Tolerance to weed harrowing in spring barley genotypes

P.K. Hansen
Danish Institute of Agricultural Sciences, Department of Crop Protection,
Research Centre Flakkebjerg DK-4200 Slagelse, Denmark
prebenk.hansen[a]agrsci.dk

Introduction

Controlling weeds in spring cereals grown under organic conditions is mostly done by post-emergence weed harrowing, where spring tines of the weed harrow control weeds by uprooting and/or covering small weeds plants with soil. In situations with relatively large weed plants and relatively small crop plants, there are increased risks of crop damage by soil cover or other mechanical damages to the crop leaves. These damages are increasing with increasing weed control intensity, and result in reduced crop growth immediately after weed harrowing. There are risks that the reduced growth reduces final crop yield too. However, there is some evidence that there are varietal differences in the tolerance to weed harrowing and that tolerance is negatively correlated with competitiveness against weeds (Rasmussen *et al*., 2004). The aim of this study was to estimate the damages by weed harrowing in four pure genotypes and three two- or one three-component mixtures of spring barley, and to analyze if there were differences in tolerance to weed harrowing between the genotypes and mixtures.

Materials and methods

Four pure genotypes, three two-component mixtures, and one three-component mixture of spring barley genotypes were examined for differences in tolerance to weed harrowing in field trials at Research Centre Flakkebjerg in 2003 and 2004. The field trials were designed as a split-split-split-plot-design in combination with an α-plan. Every whole plot contained combinations of two levels of mechanical weed control (with and without a pre-emergence harrowing and one post emergence weed harrowing); two levels of pesticide treatment (with and without herbicides and fungicides) and two levels of nutrient level (40% or 80% of the recommended nutrient rate).

Tolerance to weed harrowing was measured as an immediate effect (how much of the plant was covered with soil after weed harrowing), a short-term effect (growth rate after harrowing), and a long-term effect (effect on yield). To estimate the degree of soil covering and crop growth after weed harrowing, reflectance measurements were conducted immediately prior and after the post emergence weed harrowing with a CropScan MSR16R instrument (CropScan Inc., Rochester MN 55906 USA). In the following three weeks, four measurements were conducted to measure the barley re-growth after the harrowing. Red Edge Inflexion Point (REIP) was estimated from the reflectance measurements and growing degree days (GDD) was used as the time-scale in the re-growth analysis. The reason for using REIP is the close correlation to chlorophyll content in the crop (Gitelson *et al*, 1996). Soil covering was estimated as the difference between REIP immediate before and after weed harrowing (ΔREIP). The growth rate in the following weeks were estimated as a linear correlation between REIP and time (GDD).

Results and discussion

Results from the two-year field studies showed that there were varietal differences in the tolerance to mechanical weed control in the immediate effect as well as the short term effect, however there were marked differences in the immediate and short term effects between the two years (Fig. 1). In this figure there was, for 2004, a correlation between the degree of soil cover (ΔREIP) due to weed harrowing, and the growth rate after weed harrowing, which indicate that varieties which are covered more by weed harrowing are able to compensate by an increasing growth after harrowing. However the same correlation was not found in 2003. Regarding the long-term effect of weed harrowing on yield, there was no significant differences in 2003 but in 2004, cv. Brazil and the three-component mixture suffered significantly from weed harrowing while cv. Modena, cv. Otira and the cv. Modena + Orthega mixture seemed to benefit from weed harrowing, although not significantly. These differences are probably due to differences in growth habit at the time for weed harrowing.

