Improving lentil and vetch management and mitigating risk in the low rainfall zone

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Break Crops

Key messages

- **Variety selection should be based on target end-use, paddock constraints and matching phenology to environment.**
- **Do not increase seeding rates unnecessarily, as this can lead to higher disease and lodging risk.**
- **Herbicide choice, rate and application timing are critical in reducing risk of crop injury.**
- **Experimental use of gibberellic acid in vetch to date has not proven to be beneficial to increasing hay production or delaying phenology, despite anecdotal evidence.**

Why do the trial?

Lentil and vetch production area has increased by over 7,700 hectares in the last decade across the western and eastern Eyre Peninsula regions (PIRSA 2021). This increase in production area has coincided with a reduction in area sown to field pea, as well as recent high grain prices for lentil and developments in breeding, particularly the release of varieties with improved herbicide tolerance characteristics and varieties better adapted to low rainfall environments. The majority of pulse management research is conducted in medium and high rainfall zones, and strategies developed in these environments are often not viable or economical for growers in low rainfall regions. To improve grower confidence in pulse production there is a need for the development of pulse management strategies specifically for low rainfall environments. This article reviews recent research conducted under GRDC-funded projects on lentil and vetch production, with a focus on novel management and diversifying risk.

How was it done and what happened?

Variety selection and seeding rate

Research trials to compare biomass and grain production of vetch and lentil sown at recommended and reduced seeding rates (Table 1) were initiated in 2020 (Day, Roberts *et al*. 2021) and further validated in 2021 at three low rainfall sites, including Kimba. Three varieties each of vetch and lentil with varying phenology characteristics (Table 2) were included to refine variety selection depending on target end use. Biomass measurements were taken at late vegetative and early podding growth stages to identify production potential for grazing or hay production, and grain was harvested at crop maturity. Biomass and grain yield data was analysed using a split plot ANOVA model in Genstat 21st Edition. The trial aim is to identify optimum seeding rate and variety selection depending on target crop end use for both vetch and lentil.

Biomass production between lentil and vetch varieties was similar in both seasons, with no differences observed for late vegetative or early podding biomass ($P>0.05$, data not shown). Average biomass production at late vegetative and early podding was, respectively, 1.4 t/ha and 3.4 t/ha in 2020, and 0.69 t/ha and 1.6 t/ha in 2021. Variety selection for biomass production will depend on fit in the system, with a greater range in phenology between vetch varieties offering a unique fit in the system.

Morava is a late maturing vetch variety, suited to early sowing and spring fodder production. Studenica is a white flowering, very early maturing variety that has been bred for low rainfall areas, is particularly well suited to short seasons, and if sown early has a key role in filling the winter feed gap (Nagel, Kirby *et al*. 2021).

PBA Highland XT lentil had the highest grain yield at Kimba in 2021, equivalent to Volga vetch, and in 2020 was equal highest yielding lentil variety to PBA Jumbo2 (Table 2). PBA Highland XT is a medium seed size red lentil with improved herbicide tolerance and is showing adaptation to drier lentil-growing regions of South Australia. Morava vetch had the highest grain yield at Kimba in 2020, and equivalent grain yield to Studenica and Volga vetch in 2021.

Reducing the seeding rate of lentil and vetch didn't reduce production potential for biomass or grain at Kimba, in 2020 or 2021 ($P>0.05$, data not shown). In other environments, vegetative biomass was reduced where crops were sown at half the recommended seeding rate. However, early podding biomass and grain production was not compromised (Day, Roberts *et al*. 2021).

Table 1. Target plant density (plants/m²) and seeding rate (kg/ha) of lentil and vetch sown at Kimba, 2020 and 2021.

Seeding Rate	Lentil		Vetch	
	Plants/m²	kg/ha*	Plants/m²	kg/ha*
Recommended	120	50-70	60	45-60
Three-quarter	90	35-50	45	30-45
Half	60	25-35	30	20-30

**A range is given for seeding rate per hectare as this will vary depending on seed size and seed weight.*

Table 2. Grain yield of lentil and vetch varieties sown at Kimba 2020 (P=0.004) and 2021 (P<0.001). Different letters in the same column indicate a significant difference in grain yield between varieties in that environment.

