Assessment of 12 herbicide treatments on the crop tolerance and yield of Bounty Peas (*Pisum sativum*)

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Summary

Two trials were conducted on Bounty peas (*Pisum sativum*), one harvested for processing peas, the other for seed, evaluating 12 herbicide treatments. The processing pea trial was conducted at Seafield, Mid Canterbury and the seed pea trial was conducted at Templeton, Central Canterbury.

At either site none of the herbicide treatments applied resulted in any lasting phytotoxic effect on the crop although of the MCPB based herbicides Tropotox and MCPB caused some initial leaf twisting. Plants soon grew through this effect and there was no reduction in yield.

Weed control was variable, especially for the pre emergent treatments, due to a lack of moisture after application at both sites. Of the pre sow/pre emerge treatments the application of 2l/ha Treflan + 1l/ha Stomp and 2l/ha Treflan + 200ml/ha Spinnaker resulted in the greatest control of fathen (*Chenopodium album*). This reduced the level of weed infestation from 9 for the control to 5.3 and 5.0 respectively at the final assessment (score 1-9, 1= weed death, 9= no effect). The Treflan/Spinnaker treatment also gave good control of mallow (*Malva sylvestris*) and black nightshade (*Solanum nigrum*) at the Templeton site reducing the weed control score from 9.0 for the control to 2.0. The application of Pulsar (5l/ha) had the greatest effect on weeds at both sites reducing the level of fathen to 4.0 and mallow and black nightshade to 1.0 at the Templeton site.

There was no effect of the herbicides used on seed yield however some difference in process pea yield and TR were apparent. The 2l/ha Treflan treatment had the lowest yield and TR of 3.8t/ha and 119 respectively compared with the control at 4.7t/ha and 126. The application of 2l/ha Treflan + 200ml/ha Spinnaker resulted in the highest yield of 5.6t/ha.

Introduction

Peas are an important part of the arable crop rotation allowing a break between traditional cereal crops helping break disease and weed cycles. Weed control in these crops can have a large impact on yield especially when crops are sown in the spring coinciding with the germination of a large number of weed seeds.

Control of weeds not only helps maximise yield but it also prevents potential harvest difficulties due to the high moisture content of weeds retaining moisture in the crop and therefore requiring desiccation prior to harvest. Crop quality can also be affected due to water staining on seed peas as well as the difficulty of removing some weed seeds from the harvested crop, this is especially so for Californian thistle (*Cirsium arvense*) infestations in processed pea crops.

The present trial was designed to evaluate the effect of 12 herbicide treatments on the yield of both processing and seed peas.

Methods

The processing pea trial was sown at Seafield, Mid Canterbury on the 30/11/00 into a moist Templeton silt loam and the seed pea trial was sown on the 7/12/00 at the Cropmark Seeds Ltd office at Templeton, Central Canterbury, into a moist Templeton

Silt Loam. For both trials the pre sow treatments (Table 1) were applied prior to drilling and worked in by hand, the pre emerge treatments were applied immediately after drilling. The post emerge treatments were applied on the 29/12/00 (processing pea) and the 8/1/01 when plants were at the 5-7 node stage and weeds were at the 4-6 (fathen) and 2-4 (mallow and black nightshade) leaf stage respectively. The trial design was a CRB with 4 replicates and 12 treatments.

Table 1. Treatments applied to a herbicide assessment trial on 'Bounty' peas.

