkee South
Crop year rainfall (Nov-Oct):	363mm
GSR (Apr-Oct):	254mm
Soil type:	Clay (Grey)
Starting soil N:	68kg N/ha (0-100 cm)
Paddock history:	Lentil

## TRIAL DETAILS

Crop type/s:	Kord CL Wheat
Treatments:	Refer to methods
Seed rate	73 kg/ha
Target plant density:	130 plants/m <sup>2</sup>
Seeding equipment:	Knife points, press wheels, 30cm row spacing, cross sown into a lentil stubble
Sowing date:	21 May 2019
Harvest date:	13 December 2019
Replicates:	Six

## TRIAL INPUTS

Weeds, pests, diseases and nutrition managed as per best practice.

## METHOD

A field trial was sown using a randomised complete block trial design to assess the effect of a range of inter-row evaporative protection methods and different reflective properties (colours).

Inter-row cover treatments were:

- Protection method (nil; PVC – 225 mm half pipe cover; spray-on polymer (alginate based) and stubble mat at 6t/ha).
- Inter-row albedo where PVC half pipes were finished in three different colours. White (maximum reflection), yellow (medium reflection – straw colour) and grey (low reflection – grey clay soil colour).

## RESULTS AND INTERPRETATION

Crop growth up to flowering across all inter-row protective treatments was equivalent to the uncovered control, where on average total biomass was 9.9 t/ha (Table 1). Evidently, the inter-row cover designed to protect against evaporation had little impact during the late vegetative phase. This is likely due to the large amount of stored soil water accrued prior to sowing and well-timed rainfall events occurring up to flowering, meaning the crop rarely experienced water stress to that point in the season. For crops where white or yellow PVC interrow covers were applied, flowering biomass was 8 per cent greater than for the grey PVC cover. Comparison of the photosynthetically active radiation (PAR) or light reflected from the white and yellow covers was over three times that from the grey cover (Table 2), indicating that early crop growth may be stimulated by the increase in PAR. In this period, canopy temperature was the same across the different coloured PVC covers. For an equivalent trial in 2018, where there was no soil water reserve at sowing, and decile 2 growing season rainfall, white PVC inter-row cover significantly increased biomass at flowering by 23 per cent (3.4 vs 4.1t/ha – cv. Scepter). In this case the PVC protected against evaporative water loss in the period up to flowering, making it available to crop, whereas in 2019 this effect was not apparent due to water being less limiting up to flowering.

**Table 1. Comparison of wheat (cv. Kord CL) growth for a range of inter-row cover (protection) methods applied from mid-tillering to maturity and are compared to a soil (control). HI, harvest index; Lsd is least significant difference.**

	Flowering biomass (t/ha)	Yield (t/ha)	Grain number (per m <sup>2</sup> )	Kernal size (mg)	HI
Control	9.83	3.72	11,860	32	0.340
PVC white	10.26	4.13	12,184	34	0.348
PVC yellow	10.31	4.10	11,487	36	0.359
PVC grey	9.50	3.64	10,508	35	0.355
Polymer	9.95	4.03	11,926	34	0.356
Straw	9.48	3.51	10,583	32	0.340
<b>Lsd (P&lt;0.001)</b>	<b>0.61</b>	<b>0.33</b>	<b>1100</b>	<b>3</b>	<b>0.013</b>

Wheat yield varied across treatments; white and yellow PVC inter-row covers significantly increased yield by 11 and 10 per cent respectively compared with where there was no interrow cover (Table 1). This increase in yield was due to an 11 per cent increase in kernel size, which was potentially linked with reduced water stress during grain-filling. Albedo effects may be less, post-flowering, due to canopy closure and crop shading. For the grey PVC interrow cover there was no yield benefit over the uncovered control, although this treatment caused a significant reduction in grain number which was compensated for by an increase in kernel size compared with the uncovered control. Applying a spray on polymer at mid-tillering increased wheat yield by 8 per cent compared with the uncovered control, although this increase was not statistically significant (Table 1). For the stubble mat imposed at midtillering (straw horizontal and aligned), at 6t/ha within the inter-row, this provided no yield benefit compared with the control.

Temperature loggers located in the crop canopy indicated that the grey PVC treatment resulted in a significant increase in heat stress (temperatures above 32°C) between head emergence and flowering (Table 2). This suggests the dark colour (grey) absorbed more radiation and increased the temperature of the crop canopy causing a reduction in grain number. Interestingly, for the grey PVC, this was a similar colour to the control soil, indicating that the PVC behaved as a more efficient radiator of heat. To further test soil albedo effects on canopy temperature, soils of different colour would need to be directly compared. For the 2018 trial, the white PVC inter-row cover increased yield by 50 per cent (1.1 vs 1.7t/ha), where this relatively large increase in yield was due to an equivalent increase in grain number, reflecting the importance of the additional water available to the crop up to flowering in 2018. When comparing the effects of inter-row cover (white PVC) across 2018 and 2019, greatest relative benefits on crop growth occurred under drier conditions, where there was limited stored water at sowing i.e. 2018.

**Table 2. Comparison of micro-climate effects of the PVC inter-row covers due to colour difference and are compared to a control soil. The three PVC colour combinations tested were white, yellow and grey. The heat sum is calculated as the sum of °C above 32°C at the crop canopy during the period 5 days prior to crop heading to 5 days post-flowering. ‘Downwards’ photosynthetically active radiation (PAR) is with the sensor facing directly upwards on a clear day and ‘reflected upwards’ is with the sensor at canopy height facing downwards at the PVC inter-row cover.**

	Heat sum (crop canopy) (°C.hr>32°C)	Photosynthetically active radiation (PAR)	
		Downwards (µmol/m <sup>2</sup> /s)	Reflected upwards (µmol/m <sup>2</sup> /s)
Control (soil)	106	2487	297
PVC white	110	2528	1096
PVC yellow	125	2567	901
PVC grey	152	2541	296

## COMMERCIAL PRACTICE

Overall, imposing the inter-row PVC cover demonstrated the benefits of water conservation and/or concentration of water shed to the crop row, increasing yield by up to 10 per cent in a decile 3 growing season (with stored water at sowing) and up to 50% in a decile 2 growing season (on a dry soil profile). The spray-on polymer, which may represent a practical option in the future if given further development, may perform similarly to the PVC, although our formulation only increased yield from 3.7 to 4.0t/ha (non-significant) in 2019. The effect of inter-row colour and surface albedo was shown to influence the PAR available to crop and canopy temperature, where greater PAR increased flowering biomass of crops, whereas dark colours, inter-row, increased crop heat stress. In the future, optimal coloured polymer formulations which protect crop inter-row from evaporation and manipulate surface albedo may provide industry with a management option that increases yield, particularly in dry seasons.

## REFERENCES

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