Research Report: Seed Priming

Introduction:

Water repellent or non-wetting sands characterize more than 5 million hectares of Australia's agricultural land.

Water repellent sands are induced when micro-organisms fail to digest waxy plant residues. In hot weather, the waxes melt and coat the surface of the sand.

The wax-covered sand repels water, resulting in dry patches that inhibit seed germination.

Soil erosion and reduced crop productivity due to poor germination are common on non-wetting sands.

Non-wetting Sands

Water repellent sands are often referred to by the farmers as 'hydrophobic,' 'oily,' or 'non-wetting sands' [1]. The main cause of soils to repel water are fungi that produce hydrophobic waxes [2]. The non-wetting sands are unevenly wet, leaving a large volume of patchy dry soil, delayed germination, poor crop establishment and reduced grain yield. [3]. Delay of germination and poor crop establishment leave the soil at risk from wind and water erosion [4].

Seed priming

Seed priming is reported to force seeds to germinate irrespective of soil condition.

Seed priming starts when seed is soaked in water for some time and then drained.

Priming is a controlled hydration process; it enhances seed performance by improving the rate and uniformity of germination and decreasing seed sensitivity to external factors [5,6,7].

A primed seed goes through three stages of germination:

Phase 1: Water imbibition, it is the action where the seeds are soaked in water for a certain period to allow the seeds to hydrate and absorb the water;

Phase 2: Activation of nutrients, soaked seeds are drained and lightly dried since the enzyme is activated the seed is ready to sprout;

Phase 3: Radicle protrusion, this is the stage where the seed grows future roots.

Seed priming is not limited to only using just water, and different solutions and chemicals can be used.

The priming techniques are as follow
(1) Hydropriming is a straightforward and low-cost technique because it only uses only water for soaking;
(2) Osmo-priming, uses osmotic solution with low water potential; (3) Halo-priming uses different inorganic salt solutions;
(4) Solid Matrix-priming is a process in which seeds mixed with a solid carrier material and water in known proportion;
(5) Biopriming a process of a biological seed treatment

in combination with seed hydration; (6) Nutri-priming or nutrient priming means soaking of seeds in the nutrient solution; and (7) Thermo-priming, a method where seed is exposed to certain temperatures before sowing.

Methods and Results:

To further examine the simplest forms of seed priming, a trial was carried out at Kybunga, SA in May 2019 to assess wheat and canola seeds' emergence in a non-wetting sand after the seed was primed.

Wheat and canola seeds underwent different processes before seeding. Both crops were either hydro-primed in water only or primed in an aqueous solution including germination stimulant. Seeds were either soaked for periods of 6 hours or 18 hours. (Table 1).

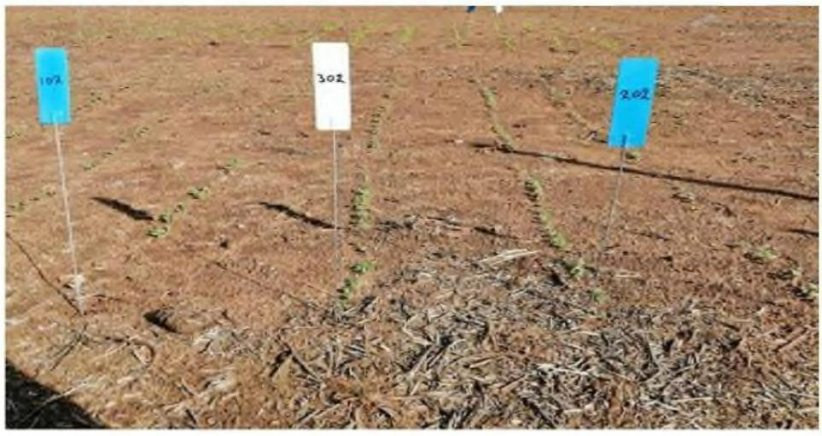

Figure 1: The primed canola (202 & 302) had faster emergence than the untreated seed (102).

The primed wheat and canola as well as an un-primed control were sown by hand on the 1st May 2019 into a non-wetting sand.

Rainfall was pretty reasonable before, during and after planting, and in normal circumstances, soil moisture would not have been considered limiting.

Crop emergence was assessed on the 4th, 6th, 8th,10th, 13th and 15th of May.

Canola on Non-Wetting:

The emergence on the 8th of May showed that the primed seeds had significantly better germination percentage compared to the untreated. (figure 1).

With regard to the primed seeds, there was no statistical difference between the seeds primed with water only, or the solution containing a germination stimulant.