Treatment	Active ingredient	Timing of application
Control (nil)	N/A	
Treflan 2l/ha	400g/l Trifluralin	Pre sow
Treflan 2l/ha+ Spinnaker 200ml/ha	400g/l Trifluralin + 240g/l Imazethapyr	Pre sow
Treflan 2l/ha + Stomp 1l/ha	400g/l Trifluralin + 330g/l Pendimethalin	Pre sow
Stomp 3l/ha	330g/l Pendimethalin	Pre emerge
Simazine 2l/ha	500g/l Simazine	Pre emerge
Gardoprim 1.5l/ha	500g/l Terbuthylazine	Pre emerge
Pulsar 5l/ha	200g/l Bentazone + 200g/l MCPB	post emerge
Tropotox Plus 3l/ha	25g/l MCPA + 375g/l MCPB	post emerge
Bladex 3l/ha	500g/l Cyanazine	post emerge
MCPB 3l/ha	385 g/l MCPB	post emerge
Topoguard 700ml/ha	350g/l Terbutryn + 150g/l Terbuthylazine	post emerge

Assessments on the crop included plant counts and phytotoxicity assessments conducted throughout the growing season. For the phytotoxicity assessments scores from 1-9 were used, a description of this scale can be seen in Table 2. The efficacy of weed control was compared relative to the control with the scale seen in Table 2 being used.

The number of pods per plant was determined at harvest by counting the number of pods on 10 plants per plot. Yield for the processing pea trial was determined by harvesting and thrashing the middle two metres out of each plot through a mini viner, TR (tenderometer) measurements (3 per plot) were also taken. The seed pea trial was direct headed after desiccation with Glyphosate and yield adjusted to 14% moisture.

Table 2. Description of crop phytotoxicity and weed control scores.

Phytotoxicity score	Crop description (compared with control)
1	Total crop death
2	Severe stunting, <10% plant population
3	Severe stunting, 10-30% plant population
4	Crop height 40-50%, 30-50% plant population
5	Crop height 50-60%, 50-70% plant population
6	Crop height 60-70%, 70-80% plant population
7	Crop height 70 -80% no reduction in plant population
8	Crop height 80-90%, no reduction in plant population
9	No effect

All treatments were applied with a motorised boom sprayer, applying 200l/ha of water through Lurmark O2, low drift nozzles at a walking rate of 5km/hr.

Results and Discussion

Processing Pea

Phytotoxicity scores were taken throughout the growing season to determine if any of the herbicides would cause any damage to the crop and these results are presented in Table 3. Overall none of the herbicides caused any phytotoxic damage to the crop however MCPB and Bladex did cause some initial leaf curling that the plants quickly grew out of. The leaf curling that occurred in the MCPB treatment is a symptom of this chemical and any herbicides containing MCPB such as Pulsar and Tropotox are also expected to have some leaf twisting without affecting yield.

Table 3. The phytotoxicity effects of 12 herbicide treatments on 'Bounty' process peas (*Pisum sativum)* (1=dead, 9= no effect)

Treatment	29/12/00	12/1/01	17/1/01	26/1/01	15/2/01
Control	9.0	9.0	9.0	9.0	9.0
Gardoprim 1.5 l/ha [1]	9.0	9.0		9.0	9.0
Simazine 2 l/ha [1]	9.0	9.0		9.0	9.0
Stomp 3l/ha [1]	9.0	9.0		9.0	9.0
Treflan 2l/ha + Spinnaker 200ml/ha [1]	9.0	9.0		9.0	9.0
Treflan 2l/ha + Stomp 1l/ha [1]	9.0	9.0		9.0	9.0
Treflan 2l/ha [1]	9.0	9.0		9.0	9.0
Pulsar 5l/ha [2]			9.0	9.0	9.0
Tropotox Plus 3l/ha [2]			9.0	9.0	9.0
Topoguard 700ml/ha [2]			9.0	9.0	9.0
MCPB 3l/ha [2]			8.8	9.0	9.0
Bladex 3l/ha [2]			8.8	9.0	8.8
Mean	9.0	9.0	8.9	9.0	9.0
trtsig	NS	NS	NS	NS	NS
blksig	NS	NS	NS	NS	NS
CV%	2.1	2.1	2.9	1.6	1.6

[1] Pre Sow and pre emergent treatments applied 30/11/00
[2] Post emergent treatments applied 29/12/00, 5-7 node

The main weed present in the trial was fathen (*Chenopodium album*) and this was present evenly throughout the trial area and was at the 4-6 leaf stage when the post emergent treatments were applied. Black nightshade (*Solanum nigrum*) was also present but only along the edge of one side of the trial and as a result this data is not presented. All the herbicides used claim to control fathen and all except Treflan claim to control black nightshade (agrichemical users manual).

