



IRRIGATION RESEARCH & EXTENSION COMMITTEE

2005



FOR IRRIGATION CROPPERS

Evaluating direct drill implements for Murray Valley conditions

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In a nutshell

- A trial was established to evaluate the performance of a number of direct drill implements for sowing wheat into a range of soil and stubble conditions in the Murray Valley
- Establishment count data showed that no implement was clearly the best across all situations
- Tyned implements gave better results in heavy, wet soils because of the tilth created in the sowing row
- Disc openers had the tendency to smear the furrow slice and this led to a range of problems at establishment and later in the season

The benefits of reduced cultivation and retained stubble are well recognised but more information on the performance of direct drill implements in such systems is required. As part of an R&D program established by Murray Valley irrigators, a range of direct drill implements was evaluated in 2004.

Reducing cultivations and retaining stubbles can increase soil organic matter content. In all soils, retained stubbles will decrease bare soil evaporation (leaving more water for the crop) and reduce raindrop impact and crusting (increasing infiltration). There is also the potential to reduce fuel costs (fewer operations and lower power requirement), improve timeliness of operations (no need for multiple cultivations), reduce fertiliser costs (less nutrients up in smoke) and improve air quality.

In red-brown earth and transitional red-brown earth soils, reduced cultivation and retained stubble will reduce slaking and thus the severity of crusting and hardsetting. It will also improve soil structure and provide better anchorage for plant roots, reducing lodging (as reported in Maarten Stapper's work).

In sodic soils, a reduction in mechanical disturbance caused by cultivation and an increase in organic matter will reduce dispersion and improve infiltration and water conductivity.

Trial for Murray Valley conditions

A trial was conducted to evaluate the performance of a number of direct drill implements for sowing wheat into a range of soil and stubble conditions typical of rice farming systems in the Murray Valley. Nine implements were evaluated (Table 1). Seven were some form of disc opener and two were tyned implements.

The McCaughey Memorial Institute cone seeder was used to sow the trial. Each implement was set up on the tool bar undercarriage at its optimal operating height and pressure. Different implements had different operating heights so implements 1 to 4 (Table 1) were set up on one toolbar, implements 6 to 9 on another toolbar and implement 5 was trialed separately.

The implements were trialed in two soil types. A red-brown earth at NSW Department of Primary Industries' Murray Valley Field Station and a non self-mulching grey clay adjacent to the Box Creek on Michael Hughes property *Kalawar*, Morago.

Three "stubble" conditions were evaluated at the Murray Valley Field Station:

- uncultivated, unirrigated soil with early growth of annual pasture (mainly grasses)
- standing rice stubble (40 cm high) left unburnt
- standing rice stubble (40 cm high) burnt

At *Kalawar*, the previous season's rice stubble had been cut and burnt.

Seventy grams of wheat seed (var. Chara) was sown through each implement over a 40m length of run. This is equivalent to a sowing rate of 100 kg/ha for a 17.5 cm (7") row spacing or 75 kg/ha for a 22.5 cm (9") row spacing. Sowing took place over three days (16, 19 and 21 July).

Soil samples were collected for volumetric water content and bulk density at each site at the time of sowing (Table 2). A cone penetrometer was also used to obtain readings of soil strength in the seed bed at the same time (Table 2).

Establishment counts were done once plants had reached the 2-leaf stage. The number of plants in a metre of row were counted every second metre along an 11 m section of each sowing row. This gave six counts for each implement and these were averaged (Figure 1). The variability of sowing with each implement was assessed by calculating the coefficient of variability from the establishment count data (Figure 1).

Tyned implements better

Soil moisture, bulk density and soil strength at the three rice stubble sites were similar (Table 2). The main difference between these three sites was the amount of stubble that the implements had to handle. The non self-mulching clay site has heavy clay topsoil whereas the red-brown earth has loam topsoil and this made a slight difference in the amount of “smearing” and the degree to which the press wheels were able to close up the sowing rows behind the disc openers.

The bulk density and soil strength at the uncultivated, annual pasture site was significantly greater than the other three sites. This was particularly reflected in the establishment counts from implements 2, 3 and 7, none of which could exert sufficient downward pressure for soil penetration so they ended up dropping the seed near the soil surface. All three of these implements are only recommended for “soft” conditions (see Table 1).

In general, the growth of seedlings that were sown with the tyned implements was much better than those sown with disc openers at all sites. Seedling growth in the standing rice stubble was very slow and young plants were spindly and weak.

Horses for courses

The observations for each implement made at the time of sowing are presented in Table 3.

