Can black grass be controlled by grazing sheep?

The Organic Research Centre has been working with John Pawsey of Shimpling Park Farm carrying out research trials funded by the Duchy Originals Future Farming Programme (DOFF). The aim of the research was to examine the efficacy of sowing timings and sheep grazing for the control of black grass in an organic cropping system. Having recently reintroduced stock back onto the farm this created a fantastic opportunity to investigate the role of livestock as an integrated approach to weed control, assessing the once traditional method of grazing winter cereals in early spring. ***Dominic Amos, Nick Fradgley*** *and* ***Ambrogio Costanza*** *report.*

The black grass problem

Black grass *(Alopecurus myosuroides)* is a major issue in UK arable cropping systems and has become more problematic due to winter heavy crop rotations and increasing herbicide resistance. Organic systems rely on cultural weed control and use crop rotations to help avoid major weed issues but many non-organic farmers are also turning to an integrated approach combining cultural methods with chemical treatment.

A lot of work has looked at cultural control methods and in particular effects of delayed drilling in the autumn and comparisons between autumn and spring cropping. However, delayed sowing implies increased risks of adverse weather affecting drilling operations, crop establishment and yield, particularly on the heavy lands that are also most affected by black grass infestations. On the other hand, early sowing dates can improve yields and limit climatic risks of delayed drilling, but are at odds with black grass control. This implies that more complex strategies have to be explored.

This work addressed the traditional method of grazing cereals in early spring, once more common on mixed farms, especially in the west of England, and still widespread in countries like the USA and Australia. Grazing a wheat crop in early spring can provide green forage during the winter feed gap as well as offering weed control, disease control by reducing disease loci and reduced lodging risk by shortening crops.

Setting up the trial

The idea for the research came from discussions with John Pawsey about the black grass problem on his farm and methods of control, such as the importance of crop competition. He has previous experience of grazing wheat with sheep in the spring, with the aim of trying to investigate potential yield losses. He observed a negative effect on crop competitiveness from reduced crop cover later in the season.

The trials were designed to test the effects of sheep grazing on black grass abundance and on wheat crop performance in a normal and early sowing date.

The research was carried out at Shimpling Park Farm in Suffolk, over the 2014/15 and the 2015/16 growing seasons. Several key parameters were assessed over the course of the trials, including black grass head numbers, crop height, crop tiller counts, grain yield and grain quality assessments such as thousand grain weight and specific weight.

In both years' trials, two drilling dates were included as factors. A 'normal' sowing timing around mid-October was chosen to mirror the farmer's practice and act as a control

Figure 1: Sheep grazing plots in Mill Field in April '16 (Year 2)

and an 'early' sowing in both years was carried out 3-4 weeks before the normal sowing date. Drilling rates were adjusted according to the sowing timing as is normal practice (170kg/ha and 220kg/ha for early and normal sown respectively).

Grazing method

Sheep grazing took place in early spring and was left up to the farmer's judgement as to when, for how long and at what stocking rate. The only major stipulation was that grazing had to be suspended before the onset of wheat stem extension (BBCH 30), to avoid any damage to the apical meristem which would cause severe yield losses. Stocking rates in year one were 6.3LU per ha (Livestock Units) with the sheep left to graze for four to five days. In year two the decision was taken, due to bad weather, to increase the stocking rate (12.5LU per ha) and reduce grazing time to three days, allowing for a shorter grazing window. John removed the sheep from the plots when he felt that enough defoliation had taken place without causing undue stress and damage to the crop.

An important aspect of the trials was to work closely with the farmer and to let him take the management decisions that he would ordinarily take in his own system to give him control and create a more realistic situation.

One significant change to the trial was an adaption of the design from year one to simplify the drilling strips in order to reduce compaction from several passes of the drill. In each year and sowing time, we had three plots that were either grazed or ungrazed.

Data collected thereby were subject to analysis of variance (ANOVA) to separate the effects of grazing from the effect of the year and of the random variation in each sowing date.

Grazing effects?

Overall, grazing had a significant effect on black grass in the early sown crop (Figure 2). The density of black grass heads was nearly 20% lower in the grazed plots, whereas in the normal sown crop differences were not significant. This suggests that grazing may be an effective strategy to reduce a high pressure of blackgrass and buffer the risks associated with earlier sowing dates.

