Competitive Effects of Weeds on Seed Yield of First Year Grass Seed Crops[1]

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ABSTRACT

Seed yields of first year crops of browntop (*Agrostis capillaris* L.), cocksfoot (*Dactylis glomerata* L.), and phalaris (*Phalaris aquatica* L.) were substantially reduced by the competitive effects of weeds, especially annual poa (*Poa annua* L.) In trials with herbicides, levels of weed cover differed. As level of weed cover increased there was a linear or curvilinear decline in seed yield. A 1% increase in weed cover resulted in a 0.5 to 1.78% decline in seed yield, averaging 0.9%, which was equivalent to a 7 kg ha^{-1} loss of grass seed. In all trials, plots treated with the herbicide ethofumesate gave the largest seed yields. Ethofumesate effectively controlled annual poa at 0.75 to 1.5 kg a.i. ha^{-1}. The tolerance of browntop, cocksfoot and phalaris to ethofumesate was 1.5, 2.25 and 2.25 kg a.i. ha^{-1} respectively.

Additional index words: **bentgrass, *Agrostis tenuis*, orchard grass, *Dactylis glomerata* L., herbicides, weed competition, annual bluegrass, *Poa annua* L.**

INTRODUCTION

Weeds are primarily regarded as problems in grass seed crops because they lower the purity and therefore the value of seed (Rolston et al., 1985). The competitive effects of weeds on grass seed yields has rarely been studied. By using data from herbicide trials in Oregon by Lee (1973, 1975, 1977), the effects of competition on some grass seed crops can be calculated. Seed yields of perennial ryegrass (*Lolium perenne* L.), Kentucky bluegrass (*Poa pratensis* L.) and Chewings fescue (*Festuca rubra* L.) established with activated carbon bands and residual herbicides were increased by up to 11, 18 and 34%, respectively (Lee, 1973). Wild oats (*Avena fatua* L.) were reported to have been so competitive that untreated Kentucky bluegrass plots were eliminated, while herbicide treated plots gave a satisfactory stand (Lee, 1975). Where wild oats were controlled in perennial ryegrass, yields were increased by 34, 46 and 82% in three trials (Lee, 1975). the control of annual poa (annual bluegrass, *Poa annua* L.) and ratstail fescue (*Festuca myuros* L.) in nine field trials using the herbicide ethofumesate increased the seed yields in best plots of Italian ryegrass (*Lolium multiflorum* Lam.) by 23 to 144%, average 61% (Lee, 1977). It can be inferred from these studies by Lee, that weeds cause competition and reduce seed yields.

In New Zealand trials Brown and Rolston (1983), reported that autumn sown cv. Grasslands Wana (orchardgrass, *Dactylis glomerata* L.), which produces an economic seed harvest in 9 months, was very sensitive to competition from annual poa. In another study Rolston and Hare (1986) reported seed yield increases in browntop (bentgrass, *Agrostis capillaris* L. syn *A. tenuis* L.) and phlaris (*Phalaris aquatica* L.) of 97 and 130%, respectively, when weeds were controlled.

This paper reports on the effects of weed competition measured as weed cover in browntop, cocksfoot and phalaris seed crops. While the trials were designed to examine the level of weed control and crop tolerance to herbicides, different levels of weed cover resulted from the range of herbicide treatments and rates. This enables the present study on competitive effects of weeds to be made by examining the relationship between weed cover and seed yield.

MATERIALS AND METHODS

Five experiments were conducted during 1981/83 at Grasslands Division Aorangi Research Farm, near Palmerston North (latitude 40°S) on a Kairanga silt loam soil. The site is temperate with warm summers and mild winters (annual mean temperature 13°C) with evenly spread rainfall averaging 900 mm year^{-1}.

Cocksfoot cv. Grasslands Wana was sown in two trials in autumn 1981 and 1983 at 1.1 kg ha^{-1} in 60 cm rows. Plots were sprayed 6 and 14 weeks after sowing for 1981 and 1983 respectively, with various herbicides at different rates, ethofumesate (0.5 to 2.0 kg a.i. ha^{-1}), methabenzthiazuron (1.0 to 3.0 kg a.i. ha^{-1}), and terbutryn (0.3 to 0.9 kg a.i. ha^{-1}).

