



The crop tolerance of peas (*Pisum sativum*) to the application of 6 common herbicide treatments. Part A, Five process pea cultivars.

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## Summary

A trial was conducted at Dromore, Mid Canterbury assessing the effect of six herbicide treatments on the yield and TR (tenderometer) of the five process pea (*Pisum sativum*) cultivars Epic, Tere, Bolero, Durango and Prolific. The six herbicide treatments included Treflan 2l/ha (400g/l Trifluralin) pre sow, Gardoprim 2 l/ha (500g/l Terbutylazine) pre emerge and the post emergent applications of Sencor 350 g/ha (700 g/kg Metribuzin), Pulsar 5 l/ha (200g/l Bentazone + 200g/l MCPB) and Bladex 3 l/ha (500g/l Cyanazine) as well as a hand weeded control plot.

Bolero had the highest pea yield of 7.8 t/ha ( $P < 0.05$ ) followed by Durango, Prolific and Tere at 7.3 t/ha with Epic having significantly ( $P < 0.05$ ) the lowest yield of 5.6 t/ha. Of the herbicide treatments Sencor, Pulsar and the hand weeded control had the highest yield of 7.5, 7.3 and 7.3 t/ha respectively. The two soil based treatments of Gardoprim and Treflan resulted in significantly ( $P < 0.05$ ) lower yields than the hand weeded control although there was no phytotoxic injury recorded throughout the growing season on any of the herbicide treatments. The application of Gardoprim to Prolific resulted in the only significant reduction in yield when compared with the untreated control, reducing the yield of Prolific by 22 %.

The main effect of Sencor significantly ( $P < 0.05$ ) reduced the TR reading at harvest from 109 for the hand weeded control to 104. The application of Gardoprim, Pulsar and Sencor to the cultivar Prolific resulted in a significant ( $P < 0.05$ ) reduction in TR from 111.6 to between 98.0 and 101.4 for this cultivar.

None of the herbicide treatments caused a reduction in the number of pods/plant but there was significant ( $P < 0.05$ ) differences between cultivars with pod numbers ranging from 4.2 for Epic to 6.3 for Prolific.

## Introduction

Adequate weed control will always be a major factor in maximising pea yields and profitability in New Zealand. There are a number of potential chemicals for use as pre sow, pre emerge or post emerge treatments however a number of these are known to cause phytotoxicity to the pea crop with varying levels of yield reduction reported in overseas literature (anon 1973, Giltrap and Roebuck 1989, Lawson and Wiseman 1974, Singh and Wright 1999, Vulsteke and Bockstaele 1974).

The prevalence of phytotoxic herbicide damage is generally associated with periods of adverse growing conditions and poor timing of chemical application (Jensen and Kirknel 1994), although severity of phytotoxicity can be cultivar dependent. The present experiment is the first part of two trials assessing the crop tolerance of 5 process and 5 field pea cultivars to the application of 6 common pea herbicides

## Methods

The trial consisted of five process pea cultivars (Epic, Tere, Prolific, Durango and Bolero) and six herbicide treatments (Table 1) and was sown on the 31/10/02 into a moist Lismore silt loam. All cultivars were sown at a rate to establish 110 plants/m<sup>2</sup> taking into account grain size and germination. The trial site received 500 kg/ha of molybdate super phosphate and 140 mm irrigation.

The pre sow herbicide treatment was applied prior to drilling and was worked in by hand, the pre emerge treatment was applied on the 2/11/02. Adequate rain fell immediately after application of these treatments to ensure activation of the active chemical. The post emerge treatments were applied on the 2/12/02 when plants were at the 5-7 node stage and weeds were between the seedling and 2-3 leaf stage. 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. Growing conditions during and after spraying were favourable with the temperature varying between 6.2°C to 21.9°C (night / day) for the two days after treatment (NIWA, pers comm.), wax levels on the leaves were not measured.

The control was hand weeded on the 9/12/02 along with the Bladex treatments as a result of poor weed control from the application of this herbicide.