Nor was there any statistical difference between the 6-hour soak or the 18-hour soak.

This suggests the easiest and most cost-effective treatment was canola primed in water for 6 hours.

Table 1	Canola	Wheat
Nil	Nil	
W6	Water: 6 hours	
S6	Solution: 6 hours	
W18	Water: 18 hours	
S18	Solution: 18 hours	

Over the next 8 days, all treatments continued to show further germination and by the 16th, all treatments, including the nil, had similar germination percentages. (Fig 2).

The rainfall at the trial site was steady, with 8mm on the day of sowing (May 1st), another 5mm over the next few days and 20mm on the 10th of May.
In the absence of rainfall, it is likely that the nil treatment would have lagged behind the primed treatments for a longer period of time.

Wheat on Non-Wetting:

1The wheat was a little slower to germinate compared to the canola however, a similar trend where the primed seed germination at a faster rate than the untreated seed was observed. (Figure 3).

Similarly, there was no statistically significant difference detected between soaking time or priming solution (Fig 4).

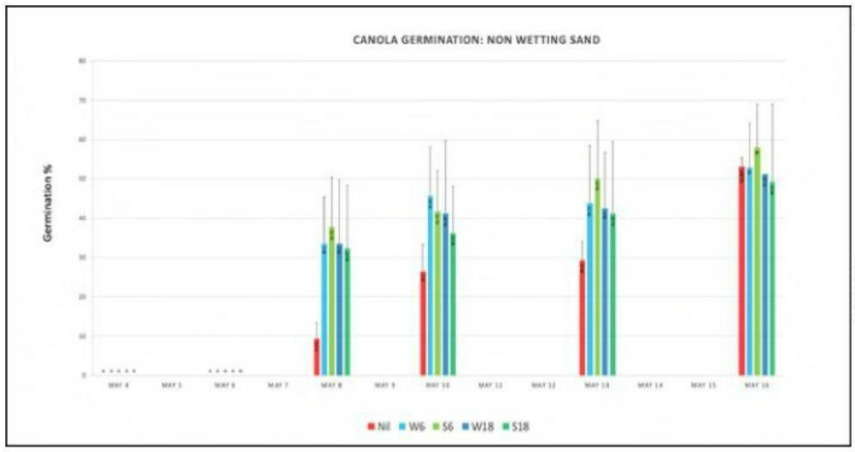

Figure 2: The primed canola seeds emerged faster and demonstrated an early advantage.

Figure 3: The primed wheat (201 & 301) had faster emergence than the untreated seed (101).

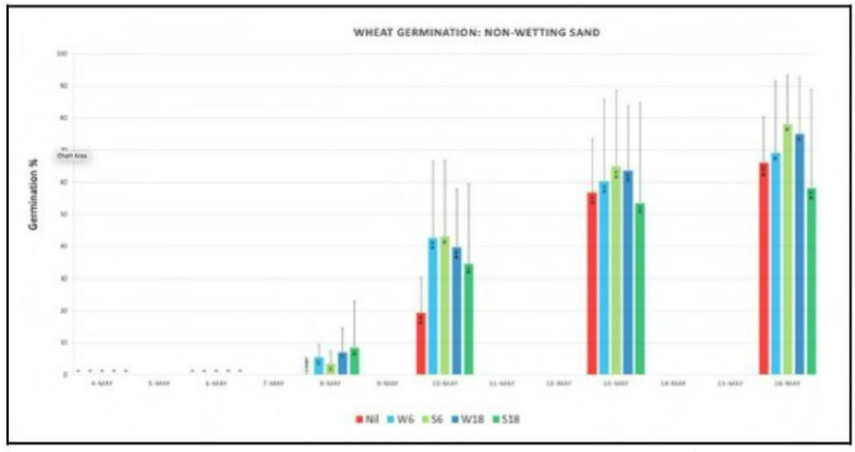

Figure 4: Priming the seeds did increase the speed of germination however, the duration of priming (6hrs or 18hrs) or the choice of priming solution (water only or water with germination stimulant) did not greatly influence the outcome.

Conclusions:

Soaking the seed in water just prior to sowing, or seed-priming, did increase the speed of germination of canola and wheat.
There was no statistical difference observed by increasing the soaking time from 6 hours to 18 hours.

The addition of a germination stimulant to the priming solution did not exhibit any statistical outcome compared to using only water.

Handling wet and swollen seed is difficult and even though primed seed can be broadcast, the next step of this trial is to determine the feasibility of sowing primed seed through conventional seeding equipment.

References:

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For more information: Greg Butler, greg@santfa.com.au