Boorhaman and Norong stubble trials 2009

WRITTEN BY

Dale Grey Department of Primary Industries Victoria, Cobram

Location: Boorhaman and Norong, Victoria

Growing season rainfall:
- **Boorhaman average annual:** 582mm
- **2009:** 379mm
- **Boorhaman average GSR:** 379mm
- **2009:** 300mm
- **Norong average annual:** 538mm
- **2009:** 349mm
- **Norong average GSR:** 350mm
- **2009:** 245mm

Soil:
- **Boorhaman:** Red loam over medium clay
- **pH ($CaCl_2$):** 5.0
- **Organic Carbon (OC):** 1.3%
- **Norong:** Grey loam over medium clay
- **pH ($CaCl_2$):** 4.8
- **OC:** 1.6%

Sowing information:
- **Fertiliser (Boorhaman):** 70kg/ha MAP
- **Fertiliser (Norong):** 80kg/ha MAP

Paddock history:
- **Boorhaman**
- **2008** — canola
- **2007** — triticale
- **2006** — wheat
- **Norong**
- **2008** — wheat
- **2007** — lupins
- **2006** — triticale

Plot size: 100 x 9m

Replicates: nil

KEY POINTS

- **Standing stubble did not reduce yield.**
- **The Norong site showed an excellent yield response to standing stubble during 2009.**

Aim

To test the effect of different stubble treatments on crop performance over time.

Method

Stubble treatments were imposed during autumn. The crop was sown with the farmer's air seeder and harvested using an auto header with a weigh bin.

The Boorhaman site trial used fungicide-treated fertiliser. The Norong site had fungicide sprayed during September and October.

Results

The Boorhaman site showed excellent yields with no yield benefit of stubble retention — the incorporated stubble plot yielded marginally higher (see Table 1). At this site, incorporated stubble has yielded highest on two previous occasions.

Gregory wheat was sown 15 May 2009 into 2.0 tonnes per hectare canola stubble on 30 centimetre spacings and harvested on 7 December 2009.

TABLE 1 Boorhaman yields under various stubble treatments, 2009

Boorhaman	Grain (t/ha)
Standing	4.0
Mulched (mown)	4.0
Incorporated	4.3

The stubble incorporation treatment yielded the lowest at the Norong site and the standing stubble treatment yielded the highest (see Table 2). This is the first year that standing stubble has been superior at this site.

Prime 323 triticale was sown 15 May 2009 into 4.3t/ha wheat stubble on 25cm spacings and harvested 15 December 2009.

TABLE 2 Norong yields under various stubble treatments, 2009

Norong	Grain (t/ha)
Mulched (Coolamon harrows)	2.7
Burnt	2.6
Standing	3.0
Mulched/incorporated	2.4

Discussion

The Boorhaman stubble management project started during 2005. The Boorhaman site completed its fifth year and the Norong site its fourth year of stubble treatments during 2009.

Sponsors

Farmer co-operators: Damian O'Keefe, Boorhaman and Neville Tweddle, Norong.

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Variety demonstration – Picola district

WRITTEN BY

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Location: Kotupna, Victoria

Growing season rainfall:
- **Annual:** 414mm
- **2009:** 256mm
- **GSR:** 269mm
- **2009:** 182mm

Soil:
- **Type:** Grey loam over medium clay
- **pH (H_2O):** 5.6
- **pH ($CaCl_2$):** 5.1
- **Organic Carbon (OC):** 2.1%
- **Colwell P:** 56

Sowing information:
- **Sowing date:** 27 May 2009
- **Fertiliser:** 40kg/ha Nutrismart/MAP 50:50
- **Harvesting date:** 7 December 2009
- **Row spacing:** 30cm

Paddock history:
- **2008** — canola
- **2007** — barley
- **2006** — wheat

Plot size: 80 x 9.1m

Replicates: 'nearest neighbour' trial design

KEY POINT

- **This year's trial was too variable to be of much value.**

Aim

To test some recently-released wheat varieties in a low-rainfall region near Picola, in Victoria's north-east.

Method

Strips of different varieties were sown with the farmer's air seeder and harvested using an auto header with a yield monitor. Fungicide was not applied throughout the year.

Results

See Table 1.

Observations and comments

This trial's check variety was variable across the site. Few conclusions can be drawn from the data. The yields didn't seem to favour any particular maturity grouping. In the previous year's trial early and early-mid maturity groupings performed best.

Sponsors

Farmer co-operators: Murray and Denise Gilby, Kotupna.

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TABLE 1 Yield results from the Picola variety demonstration

Variety	Maturity	Maximum quality classification	2010 stripe rust rating	Yield (t/ha)
Derrimut	Mid	AH	MS/R*	2.35
Axe	Very early	APW	R-MR	2.27
Correl	Mid	AH	MR-MS	2.27
Gascoigne	Mid	APW	R-MR	2.14
Ruby	Mid	ASW	S/R-MR#	2.02
Ventura (average of four)	Early	AH	MS/MR-MS*	1.91
Gregory	Mid-late	APW	MR	1.76
Catalina	Mid	AH	MS	1.73
Lincoln	Mid	AH	R-MR	1.69
			CV=	10.8%
			F prob=	0.473NS
			LSD=	1.3t/ha

R= Resistant; MR = Moderately resistant; MS = Moderately susceptible; S = Susceptible
#S to the "Jackie YR27" strain, *S to the "WA YR17" strain, provisional.

Wheat variety and phosphorus demonstration — Miepoll

WRITTEN BY

Dale Grey Department of Primary Industries Victoria, Cobram

Location: Miepoll, Victoria

Growing season rainfall:
- **Annual:** 601mm
- **2009:** 367mm
- **GSR:** 398mm
- **2009:** 251mm

Soil:
- **Type:** Grey loam over heavy clay
- **pH (H_2O):** 5.8
- **pH ($CaCl_2$):** 5.1
- **Organic Carbon:** 1.64%
- **Colwell P:** 31
- **Phosphorus buffering index (PBI):** 120

Sowing information:
- **Sowing date:** 2 June 2009
- **Fertiliser:** 100kg/ha DAP
- **Harvesting date:** 23 December 2009
- **Row spacing:** 17.5cm

Paddock history:
- **2008** — oats
- **2007** — oats
- **2006** — pasture

Plot size: 80 x 7.6m

Replicates: 'nearest neighbour' trial design

KEY POINT

- **Early-maturing varieties generally yielded higher.**
- **EGA Gregory has performed credibly during the past three years.**
- **A phosphorous response of 37% occurred with 20 kilograms per hectare of phosphorus.**

Aim

To test some recently-released wheat varieties in a higher-rainfall region of north-east Victoria.

Method

Strips of different varieties were sown with the farmer's air seeder, harvested using an auto header and weighed in a weigh-bin. Two strips were sown with the fertiliser turned off. No fungicide was applied throughout the year.

Results

See Tables 1 and 2.

Observation and comments

This trial's check variety (Ruby) was variable across the site. Only general conclusions can be drawn from the data.

Early-maturity varieties yielded the most during this trial and this could be expected given the later sowing time and the high grain-filling temperatures during November. The exception is Gregory, which seems to be well adapted to this area irrespective of season. Sown late and with a fair Colwell P of 31 milligrams per kilogram, this site responded well to applied phosphorous (P) with a 37% yield increase for the 20kg/ha of phosphorus applied.

Sponsors

Farmer co-operators: Albert and Mervyn Gough, Miepoll.

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TABLE 1 Variety information and yield data

Variety	Maturity	Maximum quality classification	2010 stripe rust rating	Yield (t/ha)
Axe	Very early	APW	R-MR	3.45
Gregory	Mid–late	APW	MR	3.25
Ruby (average four)	Early–mid	ASW	R-MR#	3.15
Sentinel	Mid–late	ASW	R-MR	3.08
Lincoln	Mid	AH	R-MR	2.98
Preston	Mid–late	ASW^	R-MR	2.88
Bolac	Mid–late	AH	R-MR	2.69
Gascoigne	Mid	APW	R-MR	2.68
Derrimut	Mid	AH	MS*	2.51
			CV=	4.4%
			F prob=	0.087 NS
			LSD=	0.59t/ha

R= Resistant; MR = Moderately resistant; MS = Moderately susceptible; S = Susceptible
#S to the “Jackie YR27” strain, *S to the “WA YR17” strain, ^provisional.