Phalaris cv. Grasslands Maru was sown in autumn (early April) of 1981 and 1983 at 2.3 kg ha^{-1} in 60 cm rows. Plots were sprayed 3 and 7 weeks after sowing for 1981 and 1983 respectively, with herbicides at different rates; asulam (0.75 to 2.25 kg a.i. ha^{-1}), ethofumesate (0.75 to 2.25 kg a.i. ha^{-1}), methabenzthiazuron (1.0 to 3.0 kg a.i. ha^{-1}), and terbutryn (0.3 to 0.9 kg a.i. ha^{-1}).

Browntop cv. Grasslands Sefton was sown in autumn (early April) of 1981 at 13 kg ha^{-1} in 30 cm rows. Plots were sprayed 3 weeks after sowing with asulam (0.5 to 1.5 kg a.i. ha^{-1}) and terbutryn (0.3 to 0.9 kg a.i. ha^{-1}) and 10 weeks after sowing with ethofumesate (0.5 to 1.5 kg a.i. ha^{-1}).

Treatments were replicated 3 or 4 times in a randomized block design. Weed cover and weed species components and crop injury were visually assessed after herbicide treatments had taken effect. Nitrogen was applied in mid-spring at 40 to 60 kg N ha^{-1}. An area of 1.8 to 3.6 m^{-2} was hand harvested from each plot. Samples were air dried, threshed, cleaned and weighed. Seed moisture, purity and germination were deter-

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mined. Yields are presented as pure live seed (PLS) corrected to 14% seed moisture.

The relationship between weed cover and seed yield was studied by regression analysis, after excluding treatments where herbicides resulted in crop injury greater than 20%.

RESULTS AND DISCUSSION

Two weed species, annual poa and twincress (*Coronopus didymus* (L) Sm.) were dominant in the trials and occurred at high densities giving 60 to 100% ground cover by mid-winter. The herbicides at different rates varied in their effectiveness in controlling these weeds resulting in a range in percent weed cover. A strong competitive effect of weeds on the three species of grass seed crops is evident in all trials (Fig. 1).

Despite differences in years and timings, a consistent pattern emerged, i.e., seed yields declined as weed cover increased. The three species of grass seed crops used are regarded as slow to establish (in contrast to ryegrass) and are more sensitive to weed competition. Seed yield losses of 0.5 to 1.78%