All pre emergent treatments were applied to a moist seedbed however only 5ml of rain fell in the following 2 week period possibly inhibiting the activity of herbicides such as Stomp, Gardoprim and Simazine that require moisture to move the active chemical into the root zone. This effect can be seen in Table 4 where Stomp and Gardoprim, both of

which require 12mm and 10mm of rain to allow movement into the root zone (Agrichemical users guide), had the lowest recorded weed control, a level at the final assessment that was not significantly different from the control (Table 4).

The application of 2l/ha Treflan with either 1l/ha Stomp or 200ml/ha Spinnaker gave the greatest level of weed control of the pre sow/pre emerge treatments. These two treatments reduced the level of weed competition from 9 for the control to 5.3 and 5.0 respectively (Table 4). The addition of Stomp or Spinnaker to 2l/ha Treflan did not significantly increase the level of weed control when compared with the straight Treflan treatment (2l/ha Treflan) however the addition of these two herbicides would broaden the weed spectrum.

Table 4. The effect of 12 herbicide treatments on weed control in process peas (*Pisum sativum*). Treatments with different letters are significantly different P<0.05) (1=death, 9= no effect).

Treatment	12/1/01	17/1/01	26/1/01	15/2/01
Control	9.0 a	9.0 a	9.0 a	9.0 a
Stomp 3l/ha [1]	6.0 b		5.8 b	7.7 ab
Gardoprim 1.5 l/ha [1]	6.0 b		5.4 bc	7.3 ac
Treflan 2l/ha [1]	6.5 b		5.4 bc	6.0 bd
Simazine 2l/ha [1]	6.8 b		4.6 bd	5.7 ce
Treflan 2l/ha +Stomp 1l/ha [1]	5.8 b		5.0 bd	5.3 de
Treflan 2l/ha + Spinnaker 200ml/ha [1]	4.3 c		3.4 d	5.0 de
Tropotox Plus 3l/ha [2]		3.3 c	4.2 bd	6.0 bd
Bladex 3l/ha [2]		3.8 bc	3.8 cd	6.0 bd
MCPB 3l/ha [2]		4.3 b	5.0 bd	5.7 ce
Topoguard 700ml/ha [2]		3.5 bc	5.0 bd	4.3 de
Pulsar 5l/ha [2]		3.5 bc	3.8 cd	4.0 e
Mean	6.3	4.5	5.0	6.0
Trtsig	***	***	***	***
Blksig	NS	NS	NS	NS
CV%	15.3	11.8	24.2	21.3
LSD	1.4	0.8	1.8	1.8

[1] Pre sow and pre emergent treatments applied 30/11/00
[2] Post emergent treatments applied 29/12/00, 5-7 node

The post emergent treatments of 5l/ha Pulsar and 700ml/ha Topoguard resulted in the highest level of weed control of all the treatments, reducing the final weed score from 9.0 for the control to 4.0 and 4.3 respectively. MCPB at 3l/ha resulted in intermediate control of fathen with the level of weed control not been significantly different from any of the other post emergent treatments.

The application of 3l/ha Bladex and 3l/ha Tropotox Plus were the least effective of the post emergent herbicides in controlling fathen. Significant reductions in the weed scores over the control did occur however this was significantly less than that achieved from the application of 5l/ha Pulsar. The agrichemical users manual recommends that if

Bladex is to be applied to Fathen at the 4 leaf stage or greater then MCPB should be added to ensure adequate control of Fathen which may explain this result.