Sowing implements are designed and manufactured to suit particular soil and crop types. In making the previous observations and the following conclusions, bear in mind that they only apply to the situations encountered in this trial and may not be transferable to other soils and crops. **In no way does any opinion expressed in this report constitute an endorsement of a particular implement.**

Examination of the establishment count data shows that no implement was clearly best across all situations (Figure 1). However, the Stubble Warrior (#5) was the most consistent performer and it did appear that tyned implements gave better results in heavy, wet soils because of the tilth created in the sowing row (trash clearance was a big issue with the Janke implement #1). The Barton disc opener (#6) had excellent trash handling ability, as demonstrated in the standing rice stubble. However, like all the disc openers, there was the tendency to smear the furrow slice in moist heavy clay soil and this led to problems with seed-soil contact, excess moisture in the furrow leading to seed death, and excessive cracking along the sowing line later in the season.

Table 4 is a subjective assessment of implement performance, based on the number of plants established and the variability in the establishment. Where establishment rates were similar, the least variable performer was chosen because it was assumed that sowing rate could be increased to improve performance but variability would remain unchanged.

Acknowledgements

Thanks to Russell Ford and the McCaughey Memorial Institute, Jerilderie, for the loan of the cone seeder and the implements used in this trial; to Lawrie and Michael Hughes for the use of the site at Kalawar and for organising the Field Day on the 21 July; and to Jim Small and Don Griffin for their help in conducting the trial.

Table 1: Descriptions of the direct drill implements evaluated for a range of soil and stubble conditions in the Murray Valley. The price per implement is ex GST and was correct as of early 2004.

Implement #	Implement	Configuration	Depth control	Recommended tillage conditions	Manufacturer	Price per unit
1	Janke Achiever Series 1	parallelogram, twin disc opener, twin angled press wheel	side wheel & press wheel	Precision sowing soft	Janke, Australia	2957
2	Janke Double Disc	parallelogram, twin disc opener, flat press wheel	press wheel	Minimum till soft	Janke, Australia	566
3	Great Plains Parallelogram	parallelogram, twin disc opener, rounded press wheel	press wheel	Minimum till soft	Great Plains, Kansas, USA	-
4	Janke Std Parallelogram knife	parallelogram, culti, tyne & knife, v-shape press wheel	frame	Minimum till firm	Janke, Australia	2597
5	Stubble Warrior	twin disc opener & tyne, flat press wheel	side wheel & press wheel	Minimum or no till firm/hard	DTS Mechanical Design, Australia	2075
6	Barton Disc Opener	single slanted disc opener, v-shape press wheel	side wheel & press wheel	Minimum or no till firm/hard	Flexi Coil	1400
7	Great Plains Basic	twin disc opener, rounded press wheel	press wheel	Minimum till soft	Great Plains, Kansas, USA	-
8	Great Plains Double Disc	parallelogram, twin angled press wheel	side wheel & press wheel	Minimum till firm	Great Plains, Kansas, USA	-
9	Stubble King	parallelogram, rounded press wheel	press wheel	Minimum till firm	P.H.M Pty Ltd, Australia	939