TABLE 2 Yield response to phosphorus fertiliser

	Yield (t/ha)	Fertiliser response
Ruby + 20kg P	2.34	37%
Ruby – 20kg P	1.71	

New inoculants provide options for grain legumes

WRITTEN BY
Matthew Denton Department of Primary Industries Victoria, Rutherglen

Aim

The aim of the experiments was to test the ability of granular inoculants to form nodules on a range of grain legumes in comparison with un-inoculated and standard peat slurry inoculants.

Background

The delivery of root nodule bacteria (rhizobia) inoculants by peat slurry application is an effective means of inoculation but some growers consider the procedure to be troublesome and time-consuming. A number of new delivery formulations promise greater ease of application and can eliminate the need for manual seed inoculation. These new inoculant formulations are likely to provide growers with user-friendly methods for storage and delivery of root nodule bacteria to legumes.

A range of granular carriers and freeze-dried products is available to meet these objectives. Granular formulations containing rhizobia are usually applied at sowing in a similar way to grain or fertiliser. Freeze-dried rhizobia can be applied directly to seed, or can be injected as a liquid in the drill rows during sowing.

KEY POINT

- **Recent trials testing a range of new grain legume inoculants revealed that inoculation improved the growth of legumes.**
- **Inoculation response was dependent on the previous history of legume and inoculant use.**
- **Granular inoculants differed markedly in their ability to nodulate a range of grain legumes**
- **Grain yields increased with greater nodulation.**

Since these inoculants have not had widespread use, the aim in this study was to test these new formulations and their effect on nodulation of grain legumes in Australian soils.

This report documents trials that have been carried out at a number of sites in Victoria and southern New South Wales.

Method

Plots were sown in randomised complete blocks with 3–4 replicates.

Rates and application procedures were carried out according to manufacturer recommendations.

Granular inoculants were applied to the soil at the same depth as the seed or approximately 50 millimetres below the seed. All experiments were sown into moist soil using an eight-row cone seeder, with 18 centimetre row spacing, to establish plots of 10–15 metres in length.

Care was taken to minimise contamination between treatment plots during sowing and sampling by decontaminating the cone seeder and sowing tubes with ethanol between treatments.

Weeds, insects and fungal pathogens were controlled by chemical spray applications, as required, at rates according to manufacturer's recommendations.

Table 1 identifies treatments used in the trial.

Results

Nodule number and mass, herbage and grain yield were frequently improved in response to inoculation with a range of different rhizobial formulations (see Table 2). Nodule numbers increased from un-inoculated plots after inoculation with attapulgite granules, freeze-dried rhizobia and peat applied as a slurry, or injected into furrows. Peat slurry on seed and peat injected into furrows provided the highest yields, along with freeze-dried rhizobia on seed.

TABLE 1 A list of the treatments used to inoculate legumes

Treatment	Description
Alosca 10	Alosca bentonite clay granule sown @ 10kg/ha with seed
Becker 6	Becker Underwood attapulgite granules sown @ 6kg/ha with seed
NZ 5.6	Novozymes peat granules sown @ 5.6kg/ha with seed
New Edge in furrow	New Edge Microbials (freeze-dried rhizobia) was diluted at a rate of one vial per 500kg seed and injected by nozzles @ a rate of 50L/ha into drill rows at sowing
New Edge on seed	New Edge Microbials (freeze-dried rhizobia) slurry applied to seed at a rate of one vial to 500kg seed.
Peat inject	Peat slurry was applied at a rate based on 250g of peat applied to 100kg of seed, and injected into drill rows @ a rate 50L/ha
Peat slurry	Peat slurry applied to seed
Nil	No rhizobia applied

TABLE 2 Nodulation, herbage and grain yields of Faba bean cv. Farah in response to inoculation with a range of peat slurry, granules and liquid inoculant formulations or un-inoculated treatments (nil)

Treatment	Nil	NZ 5.6	Alosca 10	Becker 6	New Edge on seed	New Edge in furrow	Peat slurry	Peat inject	LSD*
Nodule number per plant	0.7	2	4	13	32	10	63	30	10
Nodule DM (mg/plant)	16	57	119	311	489	253	681	401	142
Herbage (kg/ha)	3666	4135	4356	3995	4726	4166	4824	4815	955
Grain yield (t/ha)	0.94	1.17	1.19	1.13	1.28	1.28	1.42	1.37	0.238

*LSD — Least significant differences indicate where statistically significant differences were observed.

Data from 37 different trials carried out in Victoria and southern NSW showed that in south-eastern Australia, peat slurry is still the most effective way to inoculate legume crops (see Figure 1). This result is mainly due to higher number of rhizobia delivered close to the emerging root zone using peat slurry (mean 7.1 x 10^8 rhizobia per gram of product) compared with peat granules (5.3 x 10^7), attapulgite granules (1.5 x 10^6) and bentonite granules (8.1 x 10^5) used in the experiments.

The granules worked best when sown with the seed. Granules did differ markedly in their ability to form nodules on a range of legumes with peat and attapulgite granules providing greater nodulation than bentonite granules (see Figure 1).

Better nodulation usually translated to greater grain yield.

Observations and comments

The results from this research indicate the value of inoculating with effective rhizobia, which resulted in increased nodulation, herbage and grain yields compared with un-inoculated treatments.

Even greater benefits between well-nodulated treatments would be expected in a year with sufficient spring rainfall.

Increased herbage will translate to greater nitrogen availability to the following cereal or oilseed crops and will provide a benefit in reducing the need for nitrogenous fertilisers. Growers now have a greater choice of rhizobial formulations that differ in their requirements for storage, application and performance.

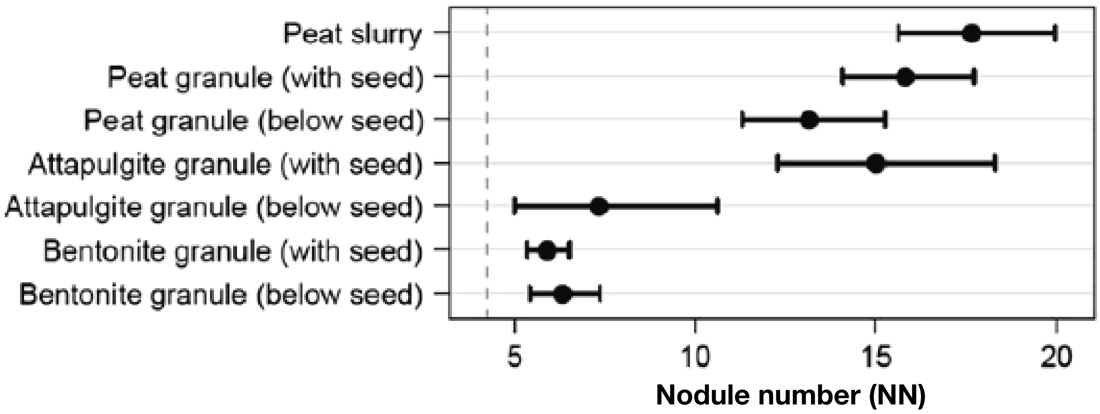

FIGURE 1 Mean nodule numbers estimated from 37 different field experiments that used faba bean, lupin, lentil, chickpea and field pea in Victoria and southern NSW from 2003 and 2007

Source: Denton *et al*. 2009, *Soil Biology and Biochemistry*, 41, 2508-2516

The results of field trials show that optimal root nodulation is required to provide the best herbage and grain yields. Cumulative results from the past five years indicate that granules with high counts of rhizobia provide nodulation and yields similar to peat slurry applied inoculants. Those with low counts typically limit nodulation and yield.

Take home messages

- **Inoculation is inexpensive** — if in doubt, always inoculate with fresh AIRG*-approved inoculants.
- **Use the correct inoculant for the legume** — Each legume needs to be matched with its correct inoculant group or total nodulation failure will occur.
- **Always sow inoculated seed within 24 hours** — Root nodule bacteria numbers rapidly decrease after being applied to seed. Sow as soon as possible to ensure effective nodulation.
- **Root nodule bacteria are living organisms** — They can die from exposure to high temperatures and contact with chemicals.
- **Careful consideration is required when selecting a root nodule bacteria product** — Examine recent trial results comparing these products.

**AIRG is the Australian Inoculant Research Group, Gosford NSW DPI.*

Sponsors

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Residual herbicides at sowing using disc and tine no-till seeding equipment

WRITTEN BY

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During the shift from conventional farming systems to no-till farming systems, the effective use of herbicides has become increasingly important.

A well-planned herbicide strategy can mean the difference between making no-till work or not.