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

Treatment	Active ingredient	Timing of application
Control (nil)	Hand weed	post emerge
Treflan 2l/ha	400g/l Trifluralin	pre sow
Gardoprim 2 l/ha	500g/l Terbutylazine	pre emerge
Sencor 350 g/ha	700 g/kg Metribuzin	post emerge
Bladex 3l/ha	500g/l Cyanazine	post emerge
Pulsar 5l/ha	200g/l Bentazone + 200g/l MCPB	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 number of pods per plant was determined at harvest by counting the number of pods on 10 plants per plot. Yield was determined by harvesting 3m<sup>2</sup> area per plot at the appropriate maturity more each variety and threshing through a mini viner, TR (tenderometer) measurements (3 per plot) were also taken from the threshed sample.

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% &/or 30-50% plant population
5	Crop height 50-60% &/or 50-70% plant population
6	Crop height 60-70% &/or 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

The trial was a completely randomised block design with 4 replicates and 30 treatments. Statistical analyses was conducted using analyses of variance (ANOVA) with least significant difference (LSD) calculated at the 95% level.

## Results and Discussion

The phytotoxicity effect of the various treatments on the pea crop were recorded throughout the season. Initially there was some leaf scorch but this was present in both the herbicide treated and untreated plots so was not related to the application of either the pre sow or pre emerge herbicide treatments. No further phytotoxicity effects were recorded throughout the growing season with all plots receiving a phytotoxicity score of 9 (as there was no variation this data is not presented). This is in contrast to a similar trial conducted the previous year where treatments of Sencor (350g/ha) and Pulsar (5 l/ha) caused some leaf scorch and plant twisting respectively (Hicks 2002). These effects are also noted in the agrichemical users manual (2002) and had no effect on yields in the previous years experiments. A possible explanation for differences in phytotoxicity response in the different seasons could be the more favorable growing conditions experienced during the 2002/03 season compared with the 2001/02 growing season.

Table 3. The main effect of 6 herbicide treatments on the TR measurement and yield of 5 process peas (*Pisum sativum*) cultivars. Treatments with different letters are significantly different ( $P < 0.05$ ).

Cultivar	Days to harvest	Pods/plant	TR	Yield (t/ha)
Bolero	82	5.2 b	109.0 b	7.84 a
Durango	84	6.0 a	125.2 a	7.34 b
Prolific	88	6.3 a	103.8 c	7.30 b
Tere	77	4.7 b	103.7 c	7.26 b
Epic	74	4.2 c	100.5 c	5.66 c
LSD ( $P < 0.05$ )		0.5	4.0	0.39
Herbicide				
Sencor 350 g/ha		5.6	104.5 c	7.50 a
Hand weeded Control		5.1	109.2 ab	7.31 ab
Pulsar 5l/ha		5.6	106.0 bc	7.23 ac
Bladex 3 l/ha		4.9	112.4 a	6.91 bcd
Gardoprim 2l/ha		5.5	110.4 ab	6.80 cd
Treflan 2l/ha		5.1	108.0 abc	6.72 d
LSD ( $P < 0.05$ )		NS	4.4	0.43
Mean		5.3	108	7.08
CV%		17.4	6.5	9.7

Plant counts were conducted to determine whether the application of Treflan, pre sow or Gardoprim pre emerge had any effect of crop establishment. There was no significant difference in plant populations between the herbicide treatments with plant

populations varying from 119-131plants/m<sup>2</sup>. There was also no significant difference in population between the cultivars with an average population of 124 plants/m<sup>2</sup>.

The main effects of pea cultivar and herbicide on pea yield, TR and pods/plant are presented in Table 3 along with days to harvest to give an indication of relative maturity between the different cultivars. Of the main effects Bolero had the highest yield (P<0.05) of 7.8 t/ha followed by Durango, Prolific and Tere with the earliest maturing variety Epic producing the lowest yield of 5.6 t/ha. Significant differences in the number of pods/plant were also evident with the later maturing cultivars Prolific and Durango having a greater number of pods/plant than both the early maturing cultivars Epic and Tere and the intermediate cultivar Bolero. Differences in TR levels between the cultivars were evident but can only be attributed to the timing of harvest rather than any difference between cultivars.