None of the treatments applied were able to completely eliminate fathen from the trial area. As a result of this competition from this weed increased over the growing season as indicated by the increase in weed scores from 26 January to 15 February (Table 4).

Mean plant population was 215plants/m^2 with the pre sow and pre emergent treatments having no effect on emergence or plant population. There was no difference in the number of pods/plant between any of the treatments (Table 5) with a mean number of pods/plant of 3.2, a similar level to that found by Moot (1993) at the plant population of 215plants/m^2.

The mean TR (tenderometer) readings for the trial was 125 (Table 5) with values ranging from 119 to 131 however there was no significant difference between treatments at the $P<0.05$ level. Although no significant differences were apparent those treatments with higher TR readings would be harvested earlier, possible reducing yield or possible at higher TR reading reducing $/t.

Table 5. The effect of 12 herbicide treatments on the number pods/plant, TR and fresh yield of 'Bounty' peas (*Pisum sativum)*. Treatments with different letters are significantly different ($P<0.05$)

Treatment	TR AV	Pod no.	Yield (t/ha)
Treflan 2l/ha + Spinnaker 200ml/ha [1]	120	3.7	5.6 a
Stomp 3l/ha [1]	122	3.1	5.3 ab
MCPB 3 l/ha [2]	130	3.3	5.2 ac
Simazine 2 l/ha [1]	123	3.2	5.0 ac
Pulsar 5 l/ha [2]	129	2.9	4.9 ac
Gardoprim 1.5l/ha [1]	130	3.0	4.9 ac
Topoguard 700ml/ha [2]	121	3.1	4.8 bd
Tropotox Plus 3 l/ha [2]	127	3.2	4.8 bd
Control	126	3.8	4.7 bd
Bladex 3 l/ha [2]	131	3.3	4.5 ce
Treflan 2l/ha + Stomp 1l/ha [1]	121	2.9	4.2 de
Treflan 2 l/ha [1]	119	3.0	3.8 e
Mean	125	3.2	4.8
Trtsig	(NS)	NS	***
Blksig	NS	NS	NS
CV%	5.4	20.2	10.3
LSD			0.7

[1] Pre sow and pre emergent treatments applied 30/11/00
[2] Post emergent treatments applied 29/12/00, 5-7 node

Significant differences in yield did occur between treatments with the 2l/ha Treflan treatment having the lowest yield of 3.8t/ha of fresh pea, this was significantly lower than the control at 4.7t/ha. Only the Treflan/Spinnaker mix increased yield significantly

over the control, increasing yield of fresh pea by 900 kg/ha. The difference in yield between treatments is difficult to explain as the relationship between yield and weed control was poor (data not shown) indicating some other factor was possibly responsible.

There was a trend for the Treflan based treatments to have lower TR values and lower yield indicating growth and development may have been affected by this herbicide. There was no apparent phytotoxicity effect throughout the growing season and Trifluralin is not known to cause yield suppression unless adverse growing conditions such as cold and excess moisture are encountered.

Seed Peas

Phytotoxicity scores for the 12 herbicide treatments are presented in Table 6. Some initial leaf curling was noted in the Tropotox and MCPB treatments but the plants quickly grew through this effect prior to the first assessment. Apart from the symptoms mentioned no other phytotoxicity effects were apparent with all the phytotoxicity scores either 8.5 or above.

Table 6. The phytotoxicity effect of 12 herbicide treatments on 'Bounty' peas taken for seed (1 = death, 9= no effect)