During the past 5-6 years, it has become apparent that the rapid change in farming systems has overtaken farmer knowledge on how to use many herbicides in conservation farming systems. Older, more traditional herbicides that were designed for use in cultivated systems can still be used effectively in no-till systems, however they are usually used in a different manner.

In addition, many herbicide labels (especially older type or generic herbicides) still have the same content on the label today as it did 10-15 years ago. Some products with generic counterparts even have totally different label claims for the exact same active ingredient. This creates many issues for growers and agronomists wanting to use these herbicides in our modern no-till farming systems.

KEY POINTS

- **Residual herbicides are essential in sustainable no-till farming systems.**
- **Knowing the properties of each residual herbicide is essential for the desired combination of crop safety and weed control.**
- **Incorporated by sowing (IBS) application of residual herbicides generally allows greater crop safety than post-sowing pre-emergent (PSPE) applications, and has made higher application rates possible. These higher rates have advantages of combating stubble tie up, extended incorporation windows, increased efficacy and broader weed spectrum, for example TriflurX®.**
- **Tine machines generally allow greater crop safety than discs.**
- **IBS in discs is much safer than PSPE in discs.**
- **Many herbicide labels have not changed as our farming system has evolved.**

This is especially the case in break crops such as chickpeas, lupins and fieldpeas, where we are nearly always trying to sow them into standing stubble.

As a response to this issue, a number of trials and demonstrations have been carried out by district agronomists during 2007, 2008 and 2009 in conjunction with local grower groups and herbicide company technical support staff, aiming to

a. Educate growers on how various herbicides work in the field in no-till cropping systems (mode of action — MOA).

b. How to use each herbicide most effectively with different sowing equipment (knife points and harrows vs knife points and press wheels vs discs).

c. Gain an understanding of the effectiveness of each herbicide in each use situation (crop safety and weed control).

d. Obtain data to support herbicide permit applications or label changes.

Trial outcomes

The main outcomes from these trials and paddock experiences are:

- Residual herbicides at sowing are effective at controlling a wide range of weeds both in crop and well into the following summer.
- Some residual herbicides also have valuable knockdown properties. This is useful because knockdown herbicide options before sowing are limited for hard-to-kill weeds.
- Knowing the chemistry and MOA of each herbicide is paramount to enable the best combination of crop safety and weed control. Heavy rainfall just after sowing, when combined with certain soils, can lead to crop damage.
- Some herbicides are mobile with soil water, while others are less mobile. Mobility can also change with time for particular herbicides. For example

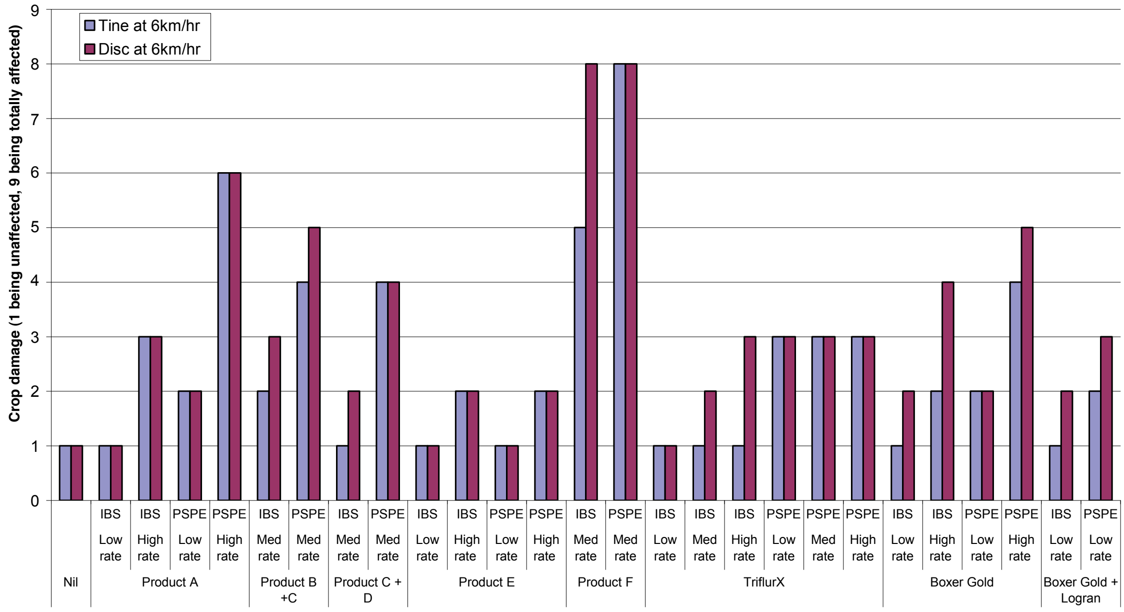

FIGURE 1 Comparison of crop safety in Ventura[A] wheat using an NDF swing arm disc (27.3cm rows) vs Morris Contour drill tine (25cm rows) on red sandy loam soils at Rankins Springs, 2009.

This trial had 15mm of rain just after sowing, and another 15mm just before emergence.

**Note that Products A to F are not registered for this use pattern and cause significant damage to wheat, and hence aren't named. These herbicides were added to the demonstration to highlight crop safety differences between IBS, PSPE and seeding equipment.

with Boxer Gold®, the longer it is allowed to bind to soil particles, the less chance of the herbicide becoming mobile in the soil. Other herbicides, such as Logran®, are mobile regardless of binding period.

- IBS application technique seems to be the safest way of using most residual herbicides, as the seed furrow is left free of high concentrations of herbicide. The soil from that furrow is thrown on the inter-row, where it is needed the most. In-furrow weed control is generally achieved by crop competition and/or small amounts of water soluble herbicides washing into the seed furrow. For this reason best results in IBS application are when water soluble herbicides are used either solely or in conjunction with a less soluble herbicide.
- Because of the furrow created by most no-till seeder, PSPE applications of many herbicides are not ideal and are usually not supported by labels, as the herbicides can concentrate within the seed furrow if washed in by water and/or herbicide treated soil. Obviously for volatile herbicides that need incorporation following application, PSPE is not a viable option.
- Tine seeders vary greatly in their ability to effectively incorporate herbicides. There are many tine shapes, angles of entry into the soil, breakout pressures, row spacings, and soil surface conditions. Each of these factors causes variability in soil throw, especially when combined with faster sowing speeds more than eight kilometers per hour). Consequently, residual herbicide incorporation is quite variable between each seeder. There are therefore no rules of thumb for sowing speed, row spacing and soil throw. Check each machine in each paddock.
- Disc machines show similar variability in their ability to incorporate herbicides. Disc angle, number of discs, disc size, disc shape, sowing speed, closer plates and press wheels all have an impact on both soil throw and also herbicide treated soil returning into the seed furrow. Some discs can throw enough soil for incorporation of herbicides such as trifluralin.
- In all cases with tines and discs, crop safety is usually enhanced by applying herbicides IBS rather than PSPE.
- Knife points and harrows cause a lot of herbicide treated soil to return into the seed furrow, and are therefore not ideally used in IBS application. Knife points and press wheels do a much better job.

** Caution: research on unregistered pesticide use.

Any research with unregistered pesticides or of unregistered products reported in this document does not constitute a recommendation for that particular use by the authors or the authors' organisations. All pesticide applications must accord with the currently registered label for that particular pesticide, crop, pest and region.

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Row spacing, inter-row sowing and phosphorus

WRITTEN BY

Dr Neil Fettell and Dr Guy McMullen Industry and Investment NSW, Condobolin Agricultural Research and Advisory Station and Tamworth Agricultural Institute

Background

The rapid rise in phosphorus prices has led growers to rethink their fertiliser practices. More frequent cropping, higher phosphorus application rates and a run of poor seasons during the past decade have resulted in higher soil phosphorus levels. Furthermore, farming practices have changed significantly with the use of knife points or disc seeders and wider row spacings, resulting in changes to the spatial pattern of fertiliser application and particularly to within-row concentration. These changes could alter phosphorus responses in the year of application. The close proximity of seed to higher starter fertiliser concentrations could enhance early uptake, although in the case of sensitive crops such as canola might depress crop establishment, unless 'double shoot' equipment is used.

