OPTIMISING TINE WEEDING IN ORGANIC PEA CROPS

F. DASTGHEIB

IWM Consultancy, 58 South Belt, Lincoln, Canterbury, New Zealand
Corresponding author: Farhad@inet.net.nz

ABSTRACT

Field trials were undertaken over three years to determine the effect of tine weeding in organic pea (*Pisum sativum*) crops in Canterbury. The tine weeding treatments were performed either as single or repeated passes at different times of crop growth. Significant weed control and yield increase were achieved with a single pass of tine weeding either at pre-emergence or at the 2-leaf stage of the crop. On some occasions two passes of tine were required to control new weeds. Late post-emergence tine weeding did not have a positive effect on pea yield.
Keywords: mechanical weed control, organic farming, spring-tine harrow, peas, weeds.

INTRODUCTION

Processing peas, especially when grown organically, are valuable cash crops. However, peas can suffer great loss due to weed competition (Harker et al. 2001). Organic pea growers in New Zealand, rely mainly on tine weeding with spring-tine harrows for weed control during the season. Most organic growers carry out several tine weeding operations during the season to control weeds. It would be useful to reduce the number of tine weeding operations as they might damage the soil and the crop.

Very few studies are reported on mechanical weed control in New Zealand. Stiefel & Popay (1990) reported 66% reduction in weed density with one pass of tine weeder but with no improvement in pea yield. Reddiex et al. (2001) tested tine weeder and spoon weeder and found no effect on weed biomass or pea yield. Overseas reports indicate the need for more research to optimise timing and frequency of harrowing for mechanical weed management (Rasmussen 1991; Welsh et al. 1997).

This study was undertaken to compare different times and numbers of tine weeding in commercially grown organic peas in central Canterbury. This report follows a previous paper (Dastgheib 2003) and summarises the results from three years of study.

METHODS

Six experiments were conducted during 2001, 2002 and 2003 on certified organic farms in central Canterbury and received the same crop management applied by the farmers. Details of experimental design, measurements and analysis for 2001 and 2002 are described in Dastgheib (2003). Briefly, both weeds and crop plants were counted in two fixed quadrats (0.5 x 0.5 m) per plot, before and one week after each tine weeding. Pea yield and weed dry matter (DM) at crop maturity was measured by hand, using two randomly placed 2 m^2 quadrats per plot. All data were analysed by ANOVA.

In 2003, plot size was 20 m long and one pass of tine weeder wide. Tine weeding treatments were designed according to the crop-weed situation as outlined in the Results section. Early post emergence weeding was conducted at 2-3 leaf stage and late post-emergence at 5-leaf stage of peas.

Five field experiments were conducted during 2001 and 2002 and have been reported earlier (Dastgheib 2003). Another field experiment was conducted at Southbridge, where cv. Aladdin was drilled on 21 November 2003. The soil was a Waimakariri sandy loam and previous crops were wheat and winter fallow.

RESULTS

All sites in 2001 and 2002

In 2001, weed density at the Rakaia and Hororata sites was similar (370 plants/m^2), while the Lincoln site had approximately 180 weeds/m^2. Pooled results from the three trials in 2001 are presented in Table 1. A single tine weeding at early post-emergence (peas at 2-leaf stage) was the most successful treatment in reducing weed density across the three farms and gave more than 70% reduction in weed numbers. All tine weeding treatments significantly increased pea yield with the highest increase in the pre-emergence tine weeding.

TABLE 1: Reduction in weed density (%) and average pea yield (t/ha) for the tine weeding treatments. Values are the mean of the three sites in 2001.

Tine weeding	% weed control[1]	Pea yield
Nil	0.0	4.19
Pre-emergence	40.2	6.47
Early post	70.5	5.89
Late post	53.2	6.10
Pre + Late	58.3	5.45
LSD (P=0.05)	15.4	1.56

[1]Weed control percentages are based on reductions in weed density relative to the nil treatment.

Both trials in 2002 showed that the best treatment was two passes of tine, pre-emergence+early post-emergence at 3-leaf stage of the crop (Dastgheib 2003). Moreover, late post-emergence weeding at 5-leaf stage was not an effective treatment.

Southbridge in 2003

Average pea population in the control plots was 118 plants/m^2. Tine weeding pre-emergence or early post-emergence at the 2-leaf stage did not affect the number of pea plants compared to the control. Post-emergence tine weeding at the 3-leaf stage caused a significant reduction ($P<0.05$) in pea population, whether alone (77 plants/m^2) or following a pre-emergence or early post-emergence tine (73 plants/m^2). Late post-emergence tine at the 5-leaf stage caused a small and non-significant reduction in pea population (88 plants/m^2), but following a pre-emergence tine weeding, this treatment caused a significant (LSD (P=0.05) =31.1) reduction (82 plants/m^2).

One pass of tine weeding pre-emergence caused a significant reduction of 57% in weed density (Table 2) while post-emergence tine at the 2-leaf stage gave 91% reduction in weed numbers. When this treatment followed a pre-emergence tine, the reduction in weed density rose to 95%. Post-emergence tine at the 3- and 5-leaf stage caused weed reductions of 74% and 72%, respectively. The greatest reduction in weed density (98%) was achieved by two passes of tine at the 2- and 3-leaf stage.

