Managing soil water repellence with banded wetting agent

David Gartner, R&D Coordinator and Anne Wilkins, Executive Officer, West Midlands Group
Stephen Davies, Paul Blackwell and Breanne Best, Department of Agriculture and Food WA

Purpose:	To evaluate banded wetting agent (SACOA 'Irrigator') for crop establishment and yield on non-wetting soils in the West Midlands.
Location:	Badgingarra and Warradarge
Soil Types:	Pale deep sand; Sandy gravel; Sandy duplex
Soil Test Results:	See Table 2; **Growing Season Rainfall (Apr-Oct):** See Table 1.

BACKGROUND SUMMARY

Crop establishment on water repellent sands using typical furrow sowing practices with narrow knife points and press wheels is often poor. Options to improve the effectiveness of furrow sowing include banding of soil wetting agents into the furrow behind the press wheel. Banded wetters assist water entry into the repellent soil that often flows into the furrow with the seed and fertiliser. Commercial soil wetting agent chemistry commonly includes surfactants which improve water entry by reducing surface tension but may also include water and nutrient retaining compounds. These components vary in proportion between products, many have only surfactant and the longevity of the surfactant varies from short to long duration. 'Irrigator' is mainly surfactant with a relatively short duration to minimise crop nutrient leaching problems.

TRIAL DESIGN

Banded 'Irrigator' wetting agent treatments were tested over a number of on-farm replicated and demonstration test strips that covered a range of crop types, sowing dates and seeding systems (Table 1).

Table 1. Summary of on-farm banded wetting agent trial details conducted with West Midlands Group growers in the Badgingarra and Warradarge area in 2012. Trials indicated with an * were fully replicated DAFWA-run furrow sowing (FS) systems research trials. # = rainfall from BOM Warradarge.

Grower	2012 Crop	GSR (mm)	Machinery used	Sowing date	Sowing rate (kg/ha)	Plot Size (m)	Reps
D. Paish	Cobbler canola	325	Flexi-coil bar, 10-inch row	12-May	5	200x12	1
D. Paish	Mace wheat	325	Flexi-coil bar, 10-inch row	01-Jun	86	250x12	1
S. Clarke	Baudin barley	399#	DBS bar, Flexi coil bin, 9-inch row	28-Jun	70	150x8	3
S. Clarke	Gat. Panic & Rhodes	399#	Shearer Trash Culti with SuperSeeder points & press wheels	29-Aug	3	150x6	4
C. McAlpine* (FS)	Tanjil lupin	325	Small-plot coneseeder	14-May	95	30x2	3 gravel 4 sand
C. McAlpine* (FS)	Mace wheat	325	Research airseeder, 12-inch row	17-May	70	300x3	4
C. Sattler	Cobbler canola	372	Flexi-coil bar, 9-inch row	8-Jun	4	100x12	3

Banded wetting agent kits were set up on the grower seeders that applied 'Irrigator' at 1.0 L/ha banded in the furrow behind the press wheels. Typically the soils were either deep sands or sandy gravels, all were water repellent (see Table 2 for soil test results).

Table 2. Summary of soil test (0-10 cm) results for banded wetting agent trials with West Midlands Group growers in the Badgingarra and Warradarge area in 2012. Note: soil analyses were not done for the Sattler site as it appeared the crop had failed at this site earlier in the season due to wind damage but it did recover and yield measurements were collected.

Soil test	Paish (Wheat)	Paish (Canola)	Clark (Barley)	Clark (Per.)	McAlpine (Wheat)	McAlpine (Lupin)
pH (1:5 CaCl2)	6.5	6.3	4.9	5.0	6.0	4.8
pH (1:5 H2O)	7.1	6.7	5.7	5.8	6.6	5.6
EC (1:5 H2O) dS/m	0.13	0.17	0.04	0.02	0.11	0.06
Organic carbon (Walkley Black) %	2.59	2.19	0.91	0.81	1.89	0.80
Nitrate nitrogen (KCl) mg/kg	44	28	12	7	40	19
Ammonium nitrogen (KCl) mg/kg	3.2	2.6	2	2	5	6
Phosphorus (Colwell) mg/kg	41	18	9	6	15	16
Phosphorus Buffer Index (PBI)	17.98	9.37	-	-	7.7	5.8
Potassium (Colwell) mg/kg	94	91	23	<15	65	19
Sulphur (KCl-40) mg/kg	14.5	29.4	3.8	1.7	7.2	8.2

