Oat variety characteristics for suppressing weeds

*The excellent weed suppression ability of oats makes them a valuable part of crop rotations in organic and conventional farming systems. ORC researchers **Thomas Döring, Louisa Winkler** and **Nick Fradgley** report new results that show how plant breeding can bring further improvement.*

Weed control is probably one of the topics that will never leave farmers' and researchers' to-do lists. Including oats in the rotation contributes towards weed control as, in comparison to other cereals, they are effective weed suppressors. Oats are allelopathic, secreting weed-growth inhibiting compounds from their roots. Also, because of their tall stature, they can create a denser canopy than other cereals such as wheat or barley, and are thereby able to suppress competing weeds by shading out light.

Nonetheless, as in other cereals, breeders are attempting to create oat varieties with decreased plant height, both to reduce the risk of lodging and to allocate a higher proportion of biomass to grain yield. This leads to a conflict of goals: reduced height for lodging resistance on the one hand and tall plant height for weed suppression potential on the other.

Importantly, because the organic sector does not yet have the resources to run dedicated organic oat breeding programmes, it still depends on conventional cereal breeding, wherein weed suppression is generally less important than lodging resistance.

Varieties and lodging

We considered whether a compromise could be achieved by finding oat varieties that display high weed suppression ability whilst being relatively small in stature. To do this, we looked at data from an oat variety trial run as part of the *Harnessing new technologies for sustainable oat production and utilisation* (QUOATS) project over three years at Wakelyns Agroforestry, Suffolk.

This replicated field experiment was conducted using five husked and three naked oat varieties under two different fertility regimes (with and without added chicken manure pellets). Among other parameters, the canopy cover (Leaf Area Index or LAI) was measured three times during the growing season; this is a measure of the light which penetrates the crop canopy and becomes available to the weeds. Crop yield and final crop height were also measured and weed cover levels were estimated post-harvest.

With this dataset we first tested whether taller varieties display more severe lodging. This was generally the case, but not in all years: in one year (2010/2011), there was no lodging at all, mainly because a very dry spring had led to stunted crop growth; in the other two years, there was a significant increase of the lodging index with crop height (Figure 1). This indicates that even within organic systems, it is useful to grow varieties that are not too tall, in order to avoid excessive lodging.

Secondly, we looked at the relationship between crop height and weed levels. As expected, we found that tall plant height was significantly associated with lower post-harvest weed levels. However, other characteristics of the crop, in particular, the mid-season LAI, were found to be better predictors of weed suppression than crop height.

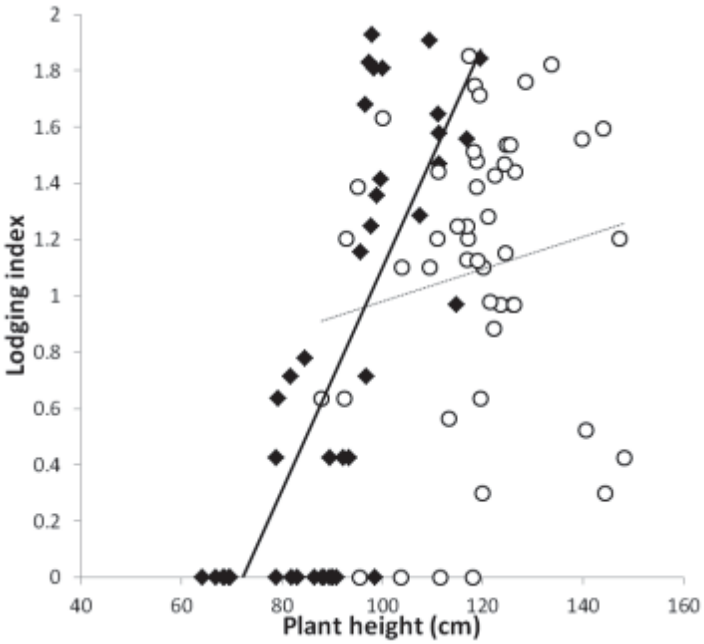

Figure 1: Taller plants increase lodging risk.
Data from 2009/2010 (in black) and 2011/2012 (in white). In 2010/11 no lodging was observed.

The importance of canopy cover (LAI)

Taller oat varieties generally tend to have a higher LAI, but an important question is whether 'outlier' varieties can be found that simultaneously exhibit low lodging risk through relatively short height and high weed suppression through a relatively high LAI. Among the husked varieties grown at Wakelyns, there was one variety (Brochan) that showed a high LAI but is not too tall in stature (Figure 2). Among naked oats varieties, however, none showed this combination of characteristics.

In terms of yield, although there are significant differences between varieties, there was no clear winner over the three years. Out of the husked varieties, Balado did yield significantly lower over the years; whether this can be attributed to its shorter height and lower LAI is unclear.

Across all varieties, we observed a significant relationship between high LAI and high yields. This is due to the fact that up to a point a denser canopy can mean more leaf area for photosynthetic energy, which will increase grain yield.

Theoretically, there can also be a trade-off between LAI and yield, as the plant uses energy producing the canopy rather than investing it into the grain. However, we found no evidence of such a trade-off, meaning that the mid-season canopy cover emerges as a useful selection criterion for oat varieties.