Crop	Variety	Maturity	Grain yield (t/ha)	
			Kimba 2020	Kimba 2021
Lentil	PBA Blitz	Early	0.51 c	1.24 c
	PBA Highland XT	Early-Mid	0.89 b	1.71 a
	PBA Jumbo2	Mid	0.79 b	1.43 bc
Vetch	Studenica	Very early	N/A	1.43 bc
	Volga	Early	0.52 c	1.52 ab
	Timok	Mid	0.56 c	N/A
	Morava	Late	1.10 c	1.42 bc
LSD (P<0.05)			*0.15*	*0.108*

Key: N/A = variety was not included in the trial, LSD = least significant difference

Herbicide in lentil

Group 5 (previously group C) lentil herbicide trials have been conducted across the low rainfall zone in 2017-2020 to assess the risk of crop damage from different Group C products, rates and application timing (Day, Roberts *et al*. 2021, Day, Roberts *et al*. 2021). To determine the genotype (G) main effect and genotype by environment (GE) interactions of these trials, a GGE biplot was used to understand mean grain yield performance and stability of treatments across the environments (Figure 1) (VSNi 2018). A GGE biplot was not generated for herbicide crop injury, as this was minimal across all environments. Metribuzin applied incorporated by sowing (IBS) resulted in lower lentil yield stability, compared to applying Metribuzin post-sowing pre-emergent (PSPE), hence this is on label to apply PSPE only. Terbuthylazine label instructs IBS use only, and the GGE biplot shows that lentil with Terbuthylazine applied PSPE has lower mean yield, compared to this product applied IBS as per label instructions. Diuron applied IBS provides higher yield stability and performance than Diuron applied PSPE, with similar yield performance to lentil where Terbuthylazine was applied IBS. Herbicide choice, rate and application timing is important to reduce risk associated with lentil production, as lentil is extremely sensitive to herbicide use in dry conditions. Herbicide crop injury can result in reduced grain yield, nitrogen fixation and weed competition, and can increase the risk of soil erosion over the summer. Decisions around herbicide use in lentil will differ depending on an individual grower's attitude toward risk, soil type, target weed populations and herbicide characteristics (Table 3). A combination of herbicide products with different solubility and leaching rates may be used to reduce risk of damage while targeting a wider spectrum of weeds. Herbicides with low solubility require good soil moisture and rainfall to achieve incorporation and are less available in the soil moisture than herbicide with high solubility, reducing their damage risk. Herbicides with high solubility, such as metribuzin, are available to move more readily within the soil and more likely to achieve off-target damage.

Gibberellic acid use in vetch

Research focused on strategic application timings of gibberellic acid (GA) in vetch production was explored at Booleroo and Kimba in 2020, with the aim of quantifying the effects of GA on phenology, plant height and dry matter production (Day, Roberts *et al*. 2021). This research compared the application of GA at maximum label rate at two growth stages compared to an untreated Nil. Additional research has also been conducted at the Hart Field Day Site (Allen, Noack *et al*. 2021) and Pyramid Hill, Victoria (Bennett 2021). Anecdotal evidence suggests that the use of GA delays flowering in vetch, however, this was not observed at Booleroo, Kimba or Pyramid Hill. A vegetative application of GA did increase plant height by 3.8-5.4 cm through stem elongation, providing improved cutting or grazing ability. Despite this increase in plant height, an increase in biomass production from a vegetative or late flowering application of GA was not observed at Kimba, Booleroo or Pyramid Hill. A biomass increase of 0.27 t/ha was observed at Hart in July, indicating the early use of GA may benefit early grazing opportunities. Grain yield has been reduced from the use of GA in some environments (data not shown).