RESULTS and DISCUSSION

Effectiveness of the banded wetting agent varied between the trials. There was a trend towards improved crop establishment in all of the trials except one in most cases the increase in plant numbers was small and not significant (Fig. 1). In the wheat furrow sowing (FS, C. McAlpine) trial the impact of banded wetting agent on emergence was more pronounced (Fig. 1). In this trial banded wetting agent had no effect on initial establishment before post sowing rain but significantly improved later establishment (Fig. 2) in response to rainfall on both deep sand and sandy gravel soil types. This improvement in crop establishment contributed to significant grain yield increases on both deep sand and sandy gravel soil types (Fig. 3). Brome grass levels were high at the site, partly due to the early sowing, and visual assessment generally suggested better competition between crop and weeds with the banded wetting agent treatments compared to knife points alone.

Overall grain yield was significantly increased in 3 of the 8 comparisons, while a further 3 trials showed trends toward higher yield but these were not significant at 95% probability (or not a 95% chance of being real) (Fig. 2). Generally, the banded wetting agent seemed to be more effective in the mid-May sowing times on soils with strong-severe repellence. At this mid-May sowing time soil moisture conditions were typically poor and variable but sufficient to germinate and establish a relatively small number of seeds with the majority germinating several weeks later with significant rain in early-mid June. On the deep sand (FS sand, wheat in Fig. 3) banded wetter increased yield by 350 kg/ha, a 32% yield increase while on the sandy gravel (FS sandy gravel, wheat in Fig. 3) yield increased by 430 kg/ha, a 32% increase over the knife points alone.

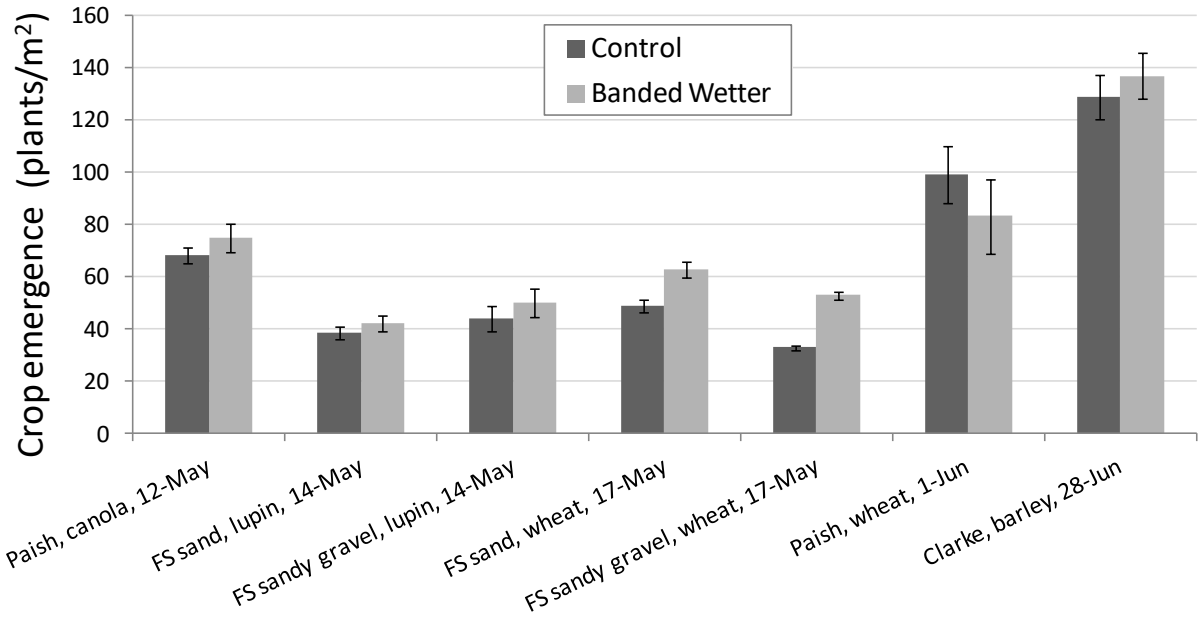

Figure 1. Summary of crop emergence numbers from on-farm banded wetting agent trials conducted with West Midlands Group growers in the Badgingarra and Warradarge area in 2012. Note: plant counts not made at Sattler site.

