Faba bean competition effects on common sowthistle - lessons learned and opportunities for growers

Asad Shabbir[1], Michael Widderick[2], Adam McKiernan[2], Greg Harvey[2], Linda Heuke[3] and Michael Walsh[1]

[1] University of Sydney, Camden, NSW
[2] Queensland Department of Agriculture and Fisheries, Toowoomba, Qld
[3] University of Sydney, Narrabri, NSW

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Take home message

- Faba bean competition effects on sowthistle were increased by reducing crop row spacing from 50 to 25 cm and increasing crop density from 20 to 30 plants m^{-2}
- At Hermitage in southern Queensland, sowthistle biomass and seed production were decreased by 36% and 18%, respectively when faba bean density was increased from 20 to 30 plants m^{-2}
- At Narrabri in northwest New South Wales, sowthistle biomass and seed production were decreased by 28% and 10%, respectively when faba bean row spacing was decreased from 50 to 25 cm
- The cultivars Nanu♁ and Nasma♁ were more weed suppressive at Hermitage and Narrabri, respectively with Nasma♁ yielding 9% higher at Narrabri compared to Nanu♁ and Warda♁ when grown in the presence of 10 plants/m^2 of sowthistle.

Introduction

Reliance on herbicides alone has resulted in the evolution of herbicide resistance in many weed populations infesting northern region grain production systems. There is a need for regular use of alternative weed control practices into weed management programs to counter the widespread evolution of resistance. Crop competition is an effective strategy of weed suppression that reduces the reliance on herbicides. Agronomic practices such as crop row spacing, plant density and choice of cultivar, can be used to enhance the competitiveness of crops against weeds.

The research reported here explores the combined impacts of faba bean row spacing, crop density and cultivar on common sowthistle growth and reproductive development with benefits to crop yield in the presence of weeds and substantial reductions in weed seed set.

Materials and methods

Four faba bean cultivars were tested in field trials at Narrabri and Hermitage in 2021. Nasma♁ and Warda♁ were tested at both sites while Marne♁ and Nanu♁ were evaluated at Narrabri, NSW and Hermitage, Qld sites, respectively. Faba bean was planted on 25 cm and 50 cm row spacings at two densities (20 and 30 plants m^{-2}). A sowthistle density of 10 plants m^{-2} was used across both sites.

Within each main plot, a fixed quadrat (2 × $1m^2$) was used as a sub-plot for weed treatment. Within each quadrat, the crop and weed plants were thinned to the required density. Quadrats in 25cm row plots

contained four crop rows, while quadrats in 50 cm row plots contained two crop rows. At the Hermitage site, sowthistle seed was sown in these quadrats the day after crop planting, then irrigated to ensure weed emergence. At the Narrabri site, sowthistle seedlings, grown in trays, were transplanted into designated quadrat areas approximately two weeks after crop emergence.

At crop maturity, weed and crop plants within the designated quadrat areas were hand harvested and placed in separate paper bags for the determination of biomass and seed production of sowthistle as well as the yield of faba bean. All bags were transferred to a dehydrator and dried at 70^{o}C for 3 days. After drying, sowthistle plants were weighed and seed production was calculated by counting the total seeds in 5 representative randomly selected seed heads from each sample bag. The average seed number of these five heads was then multiplied by the total number of seed heads in the sample to calculate the total number of seeds per 1 m^{2}. Faba bean plants were processed in a thresher for the collection of grain and calculation of yield.

Each main plot was a cultivar × row spacing × crop density treatment and within each main plot, the weed treatment formed the subplot. There were four replicates for each main treatment and each experiment was laid out in a randomized complete block design. The data on weed biomass and seed production at Narrabri site was $\log_{10}$ transformed to pass the normality test for ANOVA. For each site, a three-way ANOVA was performed using Genstat 19th Edition on the data for all growth traits (weed biomass, weed seed production, and faba bean yield) with row spacing, crop density and cultivar as the main factors. Treatment mean comparisons were assessed based on Fisher's Least Significant Differences (LSD) test at p = 0.05.