KEY POINTS

- **Wider row spacings and higher sowing rates often result in lower crop establishment percentages.**
- **Wider row spacings increase the concentration of phosphorus per metre of row if the rate per hectare is maintained. However, row spacing has had an inconsistent impact on crop phosphorus response in initial trials.**
- **Inter-row sowing at wider row spacings (for example 30 centimetres or more) reduces the availability of residual phosphorus from the previous year's fertiliser. However, even a relatively low rate of phosphorus placed with the seed reduces this effect.**

Since the soil phosphorus tests that growers and advisors use for their fertiliser decisions were calibrated using conventional tillage and narrow row spacings, we are investigating the effect of increasing row spacing, and therefore increasing concentrations of phosphorus in the seed furrow, on phosphorus fertiliser responses.

The changes to the spatial pattern of fertiliser application have implications for soil sampling and for the access of subsequent crops to residual fertiliser. In particular, the use of inter-row sowing (using +/- 2cm RTK autosteer) to improve stubble flow and reduce the proximity of seed to crown rot also results in emerging seedlings being well away from any residual fertiliser from the previous crop. These issues are particularly relevant for barley, yet there is limited information on the phosphorus requirements of this crop.

Row spacing and establishment

There are a number of studies currently examining the responses of cereal and broadleaf crops to row spacing, and also the interaction with plant population. In targeting a desired population, the likely establishment percentage has to be selected. In practice establishment rates rarely exceed 90 per cent and can fall as low as 30% depending on sowing conditions and seed quality. Germination tests do not necessarily give an accurate indication that germinated seed will be able to establish a viable plant.

Row spacing and hence seed spacing can have a significant impact on the establishment of cereals. As row spacing or sowing rate increase, the distance between seeds reduces. This can impact on the final emergence percentage and typical responses are shown for barley sown at Temora and Condobolin during 2009 (see Figure 1).

The Temora trial was dry sown and received rain shortly after sowing whereas the Condobolin trial was sown into moisture, but in both cases establishment percentage declined as seeds were sown more closely together, whether from increasing sowing rate or widening row spacing.

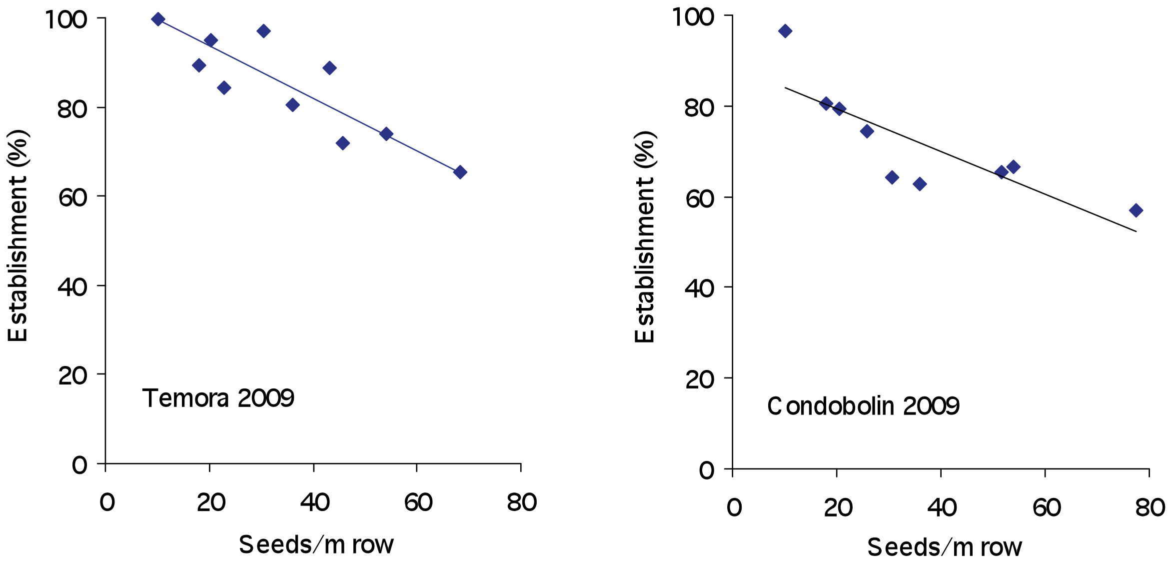

FIGURE 1 Effect of seed spacing on barley establishment percentage at two sites during 2009

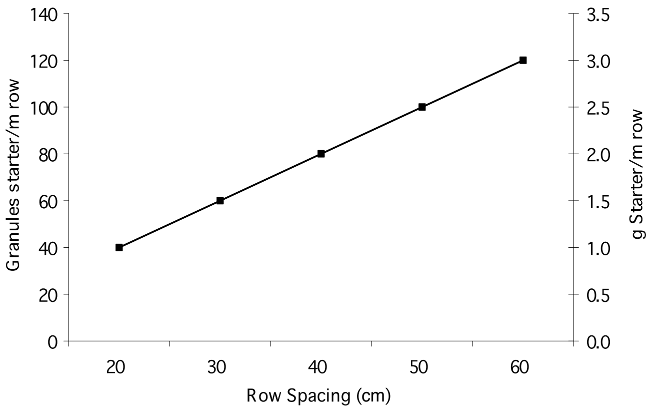

FIGURE 2 Effect of row spacing on the amount of starter fertiliser (50kg/ha applied at all spacings) within the row

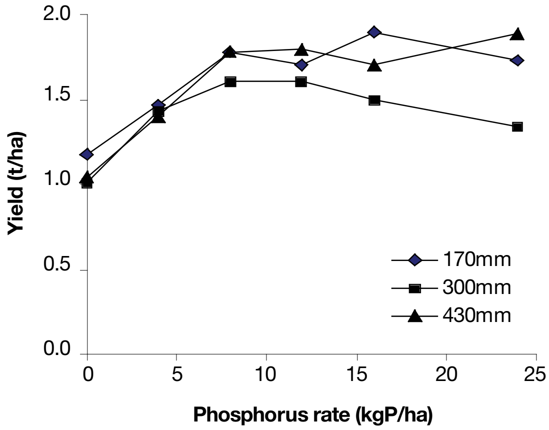

FIGURE 3 Phosphorus response at three row spacings averaged over three cultivars

Phosphorus and row spacing

The effect of row spacing on within-row fertiliser concentration is shown in Figure 2. For a typical MAP rate of 50 kilograms per hectare, increasing row spacing from 20 centimetres to 50cm results in an increase from 40 to 100 granules of MAP per metre of row.

Our current research projects in New South Wales are examining these issues. A trial was established at Condobolin during 2008 on a site that had been under pasture for about five years and had a moderate–low (22 milligrams per kilogram Colwell P) soil phosphorus level. There was some stored water at sowing but late winter and spring rainfall were well below average. Buloke and Hindmarsh barleys and Ventura wheat were compared at three row spacings and six phosphorus rates, using triple superphosphate drilled with the seed.

There was evidence of differing phosphorus response patterns among the three row spacings used, namely 17cm, 30cm and 43cm (see Figure 3). At the 17cm and 43cm spacings, yield increased with phosphorus up to 8kgP/ha and then levelled off, whereas at 30cm yield decreased at phosphorus levels above 12kgP/ha.

There were large differences in early biomass and groundcover within this trial but no yield reduction from the widest row spacing, possibly because of the combination of stored water and low in-crop rainfall.

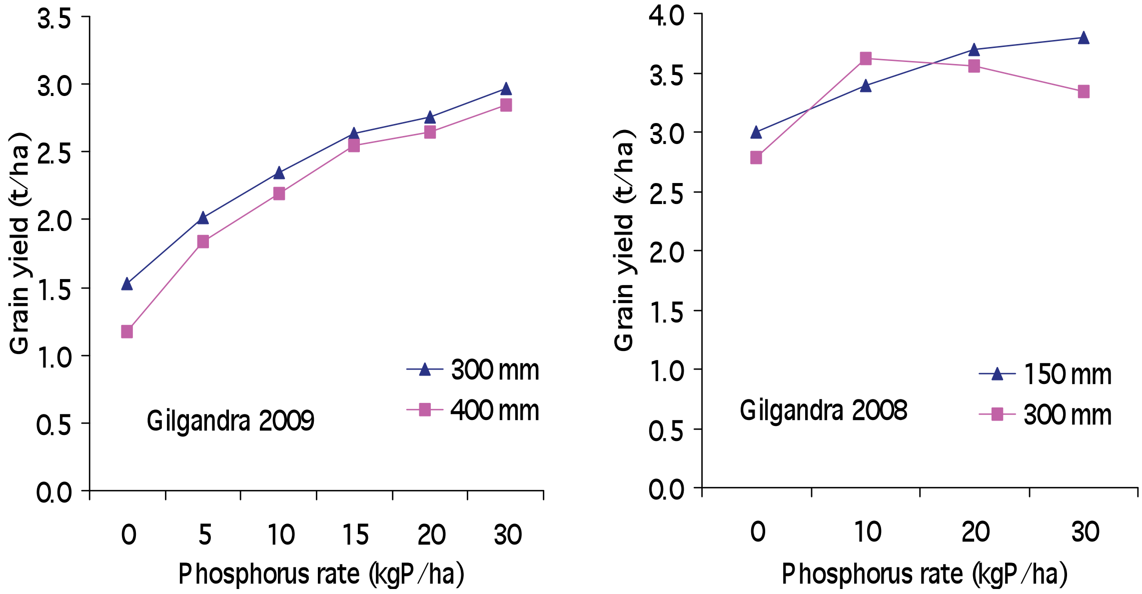

FIGURE 4 Phosphorus response at two row spacings at Gilgandra during 2008 and 2009