A canola yield increase of 0.15 t/ha (27% higher) was also measured at the Sattler site but yields were low at the site, 0.56-0.71 t/ha, because the site was wind damaged by pre-frontal winds. For the furrow sowing lupin trial at McAlpines a larger response to banded wetting agent may have been expected but the plots were sown across reasonably heavy wheat stubble which caused the tynes to bounce and probably interrupted the wetting agent stream and application to the furrows. This likely reduced the efficacy of the wetting agent resulting in a lack of a significant establishment or yield response.

At the Paish canola site plant numbers were more than adequate to meet yield potential for the site. Wetting agents have been used on this site for 4 years and crop establishment is typically good. Having consistently good plant numbers will result in good crop rows and residual root systems that can aid water entry into the repellent soil even in the absence of banded wetter.

For the Paish wheat trial there was a large, 40 mm, rainfall event shortly after seeding and this seemed to be sufficient to provide adequate establishment regardless of treatment. High yields were achieved at this site, 4.99 t/ha for the control and 5.16 t/ha for the banded wetter so the water repellence constraint was not a significant factor in crop performance!

At the Clarke barley site the crop was sown late (28 June) but was also subject to furrow infill as result of high winds after sowing which may have impacted on the efficacy of the banded wetting agent. However, despite the furrow infill barley emergence numbers were still good with >120 plants/m^2, easily adequate for the yields achieved of ~1.5 t/ha. The mean barley yields at the Clarke site were not significantly different.

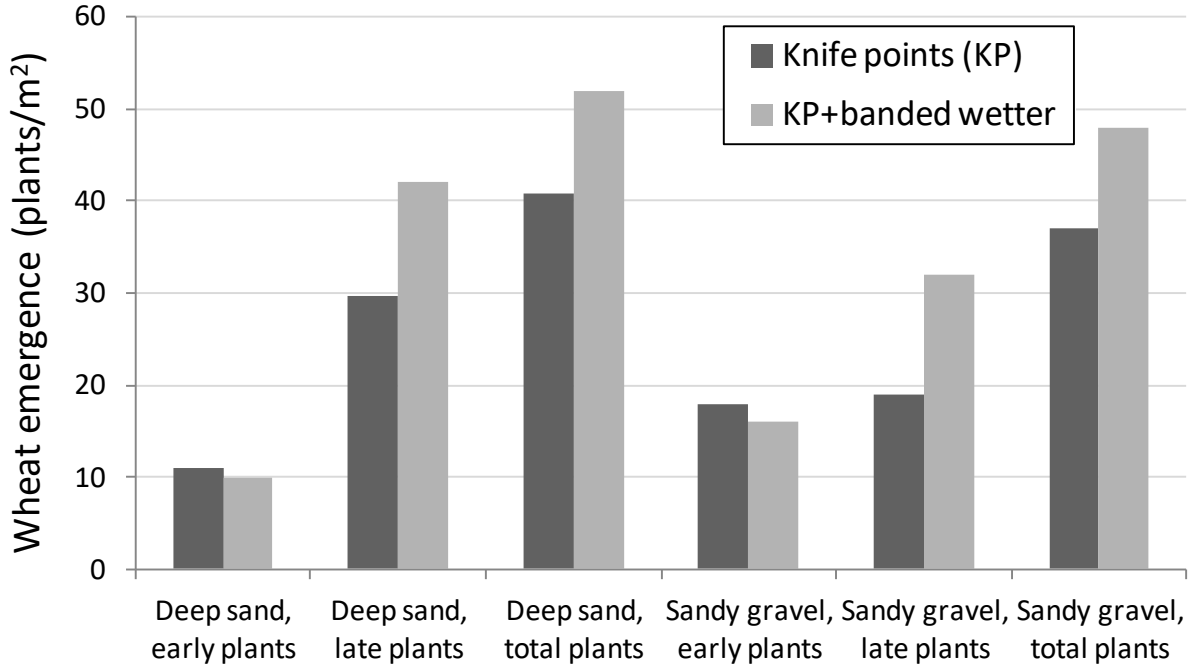

Figure 2. Impact of banded wetting agent on emergence of wheat sown on 17 May 2012 in a furrow sowing (FS) trial at Badgingarra. Early and late plants represent separate emergence cohorts that together give the total plant numbers with and without banded wetting agent for the two soil types.