Results

Hermitage

Reducing faba bean crop row spacing, increasing crop plant density and cultivar choice all increased the crop competition effects on sowthistle growth. When row spacing was decreased from 50 to 25 cm, sowthistle biomass was reduced (P <0.05) by 14% (Table 1). Increasing faba bean plant density from 20 to 30 plants m^{-2} reduced (P <0.001) the biomass of sowthistle, on average, by 36%. There were consistent reductions in sowthistle biomass across cultivars when crop density was increased from 20 to 30 plants m^{-2}. At narrow spacing (25 cm), increasing the plant density from 20 to 30 plants m^{-2} of Nanuᵇ and Nasmaᵇ treatments reduced sowthistle biomass by 50% and 39%, respectively. At the wide row spacing (50cm) and low faba bean plant density (20 plants m^{-2}), Wardaᵇ was poorly competitive and allowed sowthistle to produce on average 33% greater biomass than Nasmaᵇ and Nanuᵇ.

Table. 1 Effect of faba bean row spacing, density and cultivar on biomass of sowthistle at Hermitage, Qld.

Row spacing (cm)	Crop density (plant m^{-2})	Sowthistle biomass (g m^{-2})		
		Nanuᵇ.	Nasmaᵇ	Wardaᵇ
25	20	79.0 bcd	81.6 cd	64.6 abc
	30	38.8 a	50.6 ab	40.7 a
50	20	75.3 bcd	63.2 abc	102.3 d
	30	63.0 abc	51.9 ab	57.3 abc
LSD (P = 0.05)		25.4		

Decreasing row spacing from 50 to 25 cm reduced (P = 0.017) sowthistle seed production by 18% (Table 2). When faba bean plant density was increased from 20 to 30 plants m^{-2}, sowthistle seed production was reduced (P <0.001) by 29%. There were consistent reductions in sowthistle seed production across cultivars when plant density was increased from 20 to 30 plants m^{-2}. At narrow row spacing, the high crop plant density of Nanu reduced sowthistle seed production by 45% (P = 0.05) as compared to the low plant density of this cultivar. For cultivars Nasma, and Warda, a similar weed suppressive trend was evident, but the differences were not significant (P >0.05). At a row spacing of 50cm, Warda reduced the sowthistle seed production by 44% at high crop density compared to the low crop density (Table 2).

Table. 2 Effect of faba bean row spacing, density and cultivar on seed production of common sowthistle at Hermitage, Qld.

Row spacing (cm)	Crop density (plant m^{-2})	Sowthistle seed count (m^{-2})		
		Nanu	Nasma	Warda
25	20	111378 bc	100630 abc	91564 abc
	30	61503 a	71999 ab	70032 a
50	20	115104 c	83908 abc	150373 d
	30	96230 abc	81046 abc	85333 abc
LSD (P = 0.05)		34490.1		

Faba bean crop row spacing, plant density and cultivar all contributed to the yield of faba bean. Decreasing row spacing from 50 to 25 cm increased (P <0.001) faba bean yield by 20%. Faba bean yield was increased (P < 0.05) by 11% when crop plant density was increased from 20 to 30 plants m^{-2}. At narrow spacing, all three cultivars (Nasma, Nanu, Warda) planted with high density (30 plants^{-2}) on average yielded 37% greater than low density (20 plants^{-2}) (Table 3).

Table. 3 Effect of faba bean row spacing, density and cultivar on yield of faba bean at Hermitage, Qld.

Row spacing (cm)	Crop density (plant m^{-2})	Faba bean yield (t ha^{-1})		
		Nanu	Nasma	Warda
25	20	2.6 abc	2.4 ab	2.6 abc
	30	3.2 c	3.1 bc	2.9 bc
50	20	2.4 ab	2.4 ab	2.1 a
	30	2.5 abc	1.9 a	2.3 ab
LSD (P = 0.05)		0.67		

Narrabri

Reducing faba bean crop row spacing, increasing crop plant density and cultivar choice all increased the crop competition effects on sowthistle growth. When row spacing was decreased from 50 to 25 cm (P <0.001) sowthistle biomass was reduced by 28%. Nasma reduced (P = 0.034) sowthistle biomass on average 15% more than Nanu and Warda (Table 4). At narrow row spacing and high crop density (30 plants m^{-2}) of Marne sowthistle biomass was reduced by 26% (P < 0.05) when compared to the low crop density (20 plants m^{-2}).