Measurements at the end of the season showed that all tine weeding treatments caused significant reductions in weed DM (Table 3). The greatest reductions in weed DM were obtained by two passes of tine, at the 2- leaf and 3-leaf stages (96%), or two passes of tine, at pre-emergence and the 2-leaf stage (90%). One pass of tine at the 2-leaf stage caused a significant reduction of 80% in weed DM.

Most tine weeding treatments gave significant increases in pea yield. The greatest yield increase of 1.6 t/ha (95%) was obtained in plots that had two passes of tine, at pre-emergence and at the 2-leaf stage (Table 3). Pea yield was not significantly different from the control in treatments with one pass of tine at the 3-leaf or the 5-leaf stage or two passes, at pre-emergence and the 3-leaf stage. Tenderometer readings (TR values) show the maturity of peas and ranged from 95 to 120 with no significant difference between treatments (data not shown).

TABLE 2: Weed density (no./m²) in tine weeding treatments at different assessment dates in the pea experiment at Southbridge in 2003.

Tine weeding	Date of tine	5/12/03	12/12/03	18/12/03	29/12/03
Nil		1115	905	912	912
Pre-emergence	26/11/03	482	472	456	456
2-leaf	5/12/03	—	85	113	113
3-leaf	12/12/03	—	—	237	245
2+3-leaf		—	—	16	38
5-leaf	18/12/03	—	—	—	258
Pre+2-leaf		—	42	75	85
Pre+3-leaf		—	—	170	117
Pre+5-leaf		—	—	—	196
LSD (P=0.05)		234.7	167.9	162.5	150.8

TABLE 3: Weed dry matter (DM) (g/m²) at harvest and pea yield (t/ha) in tine weeding treatments at Southbridge in 2003.

Tine weeding	Weed DM	Pea yield
Nil	311	1.692
Pre-emergence	153	2.675
2-leaf	62	3.195
3-leaf	140	2.006
2+3-leaf	13	3.161
5-leaf	130	1.952
Pre+2-leaf	31	3.293
Pre+3-leaf	93	2.431
Pre+5-leaf	82	3.001
LSD (P=0.05)	73.7	0.893

DISCUSSION

All experiments, conducted on different farms with different weed populations and sowing times, showed that no benefit was obtained when tine weeding was delayed until the 5-leaf stage of peas. In 2002 at Southbridge, this treatment resulted in a slight yield reduction. Tine weeding is not useful at this stage mainly because it allows weeds to grow during the early period of pea growth. Moreover, passing through the crop at the 5-leaf stage is likely to damage the plants.

In most experiments, significant yield increases were obtained with certain tine weeding treatments. This is contrary to previous reports by Stiefel & Popay (1990) and Reddiex et al. (2001) who found no yield increase in peas from tine weeding. This was mainly due to low weed populations in those studies. Apparently, peas are more vulnerable than wheat to weed competition, since wheat did not show a significant yield increase to similar tine weeding treatments in parallel experiments (Dastgheib 2004).

The present study also demonstrated the importance of timing in the success of tine weeding. The best treatments, both for reduction in weed biomass and improving pea yield, were two passes of tine either at pre-emergence and the 2-leaf stage or at both the 2- leaf and the 3-leaf stages of the crop. If for soil conservation or economic reasons one pass only is preferred, a post-emergence weeding should be done as early as peas can withstand the implement, i.e. the 2-leaf stage. Although the critical period of weed competition in peas is not well defined, most research suggests early removal of weeds is critical in optimal yield. Harker et al. (2001) reported that the onset of yield loss was

usually between one and two weeks after pea emergence. Any delay in weed control during the crop growth would allow a longer period of competition and is likely to result in yield loss.

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REFERENCES

Dastgheib, F. 2003: Timing and frequency of tine weeding in organic wheat and pea crops. *Proc. Agron. Soc. N. Z. 33*: 43-49.

Dastgheib, F. 2004: Optimising tine weeding in organic wheat. *N. Z. Plant Prot. 57*: 41-44.

Harker, K.N., Blackshaw, R.E., Clayton, G.W. 2001: Timing weed removal in field pea (*Pisum sativum*). *Weed Tech. 15*: 277-283.

Rasmussen, J. 1991: Optimising the intensity of harrowing for mechanical weed control in winter wheat. *Brighton Crop Prot. Conf. - Weeds:* 177-184.

Reddiex, S.J.; Wratten, S.D.; Hill, G.D.; Bourdôt, G.W.; Frampton, C.M. 2001: Evaluation of mechanical weed management techniques on weed and crop populations. *N. Z. Plant Prot. 54:* 174-178.

Stiefel, W.; Popay, A.I. 1990: Weed control in organic arable crops. *Proc. 43rd N. Z. Weed and Pest Control Conf.:* 138-141.

Welsh, J.P., Bulson, H.A.J., Stopes, C.E., Froud-Williams, R.J.; Murdoch, A.J. 1997: Mechanical weed control in organic winter wheat. *Aspects Appl. Biol. 50:* 375-384.