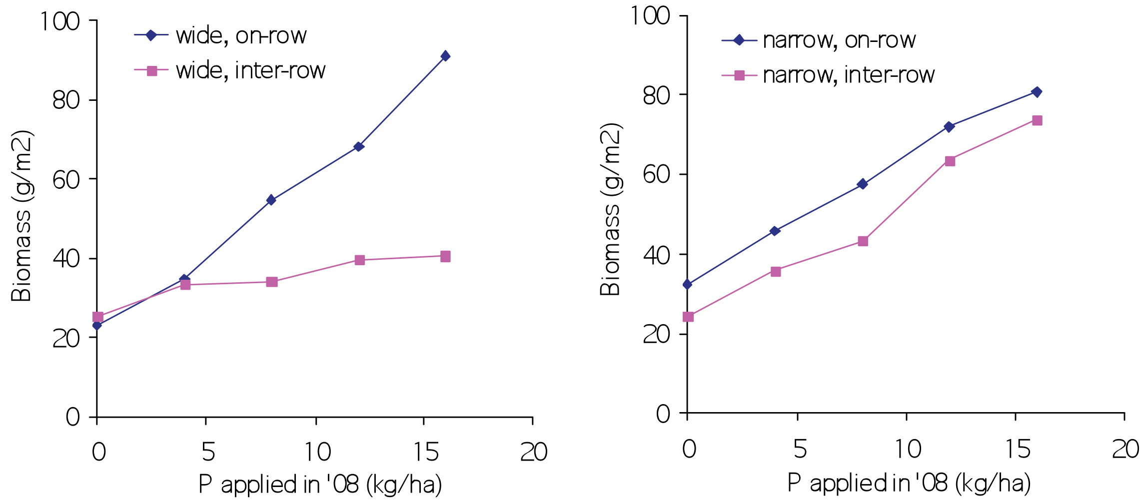

FIGURE 5 Response of early biomass during 2009 to residual phosphorus (from 2008), when on-row or inter-sown in narrow (17cm) or wide (mean of 30cm and 43cm) rows without fertiliser during 2009

Two similar trials at Gilgandra during 2008 and 2009 showed little evidence of row spacing by phosphorus rate interactions (see Figure 4). There appears to be no reason to change phosphorus fertiliser recommendations based on row spacing.

Phosphorus and inter-row sowing

A row spacing by phosphorus trial from 2008 was re-sown during 2009, using 2cm autosteer so treatments of on-row and inter-row sowing were superimposed at rates of nil phosphorus, 4kg/ha or 8kg/ha of phosphorus, using the same row spacing for each plot as used during 2008. The 2008 crops averaged about 1.8 tonnes per hectare and the site was lightly grazed after harvest.

There were marked differences in early growth (biomass at growth stage Z30) in response to both residual and new phosphorus and to row placement.

The responses to residual phosphorus are shown in Figure 5. On narrow rows, biomass doubled in response to the residual fertiliser, and while the on-row treatments were about 12% higher there was no interaction with residual phosphorus.

At the wide row spacing, there was a similar response to 2008 fertiliser as for narrow rows, when the crop was sown onto the 2008 row. However, when inter-row sown there was almost no response to the residual phosphorus. Application of a relatively low rate of fertiliser with the seed was sufficient to reduce this response markedly (data not shown).

Despite the very dry conditions at Condobolin during 2009, the effect of seed row position was still evident at maturity. At the widest row spacing, the inter-row sown plots were able to access some residual fertiliser but yields were lower than for on-row sowing at the higher residual rates, in the absence of extra fertiliser during 2009.

Grains Research and Development Corporation (GRDC) code

DAN0104 —Southern Barley Agronomy

NGA0002

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Row spacing in cereal and broadleaf crops

WRITTEN BY

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Increased interest in no-tillage and stubble retention has focused attention on row spacing. The traditional row spacing in southern New South Wales has been 18 centimetres, but there is a trend for growers to use wider row spacings.

Perceived advantages of wide row spacings include:

- Increased ability of sowing equipment to handle stubble.
- Lower draft of equipment.
- Lower cost of machinery.
- Soil water saved for the grain filling period.
- Faster sowing speeds (as soil throw between neighbouring rows is reduced).
- Ability to use incorporated by sowing (IBS) herbicides, such as trifluralin and pendimethalin, at higher label rates than a conventional system.

Perceived disadvantages of wide row spacings include:

- Slower groundcover of crop.
- Increased evaporation from soil surface.
- Reduced competitiveness with weeds.
- Increased need to band fertiliser, as higher rates of fertiliser can become toxic when concentrated in wider rows.
- Reduced grain yield.

How do wider rows affect yield?

Widening row spacing can reduce grain yield in cereals. However, in low-yielding environments this is not always the case.

There are numerous reports of experiments where increased row spacings lowered yields. However, numerous experiments also have been reported where increasing row spacing did not decrease yield.

Recent wheat trials in southern and central New South Wales show no yield effects of widening row spacing where grain yield was less than 3.5 tonnes per hectare, and significant decreases where yields were more than 3.5t/ha (see Figure 1).

Widening row spacing in canola and lupins does not appear to reduce yield when row space is increased to about 35cm.

Recent experiments in southern NSW have shown no differences in yield of narrow compared with wide row spacing (see Figure 2). The dry conditions of 2007 and 2008 mean we have no recent data on row spacings from high-yielding canola trials.

Retained stubble and row spacing

Reported effects of row spacing with retained stubble show a trend for lower yields at wider spacings (see Figure 3). Retaining stubble resulted in lower yield compared with burning or cultivating, but the difference was reduced at wide row spacings. Data from trials in central west NSW show that retaining stubble can increase grain yield.

Soil moisture evaproation

The effects of row spacing on evaporative loss from the soil vary. French and Schultz (1984) estimated that during an average growing season about 110 millimetres of rainfall was lost through evaporation. Increasing row spacing in wheat from 17cm to 30cm in the Syria variety has been reported to increase evaporation from 183mm to 205mm. Row spacings of 9cm, 18cm, 27cm and 36cm have been reported to have no effect on evaporation from soil surface in wheat crops, with average evaporation being 88mm in two experiments in low-rainfall Western Australia.

Insufficient information is available on the effect of stubble load on soil evaporation.

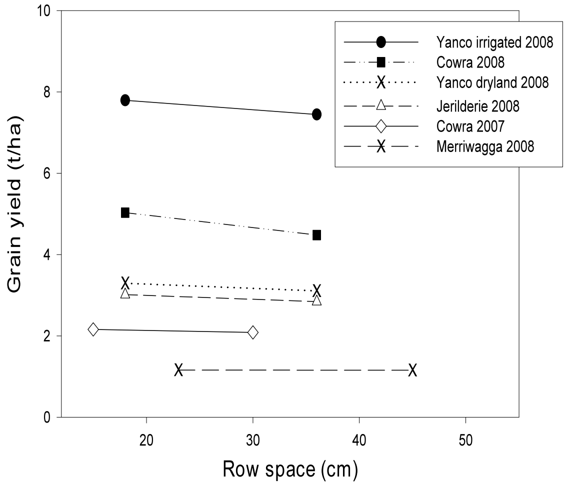

FIGURE 1 Grain yield of wheat row space trials grown in southern NSW during 2007 and 2008

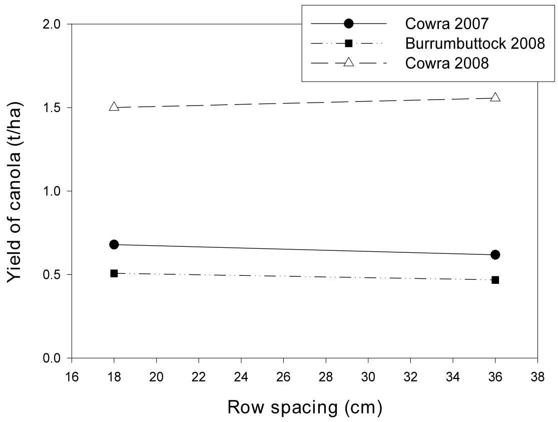

FIGURE 2 Grain yield of canola row space trials grown in southern NSW during 2007 and 2008.