Our results suggest that oat varieties which combine a high LAI for weed suppression with relatively short plant stature are particularly relevant to organic agriculture, where weed populations are sometimes hard to control.

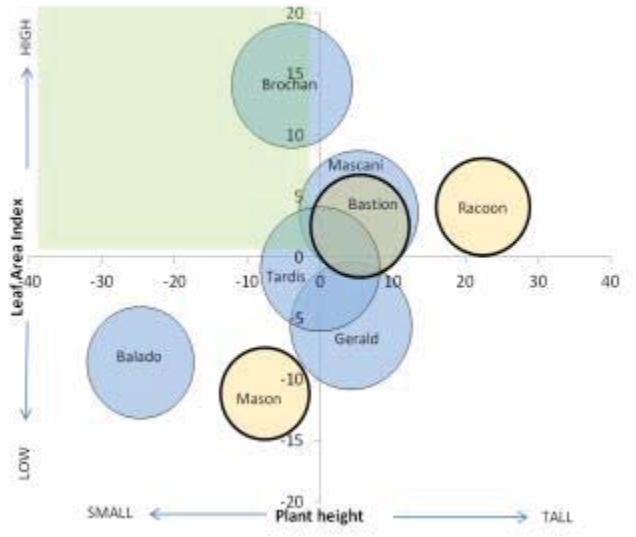

Figure 2: Relative differences (% of average) in LAI and height of selected oat varieties. Darker shaded circles are husked and lighter circles naked varieties. Size of circle indicates average yield of each variety. Shaded square shows area where below-average crop height (small stature) is combined with above-average LAI.

For plant breeders developing oat varieties for organic systems, high canopy cover should be considered an important trait.

Acknowledgements

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Book Review: *Organic Agriculture for Sustainable Livelihoods*

Edited by Niels Halberg and Adrian Muller.
Earthscan from Routledge, Abingdon (2012).
ISBN 978-1-84971-296-5. £ 29.99.

When starting to read this book I was a bit sceptical about whether yet another book on organic agriculture was needed, but I was positively surprised. The book, edited by prominent organic researchers Niels Halberg and Adrian Muller, not only claims but really does provide a timely analysis and assessment of the potential of organic agriculture for rural development.

In the battle of discourses over food production it places itself firmly on the side of the school of thought that is now frequently labelled 'sufficiency' as opposed to 'productivist' in the debate on 'sustainable intensification'.

The authors explore the role that organic agriculture can play, with a clear focus on livelihoods and the potential of organic agriculture and agro-ecology to act as a laboratory for development of future sustainable food production.

The book's main focus is on developing countries - and includes recommendations of the research needs of organic agriculture in sub-Saharan Africa - but it has broad relevance. It challenges the simple assumption that feeding the world depends only on high wheat yields and highlights recent studies showing clear differences between the relative yields of fruits and vegetables with those of cereals and oilseeds.

As 90% of the world's farms are small, with less than 2 ha, and faced with poverty and social exclusion, the authors explore whether smallholder farmers can really take part in market chain development, setting out that just being organic does not automatically lead into a 'safe haven'.

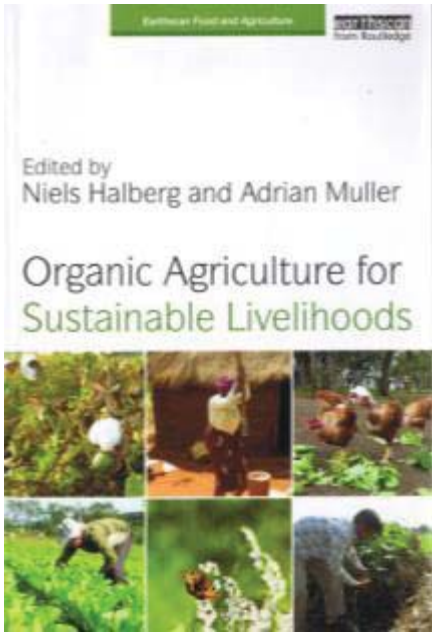
Several chapters cover agro-ecology, exploring to what extent agro-ecological methods are actually used in organic agriculture; the different meanings that the term can have; how it is applied in Latin America as a set of practices and a social movement; and proposals for a set of agro-ecological indicators related to the principles of organic agriculture that could guide future development.

The literature on climate change and other environmental impacts of organic agriculture is summarised and the potential of organic agriculture in assisting farmers to adapt to climate change is outlined.

But several chapters make it clear that the message about the wide range of benefits of organic agriculture has not yet reached many governments. The obstacles in terms of conventional mindsets and vested interests are covered and policy support in two large 'emerging' countries, Brazil and China, is examined.

Chapters have been authored by various teams, often from different parts of the world. Whilst the chapters explore different topics and can stand on their own, the editors have succeeded in bringing them together in one book.

Four well-chosen and informative case studies round the book off, covering topics as wide ranging as: farmer learning groups from Denmark to Uganda; experience with carbon credits; the impact of organic/fair trade on smallholder livelihoods in Sri Lanka; and life-cycle assessment of organic juice imported to Denmark from Brazil.



The book provides much food for thought. It is well referenced throughout and will help anyone faced with the question 'Can organic farming feed the world?'. So I would recommend it for the Christmas wish list.

Susanne Padel