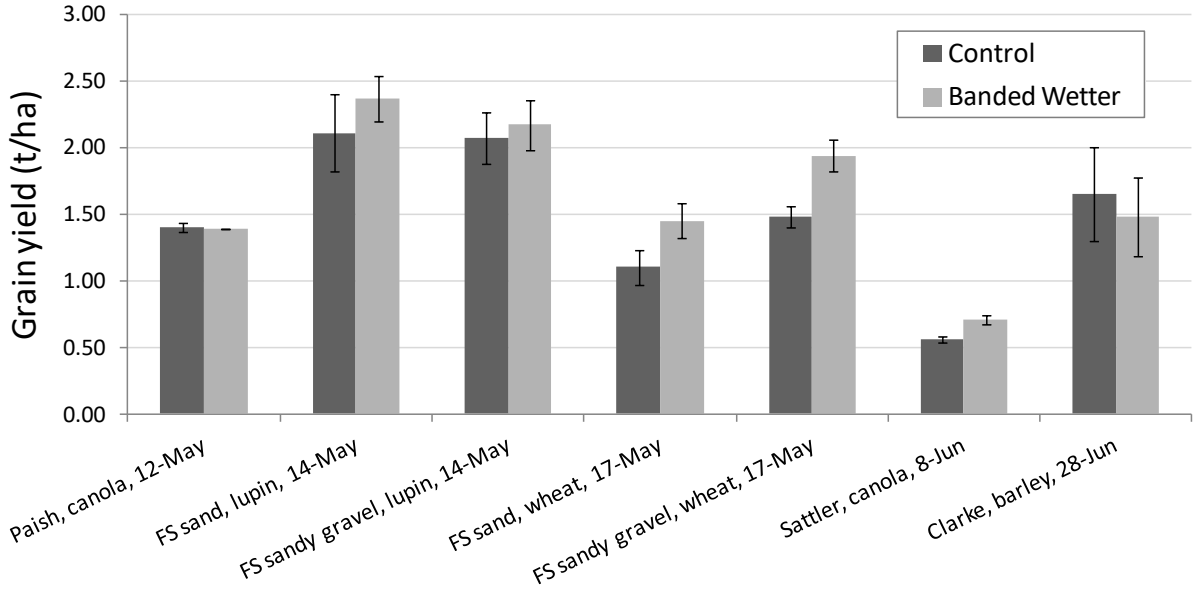

Figure 3. Summary of grain yields from on-farm banded wetting agent trials conducted with West Midlands Group growers in the Badgingarra and Warradarge area in 2012. Note: Grain yields from Paish wheat trial, sown 1June, not included on chart as yields were much larger than other trials, control yield was 4.99 t/ha and banded wetting agent 5.16 t/ha.

CONCLUSION

This set of trials indicates that SACOA 'Irrigator' banded wetting agent can improve crop establishment and grain yield but that responses can be highly variable. The 27-32% yield increase seen in 3 of the trials is very encouraging. Based on these and other trials it can be suggested that banded wetting agents are most likely to be effective when:

- Soils are moderate to strongly repellent and there are few residual roots form the previous year's crop; and points and tines are used for seeding.
- Banded wetter is applied in a consistent stream to the base of relatively stable furrows. Collapsing furrows, furrow infill and a disrupted band of wetting agent can reduce efficacy. Presswheels with a more rectangular cross section tend to rip up furrow walls and the disturbed soil buries and mixes banded wetting agent. 'V' section or round section presswheels with no deep flange reduce such problems.
- The banded wetting agent kit needs to be robust and reliable and needs to accurately apply the wetting agent in a continuous stream into the base of the furrow
- Crops sown early into dry or partially dry soil before opening rains derive more benefit from banded wetter. Banded wetting agents are typically less beneficial when used later in the sowing program when there has already been rain and the soil has started to wet up.

Growers already using wetting agents are tending to modify their usage of banded wetter to better match the likelihood of significant benefits. Some growers only use banded wetter for the dry seeding or early part of the program and don't use it later in the program after there has been more rain. Other growers are planning to use higher rates of banded wetter early in the program but then aim to reduce the rates when sowing later in the season. Both of these strategies will reduce cost while maximising the opportunity for benefits to crop establishment and yield. Current research in the state is showing that different banded wetting agent products can have a wide range of effects of crop establishment and especially on yield. DAFWA is continuing to research a range of products to help growers evaluate which types of banded wetting agent are more suitable for their farming system.

PEER REVIEW

Wayne Parker (DAFWA, Geraldton)

ACKNOWLEDGEMENTS

Particular thanks to all the growers who hosted banded wetter trial sites. Research funded by GRDC through a Kwinana-west zone grant to West Midlands Group and by DAFWA & GRDC through the "Delivering agronomic strategies for water repellent soils in WA – DAW00204" project. Thanks to SACOA for supplying the 'Irrigator' banded wetting agent for the WMG trials.