Weed competition

Increasing row spacing reduces the crop's competitive ability with weeds because it increases the space available for the weeds between the rows. Wider row spacing configurations however, do allow higher rates of IBS herbicides such as trifluralin and pendimethalin to be used with tined sowing equipment where a 'hot blanket' of herbicide is incorporated in between the seed rows.

Sponsors

The *Variety Specific Agronomy Packages* (VSAP) project contributed the data in Figures 1 and 2. This project is funded by Industry and Investment NSW (I&I NSW) and the Grains Research and Development Corporation (GRDC).

The significant contributions of Neil Fettell, Guy McMullen, Vince Van der Rijt, Rod Fisher, Graeme Heath, Mat Newell, Elio Minato and Peter Matthews are gratefully acknowledged.

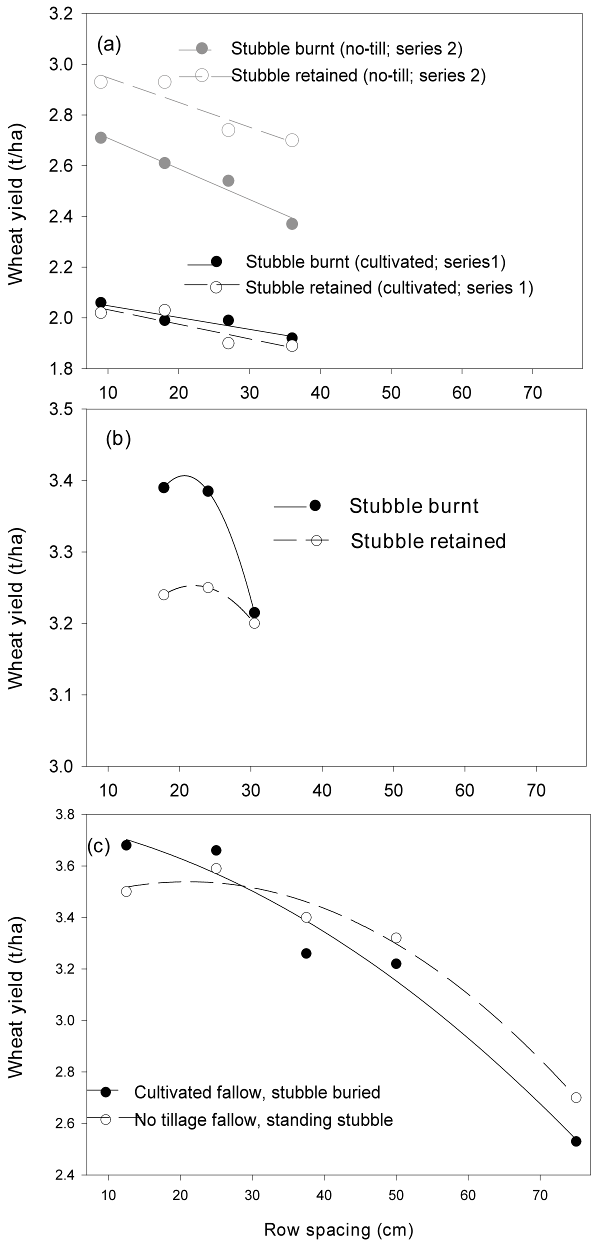

FIGURE 3 Relationships between row spacing in wheat with and without stubble present and grain yield in Western Australia

(a; Reithmuller 2004), central NSW (b; Fettell and Bamforth 1986), and in northern NSW (c; Doyle and Felton 1984). Stubble was on the soil surface and stubble was either burnt (a and b) or stubble incorporated (c).

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Variety specific agronomy package (VSAP) 2009 — wheat row spacing

WRITTEN BY

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Seasonal review:

There was no subsoil moisture following a dry summer. A good break at the end of April led to early sowing. The wheat trial was sown slightly shallow and had an uneven establishment. The winter was warm with adequate moisture, hence there was good growth. Despite the winter rain, crops dried out coming into spring and again a dry spring reduced yields. Hot conditions during grain fill in late October and early November further reduced grain yield and quality.

Location: Burrumbuttock, NSW

Growing season rainfall:
- **Annual:** 252mm
- **GSR:** 203.5mm

Soil:
- **Type:** Red clay loam
- **pH ($CaCl_2$):** 4.63 (to 10cm)
- **Phosphorus:** Bray 24ppm
- **CEC:** 12.6

Sowing information:
- **Sowing date:** 30 April 2009
- **Sowing rate:** 60kg/ha
- **Row spacing:** 18cm, 24cm and 36cm
- **Varieties:** Carinya, EGA Gregory, Ellison, Gladius, Lincoln, Livingston, Sunzell, Ventura

Paddock history:
- **2008** — wheat

KEY POINTS

- **Wider row-spacing reduced plant establishment.**
- **In a dry season row spacing had little impact on yield.**

Aim

To compare wheat establishment and yield at a range of row-spacings.

Method

Each variety was sown on three row spacings 18cm, 24cm and 36cm.

Round-up Power max was applied pre-sowing, no foliar rust spray was applied.

Results

Plant establishment and tiller counts:

Plant establishment was lower for the 36cm row spacing and the 18cm row spacing. These results were probably affected by the shallow sowing.

This was an unexpected result. Tiller counts were lower in the 36cm rows. There was no difference between the 18cm and 24cm row spacing.

Yield:

Carinya, Gladius and Lincoln were the highest yielding varieties. There was no variety by row spacing yield interaction, that is all varieties had the same response to row spacing. The 24cm row spacing had the highest yield followed by the 36cm then 18cm row spacings.

Observation and comments

The wider 36cm row spacing had reduced establishment and yield. The higher establishment of the 24cm row spacing was unexpected. Increasing the number of seeds per metre of row typically reduces establishment. Similar trials have shown that the competition within the row reduces plants per square metre. It is not clear whether the reduced yield from wider rows is a direct result of establishment or of the crop's ability to use the available resources.

The dry season favoured the early-maturing varieties, which generally yielded higher than longer-season varieties. The results on the row spacing were unexpected and influenced by the poor establishment in the 18cm rows and also a plot effect on the 24cm rows where the gap between the 24cm plots was wider than for the other plots. In the dry spring finish this allowed more moisture to be available in the inter plot

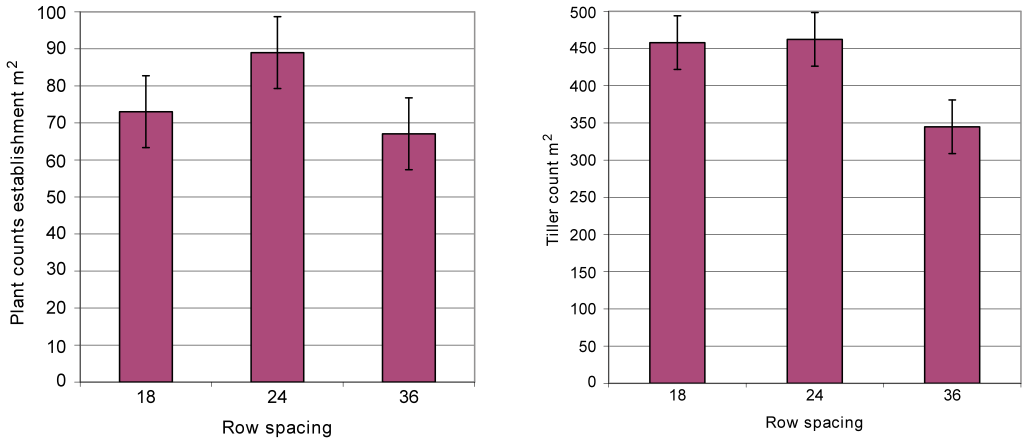

FIGURE 1 Plant establishment and tiller count for 18cm, 24cm and 36cm row spacings