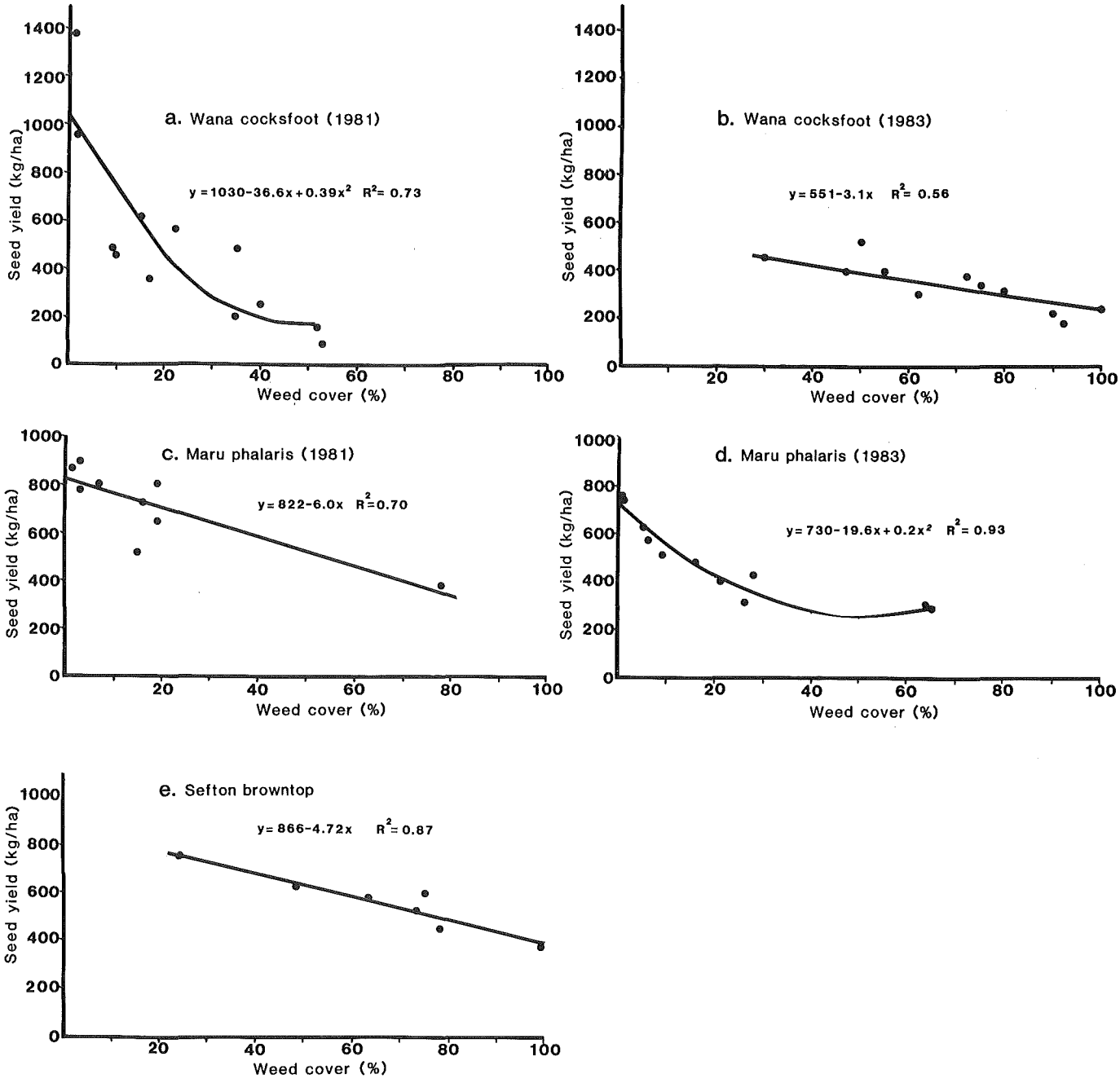

Figure 1. Effects of weed cover(x) on seed yield(y) of cocksfoot, phalaris and browntop.

occurred, averaging 0.9% for every 1% increase in weed cover, which was equivalent to 7 kg ha^{-1} of seed loss.

The difference in response between years with cocksfoot (Fig. 1a and b) is probably a result of the much later date of herbicide application in 1983 (14 weeks after sowing) compared with 1981 (6 weeks after sowing) and suggests that early weed control may give larger seed yield responses.

Our results are similar to a general pattern reported for many non-herbage grass seed crops. In a review on yield effects of herbicides on competition between crop and weed communities Hawton (1980) reports that the relationship between crop and weed top dry matter yields at harvest time is often linear.

The nature of the yield response when weed removal occurs is not clearly known, as detailed yield components were not recorded. In 3 of the 5 trials reproductive tillers were counted at harvest. There was a positive, linear relationship between reproductive tiller density and seed yield. However, variation in reproductive tiller density only explained part of the variation in seed yield, $R^2 = 0.36$ in cocksfoot, and $R^2 = 0.38$ and 0.67 in phalaris.Weed competition must, therefore, be reducing not only reproductive tiller density, but also affecting within tiller components (spikelets number, floret number, or thousand seed weight) suggesting that tiller size is also reduced by competition. Further studies are required not only to determine the effects of time of removal of competition but also the subsequent response in the components of seed yield.

In all trials the largest seed yields were recorded on plots treated with ethofumesate which is very effective for annual poa control (Lee 1977). Ethofumesate effectively controlled annual poa at 0.75 to 1.5 kg a.i. ha^{-1} with later applications being less effective. The tolerance of browntop, cocksfoot and phalaris to ethofumesate was 1.5, 2.25 and 2.25 kg a.i. ha^{-1}.

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