

# Applications of crop competitive ability in winter oats (*Avena sativa* L.)

Weed tolerance and suppressive ability in organic and low input systems

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Crop competitive ability is a key component of an integrated approach to sustainable weed management. Organic and low-input systems frequently use crop competitive ability as a method of controlling weeds. Oats often compete well with weeds, yet little is known about the differences in their competitive ability among varieties. This study investigated the weed competition abilities of different varieties from which we have identified traits important for weed tolerance and suppression.

• 5 **husked** & 3 **naked** oat varieties were tested over 4 trial years under **organic conditions**, with two fertility levels and naturally fluctuating weed populations.

## METHODS

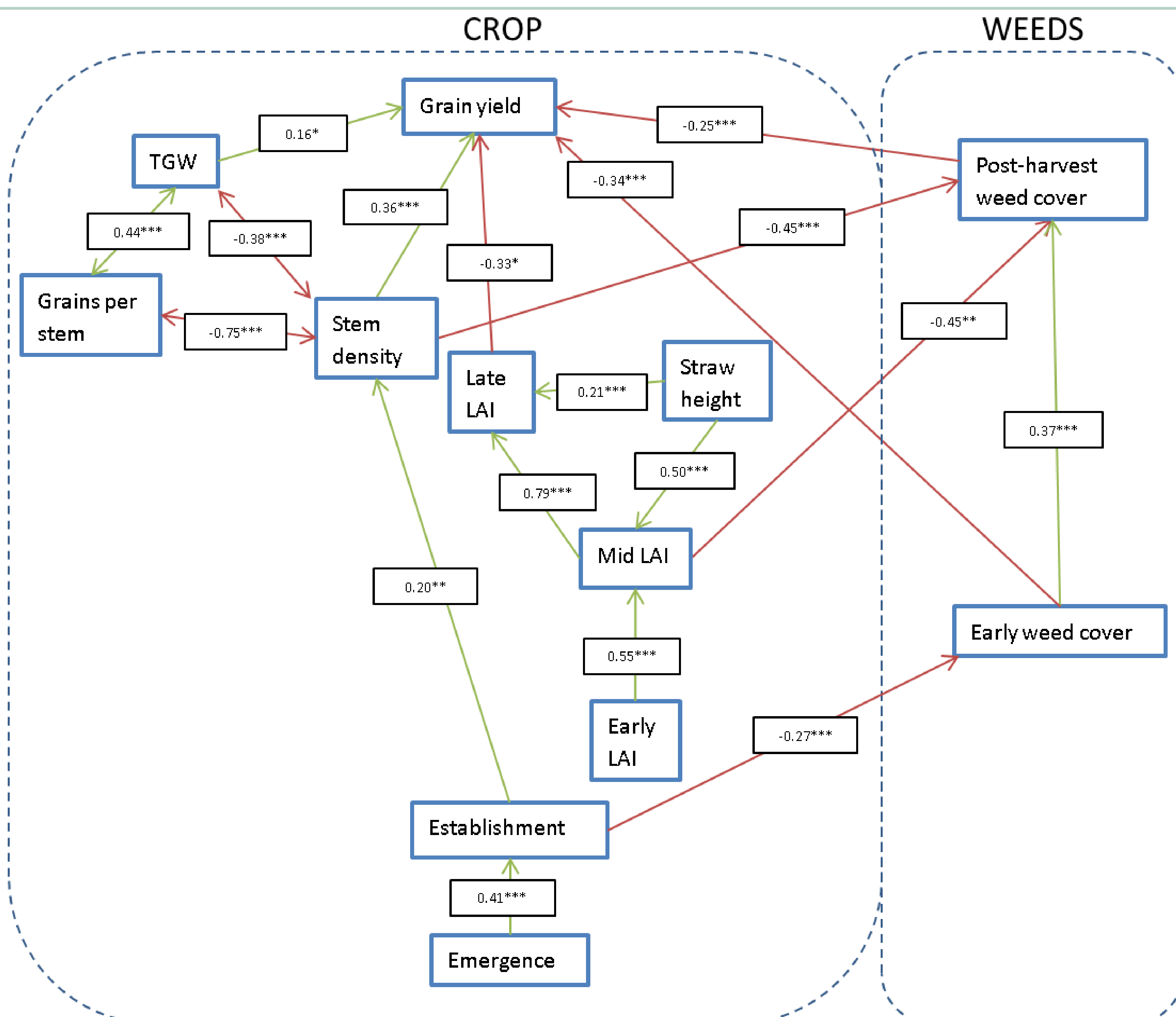
• **Crop traits** and **weed cover** were measured over the season and post-harvest

• Crop-weed interactions were analysed using **path analysis** (Fig. 1)

## RESULTS

A greater crop stem density (i.e. **tillering ability**) reduced competition from weeds and increased grain yield. However there was a trade-off against quality traits such as thousand grain weight (TGW).

Although Leaf Area Index (LAI) mid-season suppressed post-harvest weed cover, excessive vegetative growth later in the season reduced crop yield. Therefore, suppressive traits such as LAI should be enhanced only **early in the season**.