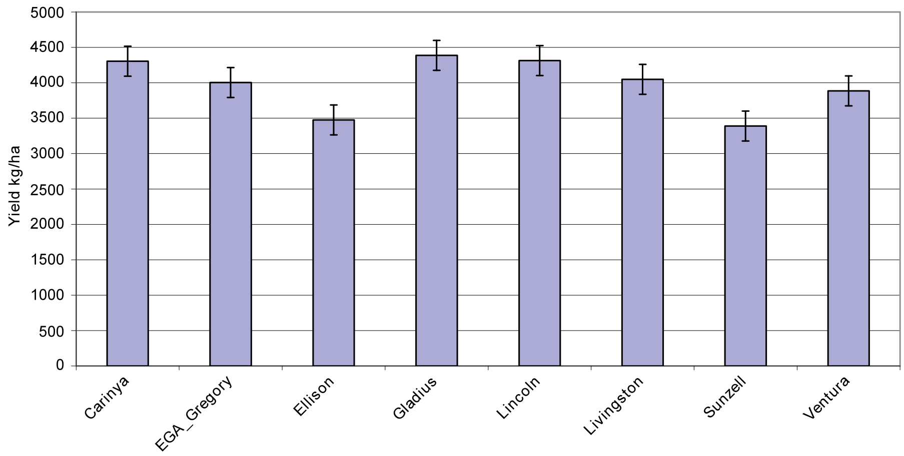

FIGURE 2 Variety yield for 18cm, 24cm and 36cm row spacings

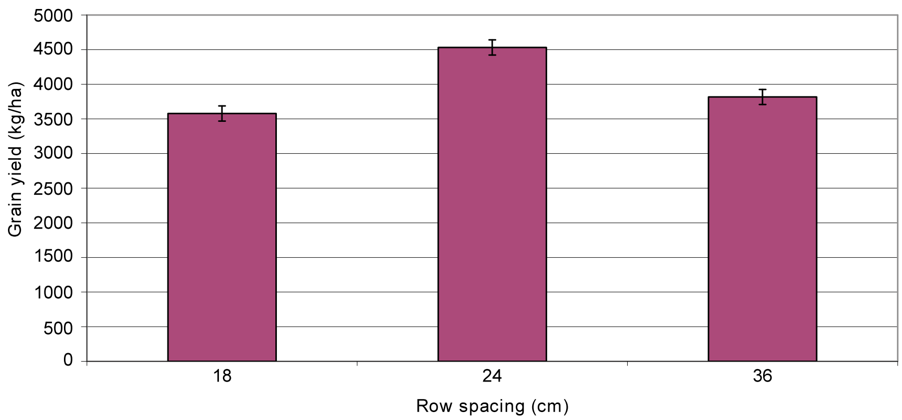

FIGURE 3 Yield response to row spacing

space to finish these plots. This is further backed up by the fact that there was no difference in tiller numbers between the 18cm and 24cm plots suggesting increased moisture at grain fill contributed to the higher yield. Under more favourable spring conditions yield in the 18cm row spacing may be equal or higher that the 24cm row spacing.

Sponsors

West Hume Landcare Group

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Variety specific agronomy package (VSAP) 2009 — canola row spacing

WRITTEN BY

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Seasonal review:

There was no subsoil moisture following a dry summer. A good break at the end of April led to early sowing. There were some problems at sowing with sowing equipment leading to patchy establishment of some plots. Following a warm dry May, the winter conditions were ideal for growth, being warm with adequate moisture. Despite the winter rain, crops dried out coming into spring and again a dry spring reduced yield potential. Rain during mid October led to reasonable yields with high oil content.

Location: Burrumbuttock, NSW

Growing season rainfall:
- **Annual:** 252mm
- **GSR:** 203.5mm

Soil:
- **Type:** Red clay loam
- **pH ($CaCl_2$):** 4.71 (to 10cm)
- **Phosphorus:** Bray 13ppm
- **CEC:** 3.84

Sowing information:
- **Sowing date:** 30 April 2009
- **Sowing rate:** 4kg/ha
- **Row spacing:** 18cm, 24cm and 36cm
- **Varieties:** Barco TT, Hyola 50, Hyola 76, OAsis CL, Tarcool, Tawriffic TT, Oasis CL

KEY POINTS

- **Wider row spacing reduced plant establishment.**
- **In a dry season row spacing had little impact on yield.**

Aim

To compare canola establishment and yield under wider row spacing for ease of sowing into previous cereal stubble under minimum till conditions.

Method

Each variety was sown on three row spacings — 18 centimetres, 24cm and 36cm.

Round-up Power max was applied pre-sowing, Verdict 0.08 was applied for grass weeds in crop and the remainder of the paddock was sown and sprayed for triazine tolerant (TT) canola. Dimethoate was applied for insect control during June.

Results

Plant establishment:

For most varieties plant establishment was lower in the wider row spacing (see Figure 1). The 24cm row spacing was sown first so was more affected by problems with the sowing equipment where all the seed was in one end of the plot — hence the variable numbers for establishment.

Overall the plant establishment was reduced from 58 plants per square metre in the 18cm row spacing to 43 plants/m^2 in the 36cm row spacing.

Yield:

In most varieties there was no difference in yield between the two row spacings. Early-maturing variety Hyola 50 yielded highest. There was no difference in the yield of other varieties. Again, the 24cm row spacing had the highest yield, probably due to the edge effect of wider gaps between the plots (see Figures 2 and 3).

Observation and comments

Despite the effects of problems with uneven sowing caused by a fault with the sowing equipment, the establishment figures for the row spacing were consistent with other (variety specific agronomy package) VSAP trials. The wider 36cm row spacing had reduced establishment compared with the other options. This result has been similar across a number of sites where the competition from a higher number of plants within the row reduces overall plants/m^2.

