Irrigated Canola Establishment in Incorporated Stubble Demonstration

Work by Clive Kirkby, a CSIRO scientist, suggests that to improve our soil carbon levels, stubbles have to be rapidly broken down by soil microbes rather than slowly decomposing on the soil surface. The risk is that by incorporating stubbles, if they do not break down quickly, they can be an issue with trash flow when trying to sow into them.
Fortunately we have irrigation to provide the necessary moisture for the microbes to breakdown the stubbles. However stubble breakdown also requires enough nutrients for the microbes, in particular Nitrogen, Phosphorus, Calcium and Sulphur.
Clive's rule of thumb is for every tonne of stubble, there needs to be 5 kg N and 3 kg P or 35 kg N/ha and 18 kg P/ha for the site in 2014.
However it was noted that shortly after emergence of the 2014 trial, the site appeared N deficient, and topdressing with 100 kg urea/ha quickly overcame the deficiency symptoms.
With this in mind, the treatments for the 2015 trial used higher rates of N in order to reduce the potential for N deficiency. This seemed to work at double the rate (ie 70 kg N/ha) and also showed an added benefit in that a more vigorous crop was more competitive with the resistant ryegrass. Soil tests taken in March 2016 saw small increases in soil carbon on the plots with the added N but it could not be attributed to the incorporated stubble yet.

The incorporation was repeated in 2016 in two parts:

1. A replicated trial comparing incorporated stubble and fertiliser and burning. These treatments then had differing N budgets post sowing.
2. Demonstration plots with different stubble and N treatments

Prior to pre-irrigation in early April, the stubble, assumed to be 11 t/ha of stubble following an 8 t/ha barley grain yield, was either burnt, left standing or multi-disced and the following pre-sowing N treatments were applied (bold treatments were replicated):

1. No added fertiliser and stubble incorporated
2. **Stubble burnt, no added fertiliser applied.**
3. 56 kg N/ha as urea plus 32 kg P/ha as triple super, stubble standing
4. 56 kg N/ha as urea plus 32 kg P/ha as triple super, stubble incorporated
5. 112 kg N/ha as urea plus 32 kg P/ha as triple super, stubble standing
6. **112 kg N/ha as urea plus 32 kg P/ha as triple super, stubble incorporated**
7. 150 kg N/ha as urea plus 32 kg P/ha as triple super, stubble incorporated
8. Manure applied at 10 t/ha, stubble incorporated.

The trial/demonstration site was then pre-irrigated.

Canola was spread at 3.5 kg/ha with 120 kg DAP/ha on April 18th and watered up. The incorporated stubble provided no issue with water flow.

Establishment was similar across all treatments.
The replicated trial treatment (incorporated stubble plus 112 kg N/ha and burn) plots were split in two and topdressed on June 16th with either 70 or 100 kg N/ha. All other plots received 100 kg N/ha. A second topdressing of 60 kg N/ha was applied on July 29th. This resulted in an N budget of either 215 or 245 kg N/ha.
The trial was direct harvested on November 29th.

Results

DEMONSTRATION Treatments	Yield (t/ha)	Oil %	Lodging Score	Vigour Score 16 June
Standing Stubble	3.08	45.1	2	3
Standing Stubble + 56N	3.01	44.1	3	7
Standing Stubble + 112N	3.33	42.3	6	8
Incorp Stubble + 56N	2.92	43.6	1	6
Incorp Stubble + 112N	2.67	41.7	6	8
Incorp Stubble + 150N	_		9	9
Burn	3.38	45.0	2	6
Manure	3.29	44.5	3	6

Vigour was based on a score of 0 – 9, where 9 is most vigorous.
No harvest results are presented for the 150 N treatment as the plots were completely flat on the ground and unharvestable.

Analysis of Stubble Treatments

Treatment	Yield (t/ha)	Oil %
Incorp + 112N	2.7	41.7
Burn	3.4	45.0
p	0.006	<0.001
lsd	0.372	0.949
cv%	6.3	1.1

Analysis of N Budget

Treatment	Yield (t/ha)	Oil %
215 kg N/ha	3.0	43.6
245 kg N/ha	3.1	43.1
p	0.355	0.199
lsd	NS	NS
cv%	6.3	1.1

Overall analysis of the trial

N Budget	215 kg N/ha		245 kg N/ha	
Stubble Treat	Yield t/ha	Oil %	Yield t/ha	Oil %
Incorp + 112N	2.5	41.3	2.9	42.2
Burn	3.4	46.0	3.3	44.1

LSD: Yield = 0.53 t/ha, Oil = 1.34%

What does it mean?

The results can be interpreted in several ways, depending on what you see as the aim of retaining stubble in the cropping system. Is it simply to avoid burning and still be able to establish canola with as few hassles as possible, or is it to utilise the stubble to build up soil carbon and improve soil structure?

Purely from canola agronomy perspective, the replicated trial comparing burning to stubble incorporated with 112 kg N/ha plus 32 kg P/ha showed burning the stubble gave significantly greater yield and oil content and therefore a better $/ha return.
Looking at the demonstration results, and keep in mind they are only demonstration plots and the results may be simply due to chance, burning still gave the best yield. Looking at the figures, I would suggest the early N rates in excess of 56 kg N/ha pre-sowing, “overcooked” the canola and produced excessive vegetative growth, which then resulted in lodging that interfered with harvest.
By spreading the seed rather than sowing, we avoided the issue of trash flow. We had sufficient stubble cover and niches for the seed to find places to lodge and when watered up, establish sufficient plant numbers for a crop. The standing stubble does not present the soil microbes with a feast that requires large amounts of N and potentially results in N tie-up post sowing. In our situation, the stubble height was no more than 100 mm and so there was no impact from light interception that can interfere with canola establishment in taller stubbles.
But if you were looking to try and build soil carbon, then incorporation is essential, and the cost and effect on the crop are secondary to your aim (though you would probably like it to have minimal impact). The 2015 trial saw a 0.3% increase in organic carbon (beware, soil OC levels from soil tests can vary greatly even when taken from the same spot and so I cannot claim the increase is all due to the treatment) where the stubble was incorporated with N and P over the control (no added fertiliser). Now 0.3 % sounds like a trivial amount, but the maths demonstrates that it represents an increase in OC of 3300 kg/ha. So raising soil OC levels by simply retaining stubble on the soil surface is not going to happen and it is going to require considerable inputs to achieve this aim.