Grain yield was reduced by both early season and later season weed competition.

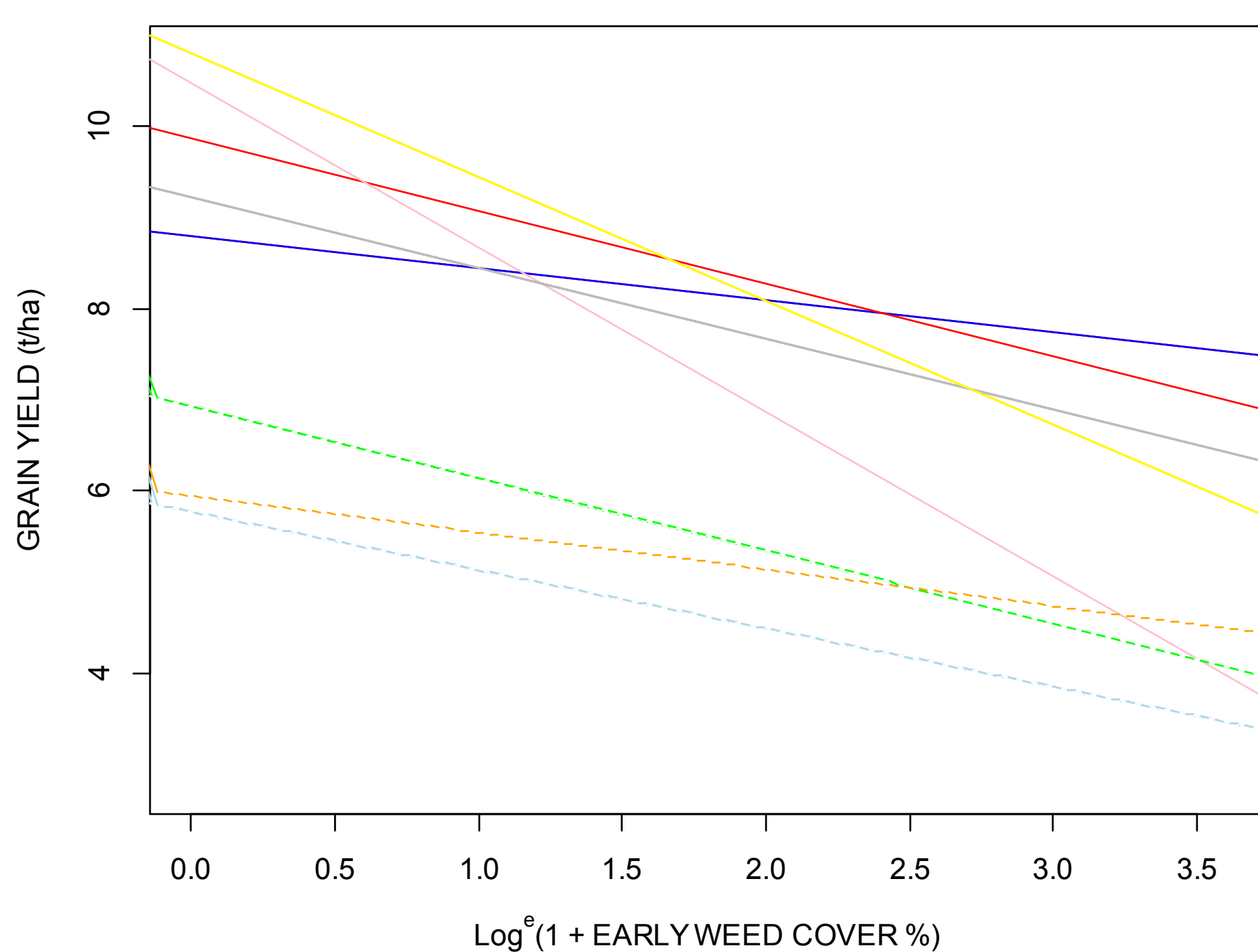
Resultant post harvest weeds were suppressed throughout the season by the shading effect of crops with high mid season **Leaf Area Index (LAI)**, and high stem density indicating **tillering ability**.