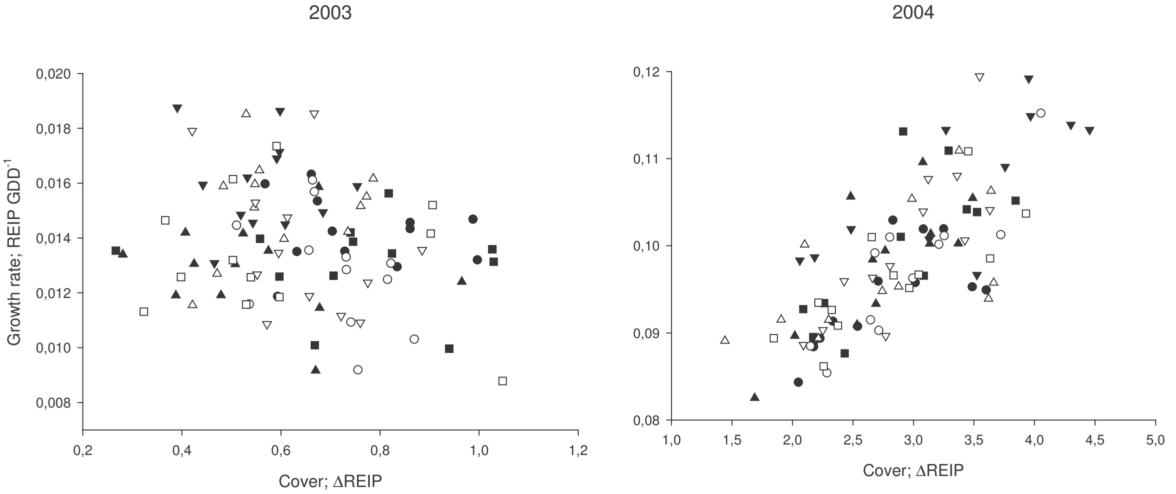

Fig. 1. Immediate effect measured as reduction in Red Edge Inflexion Point (ΔREIP) versus growth rate of Modena (●), Otira (■), Orthega (▲) Brazil (▼), 50% Modena + 50% Otira (○), 50% Modena + 50% Orthega (□), 50% Modena + 50% Brazil (Δ) and 33% Modena + 33% Otira + 33% Orthega (∇) in the 3-weeks period after weed harrowing in chemically-treated plots. Please note different scales on the x and y axes.

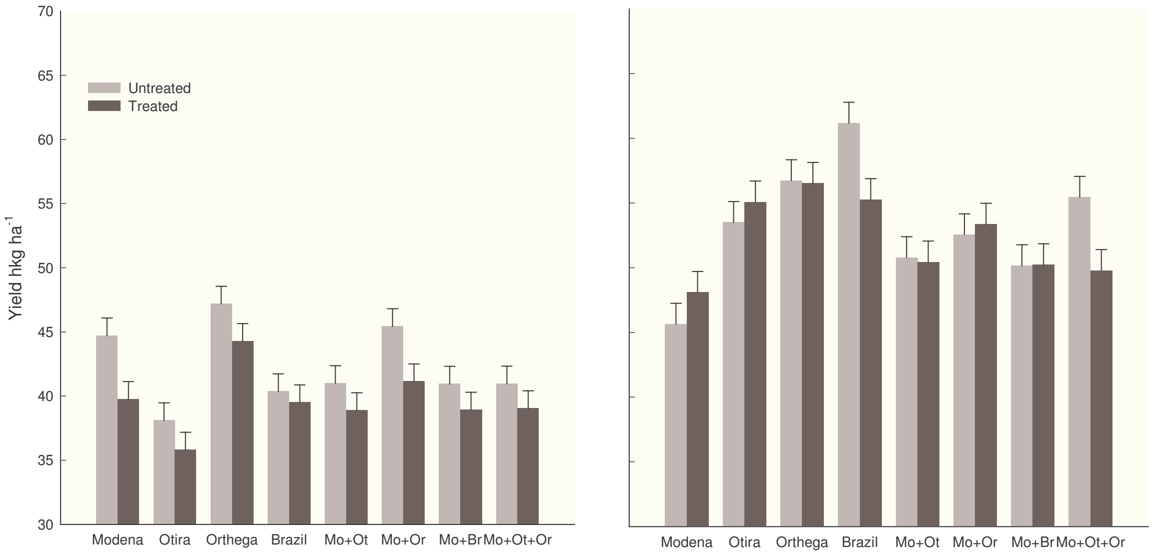

Fig. 2. Yield of the genotypes and mixtures in 2003 and 2004 in chemically-treated plots (i.e. no influence from weed competition). Light grey bars indicate mean yield from two levels of slurry application in plots *without* weed harrowing and dark grey bars indicate plots *with* weed harrowing. Please note a general yield *decrease* in weed harrowed plots in 2003, and a yield *increase* in harrowed plots in 2004 with cv. Modena and Otira and the cv. Modena + Orthega mixture (not significant) and an *decrease* in cv. Brazil and the cv. Modena + Otira +Orthega mixture ($P < 0.01$).

References

Rasmussen, J. et al. 2004. Weed Res. 44**,** 446-452.

Gitelson et al. 1996. J. Plant Physiol. 148, 501-508.