Of the herbicides applied not all gave adequate weed control with the Bladex treatments having to be hand weeded to remove any competition from fathen (*Chenopodium album*) that was the main weed present. Sencor, Pulsar and the untreated control had the highest yields of 7.5, 7.3 and 7.3 t/ha respectively with the application of the pre sow and pre emerge treatments of Treflan and Gardoprim resulting in a significant (P<0.05) reduction in yield. These two treatments resulted in a reduction in pea yield of 0.6 and 0.5 t/ha (8% and 7%) respectively when compared with the hand weeded control.

Table 4. The treatment effects of 6 herbicide treatments on the fresh pea yield of 5 process pea (*Pisum sativum*) cultivars. Treatments with different letters are significantly different (P<0.05).

Herbicide	Cultivar	Bolero	Durango	Epic	Prolific	Tere
Hand weeded Control		7.56 abc	7.73	5.84 ab	7.67 a	7.73
Bladex 3 l/ha		7.40 abc	7.23	5.24 b	7.55 a	7.13
Gardoprim 2 l/ha		8.08 abc	7.05	6.12 ab	5.95 b	6.82
Pulsar 5 l/ha		8.47 a	7.55	5.23 b	7.73 a	7.16
Sencor 350 g/ha		8.28 ab	7.51	6.25 a	7.80 a	7.68
Treflan 2 v l/ha		7.22 c	6.97	5.26 b	7.10 a	7.06
LSD(P<0.05)		0.97	N.S	0.97	0.97	N.S
Mean		7.84	7.34	5.65	7.3	7.26
CV %		9.7	9.7	9.7	9.7	9.7

Although there was no significant cultivar X herbicide interactions there were some varietal differences that become apparent when the individual treatment means are examined (Tables 4, 5 and 6). The effect of Gardoprim on yield was variable with no effect evident when applied to Bolero or Epic but when applied to Prolific, Durango and Tere there was a tendency for yields to be reduced, this effect became significant for Prolific with a 22% yield reduction. The main effect of Treflan over all the pea cultivars caused a significant reduction in yield (Table 3) however when each cultivars was examined individually the reduction in yield caused by the application of Treflan was not significantly lower than the hand weeded control.

Of the herbicides used in this experiment all have being recorded as causing some crop phytotoxicity and yield reductions in pea crops throughout the world. Reasons for yield reductions are variable but often related to poor growing conditions, dry light soils, leaching of pre emergent herbicides into the pea root zone and late application of post emergent herbicides (agrichem users mannual 2002, anon 1973, Lawson and Wiseman 1974, Vulsteke and Bockstaele 1974, Giltrap and Roebuck 1989). Gardoprim has also been associated with reduced root growth and reduced nitrogen fixation leading to a reduction in pea yield although these effects are more likely to occur on lighter soils lower in organic matter than those used for the present experiment (Singh and Wright 1999).

The application of Sencor had the most consistent effect on TR significantly ( $P < 0.05$ ) reducing it from 109 for the untreated control (main effects across all cultivars) to 104 (Table 3). This reduction in TR could be as a result of a delay in flowering although this was not noted and there were no other phytotoxic effects of Sencor on any of the pea cultivars. This reduction in TR as a result of the application of Sencor was also evident in a similar experiment (Hicks 2002) although the reduction in TR was not significant but there were notable phytotoxic symptoms on the crop. The main effects of the other herbicide treatments had little effect on TR with no significant difference between the hand weeded control and the other four herbicide treatments.

Table 5. The treatment effects of 6 herbicide treatments on the TR (Tenderometer) of 5 process pea (*Pisum sativum*) cultivars. Treatments with different letters are significantly different ( $P < 0.05$ ).

