Herbicides affect yield and nitrogen fixation in peas

Elizabeth Drew, Gupta Vadakattu, David Roget, CSIRO, Waite Campus

Key Messages

- In-crop applications of some broadleaf and grass herbicides can reduce nodulation and nitrogen fixation of peas.
- Timing of herbicide application and seasonal conditions play an important role in herbicide-legume interactions.
- Late applications of some broadleaf and grass herbicides can reduce crop yields.

Why do the trial?

In the low rainfall region of the Murray Mallee, a number of herbicides recommended for use in legumes (vetch and peas) have been found to reduce the number of nodules per plant and nitrogen fixation. Herbicides are a vital component within current fanning systems and are commonly used in legume crops and pastures to control weeds.

Trials were conducted at the Minnipa Agricultural Centre in medic and peas in 2002 and 2003 and in peas in 2004. Trials in 2003 indicated post-emergent applications of some herbicides caused crop yellowing and reduced nodulation of peas. Single applications of flumetsulam, imazethapyr, metribuzin, and clethodim caused yield reductions in peas (Refer to 'EPFS 2003 pg 40' for more information). The aim of the trial in 2004 was to investigate the effects of six commonly used herbicides for the control of grass and/or broadleaved weeds in peas on the growth, nitrogen fixation and yield of the crop. The impact of spray time was also investigated.

How was it done?

Replicated plots of Parafield peas (fertilised with 0:20:0 @ 70 kg/ha) were sown on 3rd June 2004.

Half the post-emergent herbicide treatments were applied on the 30th June when the crop was at the 3-node growth stage. The remainder of the trial was sprayed on September 1st just as flowering commenced (10-20% crop had commenced flowering). It should be noted that spraying during flowering is not recommended practice for herbicide treatments flumetsulam and diflufenican. Herbicides were applied using a 2.0m shrouded boom with TeeJet® 11002 nozzles at a pressure of 32 psi. Water volume was 100 L/ha.

Assessment: plants were sampled three weeks after the initial herbicide application. Plant dry matter and nodulation was assessed. Anthesis (end flowering) dry matter cuts were taken on 21st of October. Peas were harvested on 28th October.

Table 1: Herbicide treatments applied to Peas.

Active Chemical	Herbicide Rate	Additive	Recommended label application time
Control (no herbicide)	-	-	-
Flumetsulam 800 g/kg	25 g/ha	Uptake 0.5%	2-6 node
Difiufenican 500 g/L	200 ml/ha	-	3 node - pre flowering
Butroxydim 250 + Fluazifop P butyl	280 g/ha	DC Trate 2%	Any
Clethodirn 240 g/L	250 ml/ha	Hasten 1%	Not stated
Sethoxydim 186 g/L	1.0 L/ha	DC Trate 1%	Not stated
Haloxyfop 520 g/L	40 ml/ha	Uptake 0.5%	2 node - full flowering

What happened?

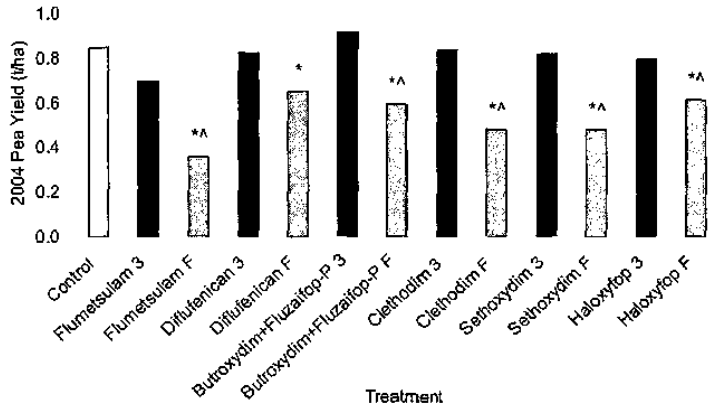
Results for 2004 show the initial application of herbicides had no significant effects on crop growth or nodulation measured at three weeks after spray time, however some trends were apparent, compared to the clear effects observed at the site in 2003 *{Table 2).* Several factors contribute to the magnitude of the herbicide effect including crop health and herbicide application time. Plants were sprayed much earlier in the growing season in 2004, 4 weeks after sowing vs. 6-8 weeks after sowing in 2003, which is reflected in the SDW in *Table 2.* Larger plants in 2003 would not only have a greater capacity to absorb the herbicide, but would also have a greater demand for nutrients and moisture and therefore be more susceptible to environmental stress at the time of spraying.

Late herbicide application of herbicides in 2004 (start flowering) significantly reduced anthesis crop dry matter (data not shown) and yields *(Figure 1)* compared to unsprayed and 3 node sprayed treatments. The grass herbicides tested reduced yields up to 43%, it should be noted that while broadleaf herbicides flumetsulam and difiufenican reduced yields they are not recommended for late spraying *(Table 1).*

Table 2: Comparison of herbicide effects on nodulation (Nodule score and Effective nodules per plant) and shoot dry matter (SDW) in peas grown at Minnipa in 2003 and 2004. Results are for three weeks after herbicide application (Tl). * indicates values significantly (P<0.05) lower than control treatments.

Herbicide	2003		2004	
	Nodule Score (/5)	SDW(Tl)t/ha	Eff nod/plant	SDW(Tl)t/ha
Control	3.85	**1.64**	**44.6**	**0.23**
Flumetsulam	*2.95	**1.53**	**28.6**	**0.23**
Difiufenican	**3.20**	**1.71**	**41.4**	**0.24**
Diuron PSPE	*3.15	**1.62**	-	-
Metribuzin	***2.25**	***1.10**	-	-
Imazethapyr	***2.90**	**1.52**	-	-
Butroxydim + Fluazifop P	-	-	**35.1**	**0.25**
Clethodim	***2.79**	***1.26**	**32.6**	**0.26**
Sethoxydim	-	-	**32.7**	**0.22**
Haloxyfop	***3.05**	**1.63**	**42.6**	**0.22**

Figure 1. Herbicide spray time (3 = 3 node, F = flowering) affected yield of Parafield peas grown at Minnipa in 2004. * indicates values significantly (P<0.05) lower than controls and ^ indicates where yield is significantly (P<0.05) lower in flowering application compared to 3 node application of the same herbicide.



What does it mean?

Reductions in nodule number due to herbicide applications can translate to a reduction in nitrogen fixation by the legume thus affecting the legume crop yield and also less nitrogen carry over benefit to the following wheat crop, as was observed in pea trials at Waikerie in 2003. Further analysis will determine if herbicides affected nitrogen fixation at Minnipa in 2004.

As the growing season progresses the crop has an increasing demand for moisture and nutrients. Late applications of herbicides is an additional stress to the crop which can either directly impact on pod formation or reduce photosynthesis during flowering and pod filling when the demand for carbon is high. Hence, the consequence of late spraying can be reduced yields.

Herbicides are essential in intensive faming systems, particularly with the move towards reduced till systems and management should not be compromised. Our work aims to identify which herbicides may put a legume or pasture crop at risk, hence allowing farmers to make more informed herbicide choices. Early control of weeds through the use of post-emergent herbicides may have less impact on legume nodulation, nitrogen fixation and crop yields than late herbicide applications.

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Rainfall:

Av. annual: 326 mm
Av. G.S.R.: 241 mm
2004 total: 288 mm
2004 G.S.R.:223mm

Paddock History

2004: Pulse trials
2003: Barque barley
2002: Yitpi wheat

Soil Type

Alkaline red sandy loam, pH 8.9

Plot size

10m x 1.44m x 4 Reps.