Table. 4 Effect of faba bean row spacing, density and cultivar on biomass of common sowthistle at Narrabri, NSW.

Row spacing (cm)	Crop density (plant m^{-2})	Sowthistle biomass (g m^{-2})		
		Marne(Þ)	Nasma(Þ)	Warda(Þ)
25	20	1.52 bcd	1.13 a	1.39 abc
	30	1.13 a	1.25 ab	1.25 ab
50	20	1.92 d	1.51 abcd	1.91 d
	30	1.78 cd	1.58 bcd	1.86 d
LSD (P = 0.05)		0.38		

Reducing faba bean crop row spacing, increasing crop plant density and cultivar choice all increased the crop competition effects on sowthistle seed production. Decreasing row spacing from 50 to 25 cm reduced (P <0.001) sowthistle seed production by 10%. Nasma(Þ) reduced (P = 0.04) sowthistle seed production on average 8% more compared to Nanu(Þ) and Warda(Þ). Faba bean density had no effect on seed production of sowthistle at this site (Table 5).

Table. 5 Effect of faba bean row spacing, density and cultivar on seed production of common sowthistle at Narrabri, NSW.

Row spacing (cm)	Crop density (plant m^{-2})	Sowthistle seed (m^{-2})		
		Marne(Þ)	Nasma(Þ)	Warda(Þ)
25	20	3.3 abc	2.9 a	3.2 abc
	30	3.0 ab	3.1 ab	3.1 ab
50	20	3.5 bc	3.2 abc	3.4 bc
	30	3.5 bc	3.3 abc	3.6 c
LSD (P = 0.05)		0.39		

Reduced faba bean crop row spacing, and cultivar choice contributed to the yield of faba bean. When crop row spacing was decreased from 50 to 25 cm faba bean yield increased (P = 0.01) by 13%. Nasma(Þ) yielded on average 9% more (P > 0.05) compared to Warda(Þ) or Marne(Þ). Crop density had no effect on faba bean yield at Narrabri (Table 6).

Table. 6 Effect of faba bean row spacing, density and cultivar on yield of faba bean at Narrabri, NSW.

Row spacing (cm)	Crop density (plant m^{-2})	Faba bean yield (t ha^{-1})		
		Marne(Þ)	Nasma(Þ)	Warda(Þ)
25	20	3.0	3.1	2.7
	30	2.6	3.0	2.7
50	20	2.4	2.4	2.6
	30	2.5	2.8	2.4
LSD (P = 0.05)		0.66		

Summary

Crop competition is an effective weed management approach that can reduce the pressure on herbicides. Faba bean competition effects on sowthistle are increased by reducing crop row spacing (25 cm) and increasing crop density (30 plants m^{-2}). Reduced crop row spacing consistently reduced sowthistle seed production and biomass across both Hermitage and Narrabri sites. At Narrabri, sowthistle biomass and seed production were decreased by 28% and 10%, respectively when faba bean row spacing was decreased from 50 to 25 cm. At Hermitage, sowthistle biomass and seed production were decreased by 36% and 18%, respectively when faba bean density was increased from 20 to 30 plants m^{-2}. The cultivars Nanu℗ and Nasma℗ were more weed suppressive at Hermitage and Narrabri, respectively with Nasma℗ yielding 13% higher at Narrabri as compared to Nanu℗ and Warda℗. More competitive planting configurations and cultivars also resulted in increased yield in these field trials.

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Contact details

Asad Shabbir (Postdoctoral Research Associate – Weed Ecology)
University of Sydney
Ph: 02 4651 9884
Email: asad.shabbir@sydney.edu.au

Michael Widderick (Principal Research Scientist)
Queensland Department of Agriculture and Fisheries
Ph: 07 4529 1325
Email: Michael.widderick@daf.qld.gov.au

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