Herbicide	Cultivar	Bolero	Durango	Epic	Prolific	Tere
Hand weeded control		108.3 ab	120.8 b	101.3	111.6 a	104.1 ab
Bladex 3 l/ha		109.9 ab	139.7 a	102.1	107.5 ab	102.9 ab
Gardoprim 2 l/ha		116.8 a	120.2 b	102.6	101.4 b	111.0 a
Pulsar 5l/ha		108.0 ab	124.1 b	98.1	98.0 b	101.8 ab
Sencor 350 g/ha		104.6 b	118.9 b	96.9	100.7 b	101.3 ab
Treflan 2 l/ha		106.2 b	127.3 b	102.0	103.8 ab	100.9 b
LSD( $P < 0.05$ )		9.9	9.9	NS	9.9	9.9
Mean		109.0	125.2	100.5	103.8	103.7
CV %		6.5	6.5	6.5	6.5	6.5

When the individual treatment effects are examined for each cultivar (Table 5) few significant effects were present with the TR of Bolero, Epic and Tere not being significantly affected by the application of any of the herbicide treatments when compared with the hand weeded control. The application of Bladex to Durango resulted in a significant increase in TR by 18.9 units over the hand weeded control, an affect not seen in the other treatments. The increase in TR may have been extenuated by the higher average TR of Durango compared with the other cultivars. The TR of Prolific tended to be the most affected by the application of the herbicide treatments with all of the herbicides resulting in a reduction in TR. This reduction was significant for Gardoprim, Pulsar and Sencor.

The main effect of herbicide on the number of pods/plants resulted in no significant difference between herbicide treatments with a mean number of 5.3 pods/plant (Table 3). There were however some differences between cultivars (Table 6) with the number of pods/plants increasing in response to some herbicides. The application of Gardoprim and Sencor to the cultivar Durango resulted in a significant ( $P<0.05$ ) increase in the number of pods/plant from 5.6 for the hand weeded control to 7.3 and 6.8 respectively. A similar effect was seen when Gardoprim, Pulsar and Sencor were applied to the cultivar Prolific increasing the number of pods/plants from 5.8 for the hand weeded control to 7.0, 7.0 and 6.7, an increase that was significant ( $P<0.05$ ) for both Gardoprim and Pulsar but not Sencor. A possible explanation for this is that these three herbicides, Gardoprim, Pulsar and Sencor resulted in the best weed control possible allowing extra pods to be set on the later maturing pea varieties.

Table 6. The treatment effects of 6 herbicide treatments on the number of pods/plant of 5 process pea (*Pisum sativum*) cultivars. Treatments with different letters are significantly different ( $P<0.05$ ).

Herbicide	Cultivar	Bolero	Durango	Epic	Prolific	Tere
Hand weeded control		5.2	5.5 b	4.2	5.4 c	4.4
Bladex 3 l/ha		4.8	5.6 b	4.1	5.8 bc	5.2
Gardoprim 2 l/ha		4.7	7.3 a	4.2	7.0 a	4.3
Pulsar 5l/ha		5.7	5.7 b	4.5	7.0 a	5.0
Sencor 350 g/ha		5.5	6.8 a	4.4	6.7 ab	4.5
Treflan 2 l/ha		5.3	5.1 b	3.8	6.2 abc	5.2
LSD( $P<0.05$ )		NS	0.9	NS	0.9	NS
Mean		5.2	6.0	4.2	6.3	4.7
CV %		17.4	17.4	17.4	17.4	17.4

## Conclusions

- None of the pre emergent herbicides affected emergence
- None of the herbicides caused any visible phytotoxicity effect
- Bolero had significantly the highest pea yield and Epic the lowest of the five pea cultivars tested
- The application of Gardoprim to Prolific resulted in the only significant yield reduction when compared with the hand weeded control
- The main effect of Treflan significantly ( $P<0.05$ ) reduced the yield of pea by 0.6 t/ha although there was no significant difference between the hand weeded control for individual cultivars
- The TR of Prolific was the most affected by the herbicide applications
- The main effect of Sencor caused a significant reduction in the TR of the peas at harvest although there was no significant difference between the hand weeded control for individual cultivars
- None of the herbicides caused a reduction in the number of pods/plant

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