Treatment	12/1/01	26/1/2/01	7/2/01	20/2/01
Control	9.0	9.0	9.0	9.0
Gardoprim 1.5l/ha [1]	9.0	9.0	9.0	9.0
Simazine 2l/ha [1]	9.0	9.0	9.0	9.0
Treflan 2l/ha + Stomp 1l/ha [1]	9.0	9.0	9.0	9.0
Stomp 3l/ha [1]	8.8	9.0	9.0	9.0
Treflan 2l/ha [1]	8.8	9.0	9.0	9.0
Treflan 2l/ha + Spinnaker 200ml/ha [1]	8.5	9.0	9.0	9.0
Bladex 3l/ha [2]		9.0	9.0	9.0
Topoguard 700ml/ha [2]		9.0	9.0	9.0
Tropotox Plus 3l/ha [2]		9.0	9.0	9.0
MCPB 3l/ha [2]		9.0	9.0	9.0
Pulsar 5l/ha [2]		9.0	9.0	9.0
Mean	8.9	9.0	9.0	9.0
Trtsig	NS	NS	NS	NS
Blksig	NS			
CV%	5.3			

[1] Pre sow and pre emergent treatments applied 7/12/00
[2] Post emergent treatments applied 8/1/01, 5-7 node

Weed pressure was generally low with only a light infestation of mallow (*Malva sylvestris*) and black nightshade present in the trial area. The effect of this can be seen in the high CV% (co-efficient of variation) seen in Table 7 indicating that variation in weed population had an effect on the weed control scores along with the effect of the herbicide treatments.

Of the pre sow/pre emerge treatment the mixture of 2l/ha Treflan + 200ml/ha Spinnaker gave the greatest weed control, reducing weed control scores from 9 for the control to 2.0 at the final assessment (Table 7). The addition of the 200ml/ha of Spinnaker significantly increased the level of weed control over the straight Treflan treatment reducing the weed scores from 5.8 to 2.0. This result is expected as Spinnaker is registered for control of both black nightshade and mallow whereas Treflan is not.

Combining Stomp at 1l/ha with 2l/ha Treflan gave no greater weed control than when these chemical were applied separately with final weed scores varying from 5.0 - 6.6.

Gardoprim (1.5l/ha) and Simazine (2l/ha) along with the Treflan + Stomp mixture resulted in the lowest level of weed control with the Gardoprim treatment having no significant effect on weed control when compared to the control. The efficacy of both Gardoprim and Simazine could have been reduced by the lack of rain in the 2 week period after application preventing movement of the active chemical into the root zone.

Table 7. The effect of 12 herbicide treatments on weed control in 'Bounty' peas (*Pisum sativum*) taken for seed. Treatments with different letters are significantly different P<0.05) (1=death, 9= no effect).

Treatment	12/1/01	26/1/01	7/2/01	20/2/01
Control	9.0 a	9.0 a	9.0 a	9.0 a
Gardoprim 1.5l/ha [1]	3.8 cd	6.2 ac	6.0 ac	7.4 ab
Simazine 2l/ha [1]	7.4 ab	3.6 ce	4.0 bd	6.6 bc
Treflan 2l/ha + Stomp 1l/ha [1]	5.4 bc	5.3 bd	6.0 ac	6.6 bc
Treflan 2l/ha [1]	6.7 ac	7.1 ab	8.0 ab	5.8 bc
Stomp 3l/ha [1]	4.4 bd	3.6 ce	4.0 bd	5.0 cd
Treflan 2l/ha + Spinnaker 200ml/ha [1]	1.0 d	1.0 e	1.0 d	2.0 ef
Bladex 3l/ha [2]		5.3 bd	6.0 ac	5.8 bc
Topoguard 700ml/ha [2]		5.3 bd	6.0 ac	5.0 cd
Tropotox Plus 3l/ha [2]		2.7 de	3.0 cd	3.4 de
MCPB 3l/ha [2]		1.9 e	2.0 cd	1.8 ef
Pulsar 5l/ha [2]		1.9 e	2.0 cd	1.0 f
Mean	5.4	4.4	3.2	3.8
Trtsig	**	***	***	***
blksig	NS	NS	NS	NS
CV%	43.9	50.5	46.7	26.9
LSD	3.5	3.2	2.2	1.5

[1] Pre sow and pre emergent treatments applied 7/12/00
[2] Post emergent treatments applied 8/1/01, 5-7 node

All the post emergent treatments significantly reduced the level of weeds when compared to the control. This effect was greatest for the three treatments containing MCPB, 5l/ha Pulsar, 3l/ha MCPB and 3l/ha Tropotox with weed scores at the final assessment of 1.0, 1.8 and 3.4 respectively. The weed control provided by Bladex and Topoguard treatments was less than the MCPB based treatments, reducing the level of weeds at the final assessment from 9 for the control to 5.8 and 5.0 respectively.