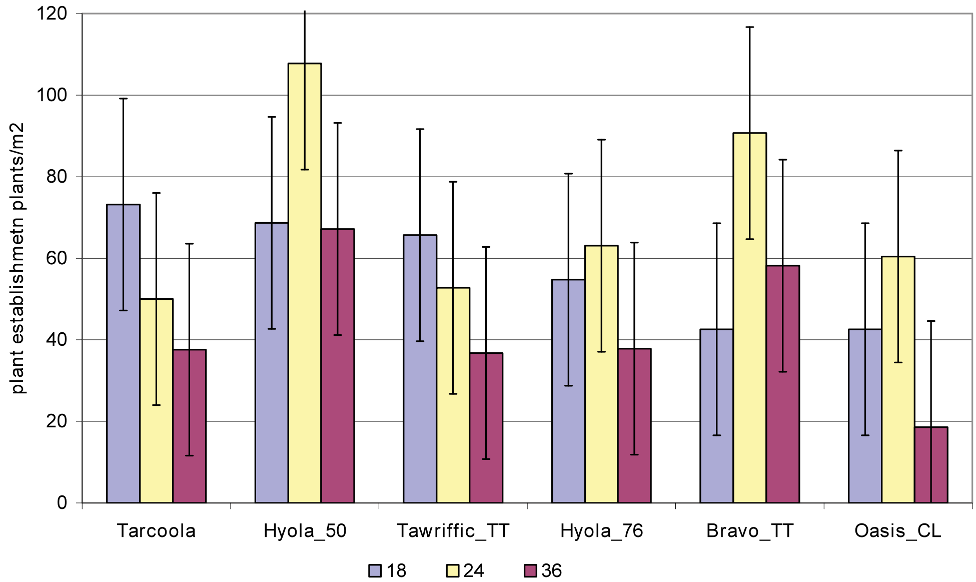

FIGURE 1 Plant establishment for 18cm, 24cm and 36cm row spacings by variety

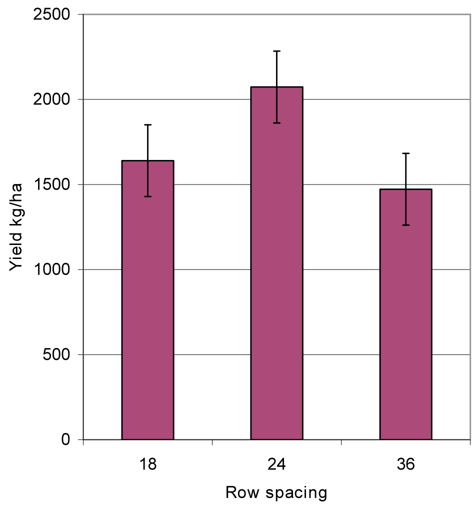

FIGURE 2 Variety yield for 18cm, 24cm and 36cm row spacings

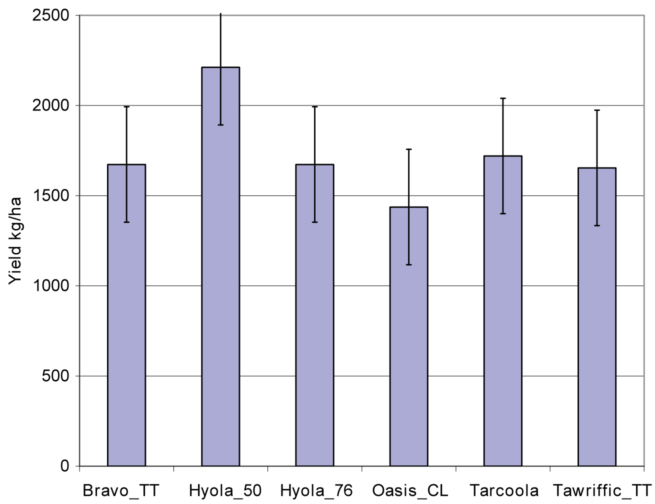

FIGURE 3 Yield of canola varieties

Despite the dry season there was no difference in yield between the 18cm and 36cm row spacings. There is a trend showing yield drops off in the wider row spacings, although the difference is not significant. In a high-rainfall environment a yield penalty would be expected with wider rows but this has not been observed so far. The unexpected results in the 24cm row spacing are likely to be due to trial design.

Sponsors

West Hume Landcare Group

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Effect of cereal species and maturity time on quantity, energy and protein of forage mixes

WRITTEN BY

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Location: Between Henty and Culcairn, NSW
Growing season rainfall: **Annual:** 464mm **GSR:** 278mm
Soil: **Type:** Red loam
Sowing information: **Sowing date:** 20 May 2009 **Fertiliser:** 100kg/ha GLS
Replicates: 3

KEY POINTS

- **Oats lost feed quality much faster than other cereals.**
- **Wheat and barley do have increased energy at mid dough stage compared with a flowering or milky dough stage.**
- **Adding vetch to a silage mix increased crude protein (CP) from 6.31 to 17.7 per cent.**

Aim

The aim of this trial was to compare different cereals with or without mixing for changes in forage quality from boot stage thought to flowering, milky dough and mid dough stage.

Method

Different cereal varieties of two maturity types (winter and spring) were sown with or without vetch in the mix. The following cereal varieties were used:

1. Wedgetail wheat (winter wheat).
2. Strezlecki wheat (spring type).
3. Mannus oats (winter type).
4. Echidna oats (spring type).
5. Urambie barley (winter type).
6. Gairdner barley (spring type).
7. Tobruk triticale (winter type).

The plots were harvested when each mix reached boot, flowering, milky dough and mid dough stage. The samples were tested at Wagga Wagga feed test lab for protein, energy (digestability) and dry matter (DM) production was calculated.

Results

Some of the results are a product of the season, — it was a dry spring and some of the longer season varieties died before harvest was completed. This occurred in the Wedgetail wheat and Tobruk triticale (the last two Tobruk samples were not harvested as they died from drought stress).

DM production generally increased with maturity from boot stage to flowering, but not from flowering onwards (see Figure 1). This lack of increase post flowering may have been due to the dry spring season. This was particularly the case with the winter type wheat and triticale, which was starting to die of drought stress before harvesting was completed. DM production did not change with addition of vetch possibly due to season or the fact that the site had low nitrogen nutrition, so the added nitrogen from vetch improved production and delayed maturity. Previous studies have sown that vetch decreased DM production.

Crude protein

As expected, protein declined with maturity (see Figure 2). There were differences between crude protein (CP) in the varieties. Barley and wheat had the highest CP and oats the lowest. Tobruk triticale unexpectedly also had slightly lower protein but this may have been due to it being the longest season variety sown and it did not cope with the tough finish to the season. Adding vetch to the mix increased protein significantly by between 6.31 and 17.7 per cent (see Figure 3).

The increased protein would have a marked increase on production when the mixes are used as forage. For example, Echidna oats with the vetch. With the high protein, wethers would gain weight at 224 grams per day, while without vetch in the mix weight gain would be only 91g/day when cut at boot stage. By comparison cattle fed Wedgetail wheat cut at boot stage would gain 240g/day in the mix without vetch, once vetch is added cattle would gain 1 kilogram/day.

Metabolisable energy

Metablisable energy ME declined with maturity (see Figure 4). There was no significant difference in ME with the inclusion of vetch. ME increased as grain filled in the spring type wheat and barley. However, due to the dry conditions triticale and winter wheats did not show this trend. Oats did not increase in energy after boot stage and had the sharpest decline in energy after boot stage.

Observations and comments

Even during a dry season the grain quality effect, where forage quality increases at mid dough, can occur depending on the variety.

Optimum cutting time for oats appears to be boot stage for maximum quality. Other cereal species do have the option of a later cutting at mid dough stage for increased DM, while a slight increase in quality occurred compared with cutting at flowering or milky dough. However in drought-stressed crops this is not the case and cutting at boot stage is best across all species to maximise quality. Cereals without a legume in the mix should be cut at boot stage to maximise forage quality.

Adding a legume such as vetch to the mix can increase the protein from maintenance to production levels and also increased the energy of the forage later into the season allowing for a slightly later cutting if needed.

Sponsors

Rural Industries Research and Development Corporation (RIRDC).

Farmer co-operator: Andrew Cotter, Henty.

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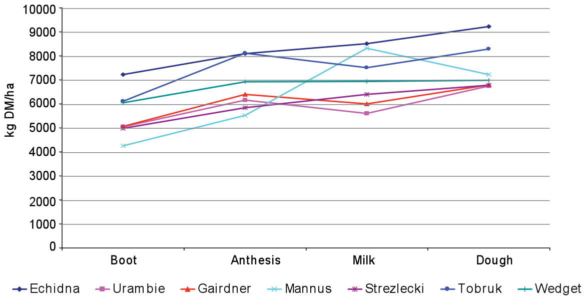

FIGURE 1 Dry matter production of varieties during the season
Difference in production between cereals

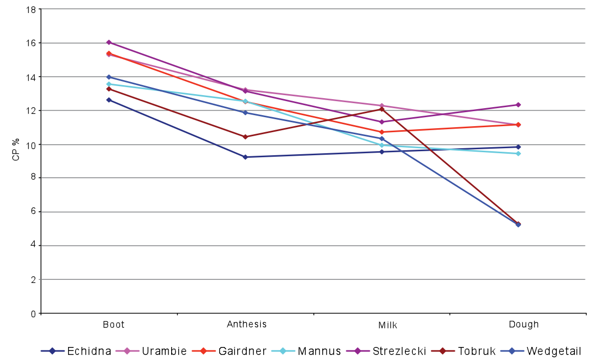

FIGURE 2 Forage crude protein during season

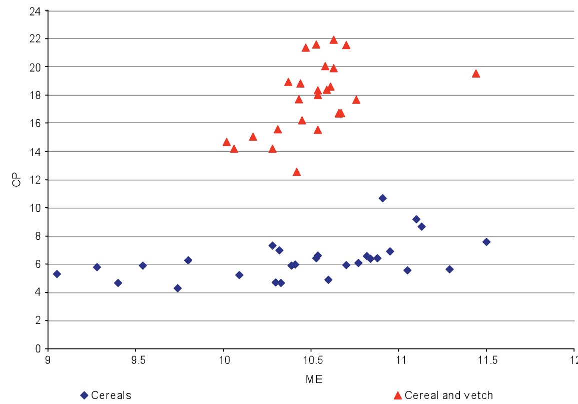

FIGURE 3 Correlation between metabolisable energy and crude protein of vetch and no vetch treatments

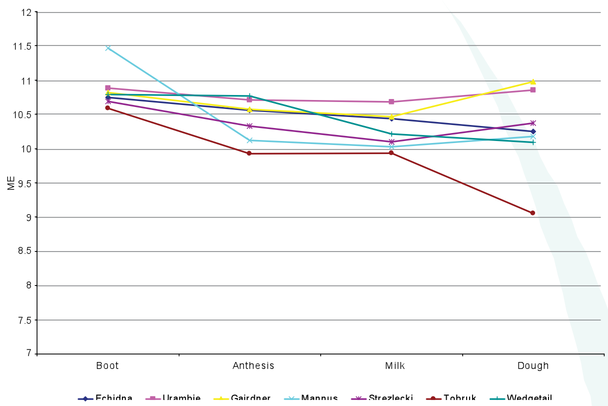

FIGURE 4 Metabolisable energy of forages during the season