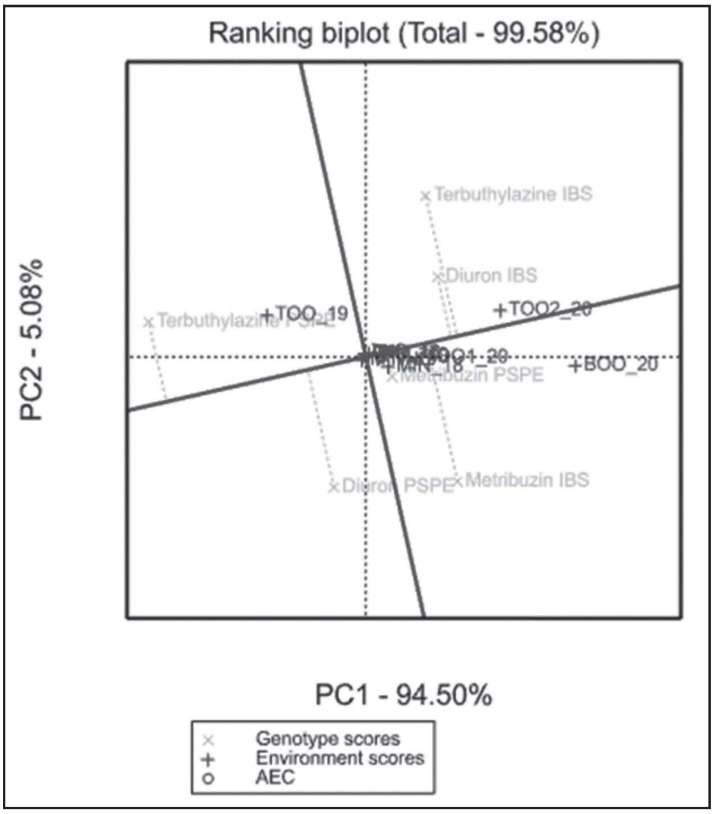

Figure 1. GGE biplot showing yield performance and stability ranking of herbicide treatments applied to lentil at multiple low rainfall environments, 2017-2020.

Table 3. Herbicide label instructions and characteristics, such as solubility rate and binding ability, of herbicide products registered for pre-emergent use in lentil.

Herbicide	Diuron	Metribuzin	Terbuthylazine
Product cost*	$14 per kg	$50 per kg	$21 per kg
Label rate	IBS: 0.83-1.1 kg/ha PSPE: 0.55-0.83 kg/ha	Light sandy soils: 180 g/ha Medium soils: 280 g/ha Heavy soils: 380 g/ha	0.86-1.2 kg/ha
Label instructions	Apply the lower rate on light sandy soil	Only apply post-sowing pre-emergent to a crop sown at least 5 cm deep.	Apply IBS only. Do not use on light soil types. Do not use rates higher than 0.86 kg/ha on soils with pH 8.0 and above.
Solubility	Low	High	Low
Binding	Slightly mobile	Mobile	Moderately mobile
Target weeds (not all weed species listed)	Capeweed, crassula, double gee, erodium, toad rush, wild radish, wild turnip	Capeweed, charlock, chickweed, creeping speedwell, deadnettle, horehound, stinging nettle, wild turnip, wild radish, winter grass, fumitory, fat hen, heliotrope, hogweed, Indian hedge mustard, rough poppy, shepherd's purse, toad rush, sowthistle, three-cornered jack(s)	Burr medic, dead nettle, Indian hedge mustard, prickly lettuce, shepherd's purse, sowthistle, toad rush, turnip weed, wild turnip, wireweed

KEY: IBS + incorporated by sowing, PSPE = post-sowing pre-emergent.
**Source: PIRSA Gross Margin Guide 2021.*

What does this mean?

While pulse and grain legume production continue to expand in the low rainfall zone, research and validation of current and novel management strategies will need to continue to develop management strategies specific to low rainfall zones that focus on improving production and profit.

A review of recent lentil and vetch research has determined variety selection can be complex and final choice will depend on grower's attitude toward risk, target end use, time of sowing, and paddock constraints (e.g., herbicide residues, salinity). Lentil varieties with improved herbicide or salt tolerance are available to growers and have a unique fit in farming systems to address herbicide residues or soil constraints. A broad range of phenology in vetch provides varieties suited to a range of sowing times and target end uses. Seeding rate of lentil and vetch can be reduced without compromising on production potential, particularly early podding biomass production and grain production. It is important to not reduce rates too low as this can reduce production and will leave crops exposed to weed and aphid infestations, while increasing seeding rates can increase risk of foliar disease and lodging.

Lentil is extremely sensitive to Group 5 (previously Group C) herbicide in dry conditions, and herbicide choice is important in reducing risk of crop injury. Herbicide choice will differ depending on an individual grower's attitude towards risk and experience with products, soil type, target weed populations, environmental conditions, herbicide solubility and leaching rate. It is important to remember that product label rates, plant-back periods and directions for use must be adhered to.

Anecdotal evidence suggests that GA can be used to delay phenology or increase hay yield potential in vetch. However, this has not been observed in field-based trials. GA has potential to be utilised early in the season to boost plant height and potentially biomass production, to provide easier grazing for livestock. Late season applications of GA during reproductive growth stages are unlikely to benefit the crop and may have a negative effect on growth and grain production.

Acknowledgements

The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC (DAV00150 – Southern Pulse Agronomy, DAS00162A – Low rainfall break crop validation, UOA2105-013RTX – SA Grain Legume Validation), and the authors would like to thank them for their continued support. The continued assistance in trial management from SARDI Agronomy groups at Clare, Pt Lincoln and Minnipa is gratefully acknowledged and appreciated.

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