The mean plant population was 193 plants/m^2 with no significant differences between treatments indicating that the pre sow/pre emergent treatments had no effect on germination or emergence. There was also no effect on the number of pods/plant and at a mean of 6.6 was slightly higher than that found by Moot (1993) for similar population. There was no significant difference in seed yield between any of the treatments (Table 8) with yields varying from 2.0t/ha for the control to 2.6t/ha. The mean trial yield of 2.3t/ha is lower than 4.2 t/ha found by Russell *et al.* (1999) for bounty peas in a regional pea evaluation possibly as a result of early moisture stress and the late sowing reducing yield potential (Stoker year unknown).

The non significant difference in yield between the treatments indicates that none of the herbicides applied caused any seed yield loss. It also indicates that the low weed infestation in the trial area had little effect on yield although the control did have the lowest yield this difference was not significant.

The yield reduction caused by the application of Treflan in the process pea trial was not apparent when the second trial was harvested at maturity. The reason for this difference is unknown, as mentioned earlier, as no apparent phytotoxicity effects were seen.

Table 8. The effect of 12 herbicide treatments on the number of pods/plant and yield of 'Bounty' peas taken for seed.

Treatment	pods/plant	Yield t/ha
Pulsar 5l/ha [2]	6.9	2.6
Gardoprim 1.5l/ha [1]	6.3	2.5
Bladex 3l/ha [2]	6.9	2.4
Tropotox Plus 3l/ha [2]	7.5	2.4
Simazine 2l/ha [1]	6.2	2.3
Treflan 2l/ha + Spinnaker 200ml/ha [1]	6.9	2.3
Treflan 2l/ha + Stomp 1l/ha [1]	6.9	2.3
Treflan 2 l/ha [1]	6.0	2.2
MCPB 3l/ha [2]	6.4	2.2
Topoguard 700ml/ha [2]	6.5	2.2
Stomp 330e 3l/ha [1]	6.5	2.1
Control	6.3	2.0
Mean	6.6	2.3
Trtsig	NS	NS
Blksig	NS	NS
CV%	10.0	12.8

[1] Pre sow and pre emergent treatments applied 7/12/00
[2] Post emergent treatments applied 8/1/01, 5-7 node

Conclusions

- 5l/ha Pulsar gave the best weed control at both sites controlling fathen, black nightshade and mallow.
- Of the pre sow/pre emerge herbicides the Treflan 2l/ha + Spinnaker 200ml/ha mix gave the best weed control at both sites.
- There was no significant difference in weed control and yield between the MCPB and Tropotox treatments.
- The application of Treflan tended to reduce TR readings although this was not significant at $P<0.05$ level.
- The application of 2l/ha Treflan significantly reduced the yield of processing pea compared with the control.
- The application of 2l/ha Treflan + 200ml/ha Spinnaker significantly increased yield of processing peas over the control.
- The MCPB based treatments caused some initial leaf twisting however there was no lasting phytotoxic effect on the crop.
- None of the herbicides had any effect on emergence or pods/plant.
- None of the herbicides had any effect on the seed yield of bounty peas.

Further work

Determine if variations in the TR and yield caused by the application of some of the herbicides is repeatable.
Compare Gardoprim, Stomp and Simazine to the other chemical under conditions that are suitable for these pre emergent herbicides.
Compare mixes of some post emergent herbicides such as MCPB and Bladex to broaden weed spectrum and efficacy against more advanced weeds.

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