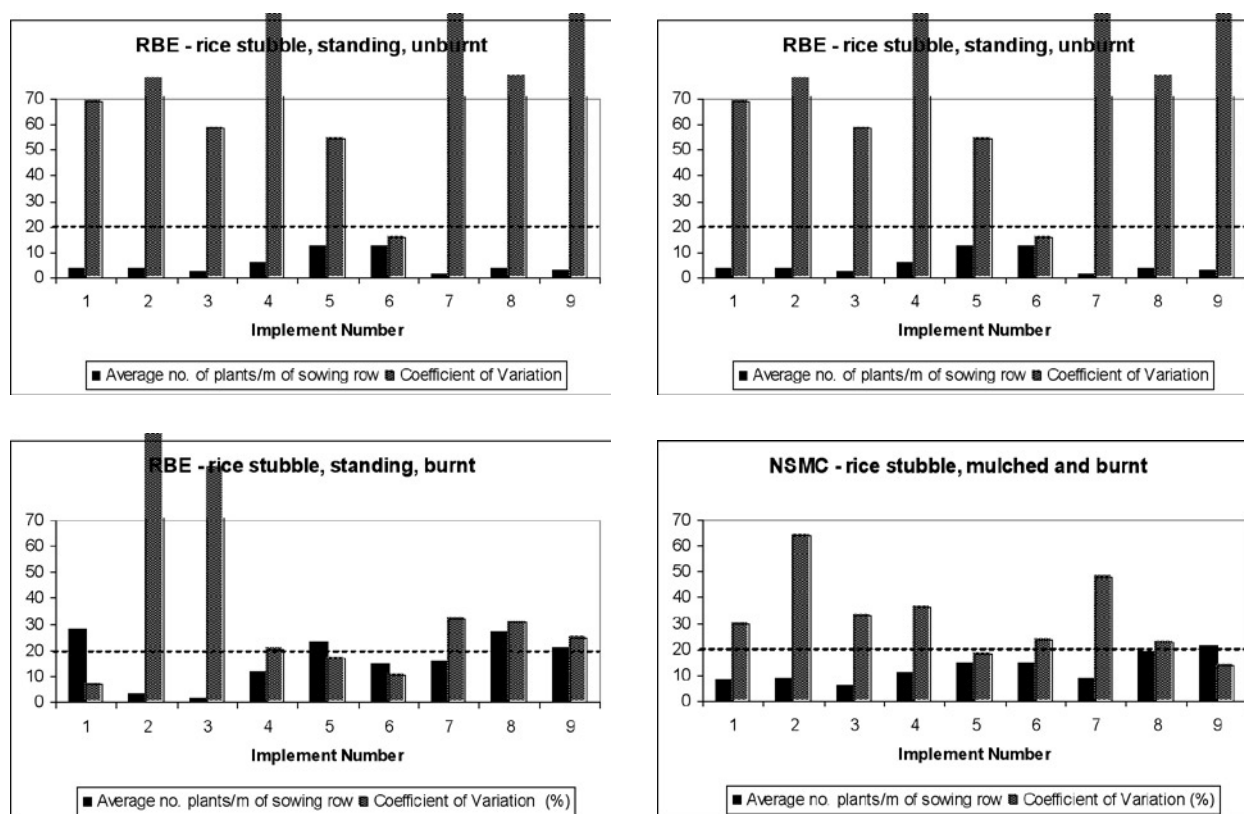


Figure 1. The average number of plants established per metre of sowing row and the variability of the establishment at each site. 20 plants per metre of sowing row is equivalent to 115 plants/m² for a 7" row spacing. A Coefficient of Variation of 20% is considered a maximum limit, above which the results within a treatment are considered too variable to attribute to the particular treatment.

Table 2: Results of soil sampling in the top 5 cm of the profile at the time of sowing

Soil type & treatment	Sowing date	Bulk density (g/cm ³)	Soil strength (kPa)	Volumetric water content
RBE, uncultivated, unirrigated, pasture	16 July	1.45	1638	18 %
RBE, standing rice stubble, unburnt	19 July	1.10	924	27 %
RBE, standing rice stubble, burnt	19 July	1.19	767	27 %
NSMC, rice stubble cut and burnt	21 July	1.13	830	24 %

RBE = red-brown earth, NSMC = non self-mulching clay

Table 3: Observations of the operation of each implement made at the time of sowing

Implement	Sowing depth (cm)		Comments
	pasture	rice	
1	5.0	5.0	Press wheel didn't close the furrow slice in standing stubble because the machine rode up on rice crowns. Wherever there was stubble at the NSMC site, no plants emerged.
2	surface	4.0	These two were too light – not enough pressure for ground penetration in dense soils and not enough pressure from press wheel to close the furrow slice in wet rice soil.
3	surface	4.0	
4	5.0	5.5	Excessive trash built up on the tyne in heavy stubble.
5	5.0	5.5	Excellent trash clearance. Created a wide furrow which moved some of the stubble out of the way.
6	5.5	6.0	Excellent straw and trash handling ability, BUT the establishing plants were very thin and weak. Sowing was at shallowest setting but still possibly too deep.
7	surface	0.5	The performance of these three implements was very similar. Soil penetration and seed coverage was poor in the denser soil at the pasture site. They all handled trash well and achieved good soil penetration at the rice sites. The double press wheel (#8) gave better furrow closure in the rice sites than the single press wheel (#7 and #9).
8	0.5 – 1.0	3.5	
9	0.5 – 1.0	2.0	

NSMC = non self-mulching clay

Table 4: Assessment of implement performance based on the number of plants established and variability of establishment

Treatment	Best	Acceptable	Worst
RBE, uncultivated, unirrigated, pasture	5	6, 9 then 4	2 & 3
RBE, standing rice stubble, unburnt	6	5	the rest
RBE, standing rice stubble, burnt	1 & 5	6 then 8 & 9	2 & 3
NSMC, rice stubble cut and burnt	9 & 5	8 then 6	2 & 7

RBE = red-brown earth, NSMC = non self-mulching clay