**Crop height** did not directly suppress weeds but is correlated with a greater **LAI**.

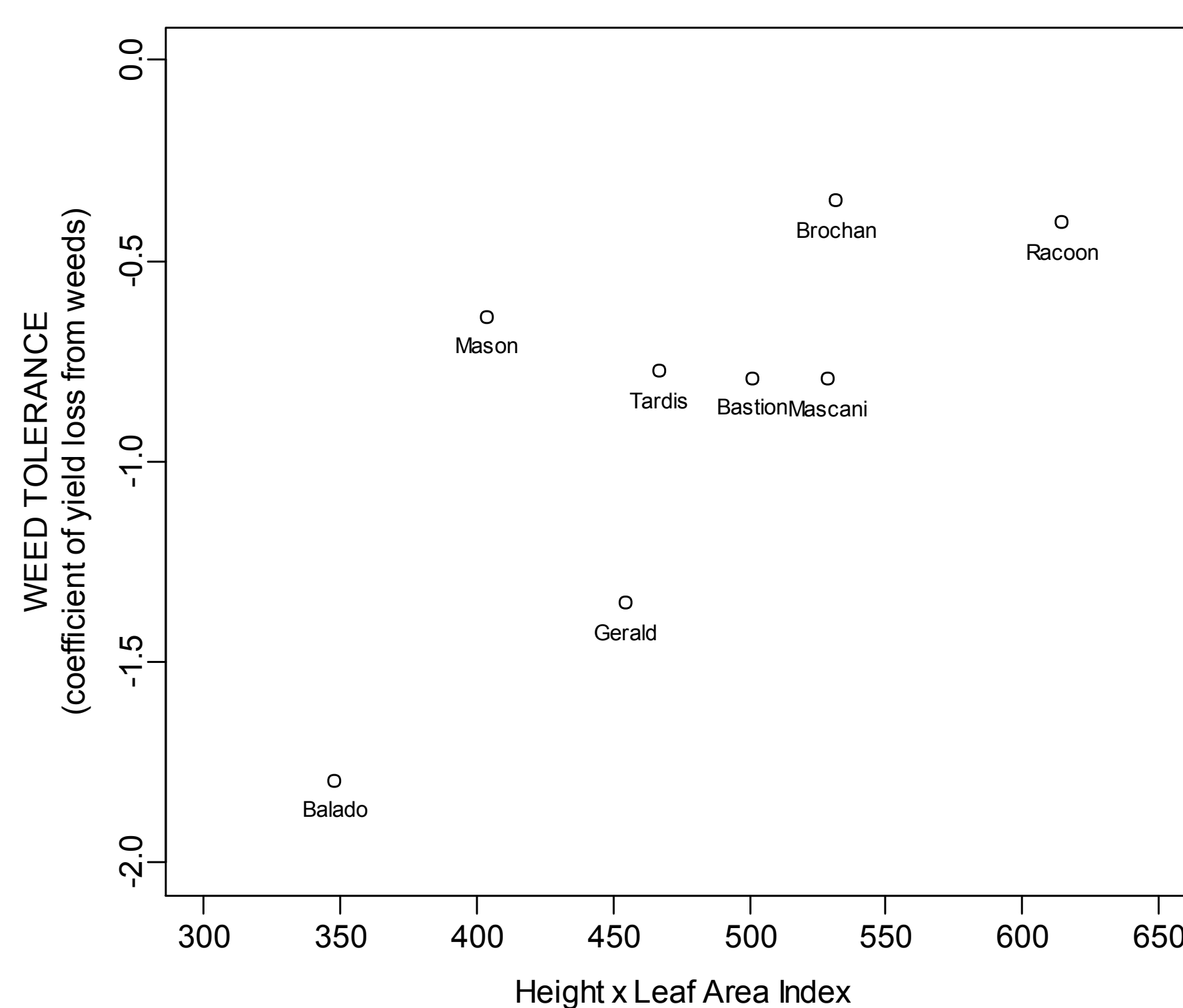
Weeds were suppressed at an early stage by crops with good **establishment rates** which suggest a possible role for below ground competitive interactions.

**Figure 1.** Path diagram showing the hypothesised direct effects on husked oat grain yield and weed cover. Only standardised direct path coefficients (unidirectional arrows) and correlation coefficients (double-headed arrows) significant at  $P < 0.05$  are included in the diagram. Asterisks indicate significance levels; \* =  $P < 0.05$ , \*\* =  $P < 0.01$ , \*\*\* =  $P < 0.001$ .

Grain yield correlated negatively with increased weed cover and there was a significant variety by weed cover interaction ( $P < 0.001$ ) indicating differences in **weed tolerance** among varieties (Fig. 2). Differences in the varieties weed tolerance can be conferred by a combination of both crop height and canopy cover (LAI) (Fig. 3).



**Figure 2.** The relationship between grain yield and percentage early weed cover. The slope of each line indicates the relative **weed tolerance** (rate of yield loss with greater weed levels) of each variety: **Mascani**, **Brochan**, **Balado**, **Gerald**, **Tardis**, **Mason**, **Bastion**, **Racoon**. Solid lines indicate husked varieties, dashed lines indicate naked oat varieties.



**Figure 3.** The relationship between a variety's weed tolerance and a combination of a variety's average height multiplied by its Leaf Area Index.

Weed suppressive trait	Broad sense heritability (H <sup>2</sup> )
Tillering ability	0.90
Establishment rate	0.67
Mid season LAI	0.73
Late season LAI	0.70
Height	0.98

## CONCLUSIONS

- Traits relating to early season competition may be related to below ground competition for nutrients and rapid canopy development for light competition.
- Tillering ability is a key trait for stronger weed suppression and higher yield, and also has good heritability.
- Later season suppressive traits that involve high vegetative growth should be limited to minimise productivity trade-offs.
- Weed tolerance is also important for dealing with uncontrollable weeds and may be conferred by a combination of LAI and sufficient height.