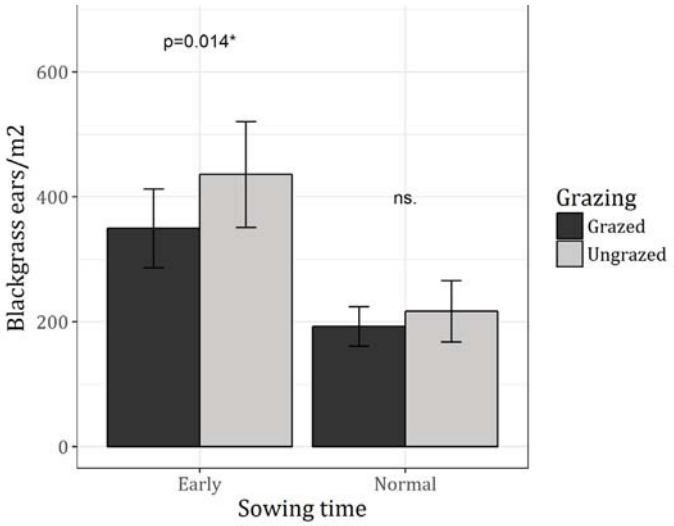

Figure 2: Effect of sheep grazing on blackgrass ear numbers for the two sowing timings. Bars are mean values over the two years (tot. 6 observations) ± standard error of the means. ANOVA p-values for the effect of grazing are shown.

Our study found a small reduction in grain yield from grazing but it wasn't found to be statistically significant for either drilling (Figure 3). However, the data suggest we can't be too certain that there is definitely no yield penalty for the normal sowing timing. These results suggest that a possible yield penalty from grazing in the normal-sown wheat was not mitigated by a significant reduction in blackgrass head numbers and an associated reduction in weed competition as was the case in the early-sown crop. An Australian review by Harrison et al. 2011[1], found that 270 dual purpose crop experiments (grazed or cut), revealed an average grain yield

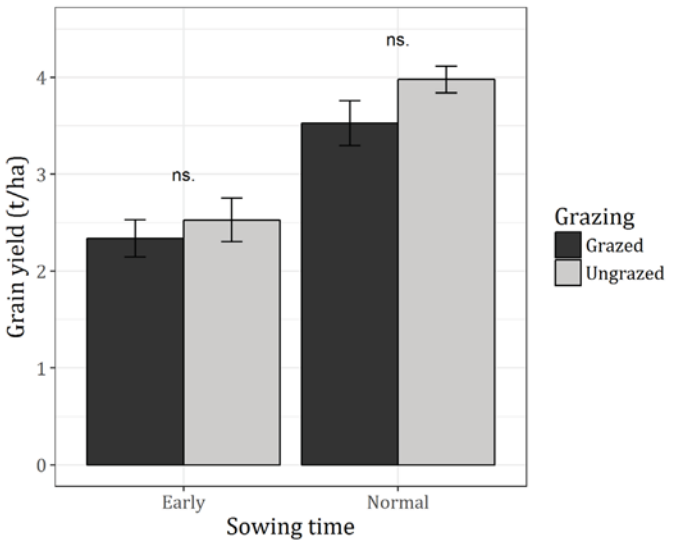

Figure 3: Effect of sheep grazing on grain yield for two sowing timings. Bars are mean values over the two years (tot. 6 observations) ± standard error of the means. ANOVA p-values for the effect of grazing are shown.

reduction of 7% (+/- 25%). Another consideration is that grazing took place on the same calendar dates (rather than days after sowing) so the crops were at slightly different stages of development. The less advanced normal sown crop may therefore have been less tolerant of grazing. It also means the black grass may not have been advanced enough to be damaged, hence the insignificant result for black grass ear numbers.

Related to these findings are the data from crop tiller counts which were not significantly affected by grazing in the early sown crop but which showed a strong trend towards reduction in the normal sown crop.

Another relevant finding is the significant reduction in crop height from grazing observed for both sowing timings, which may reduce the crop's competitiveness with some weeds but it didn't appear to be linked with black grass numbers since the shortest grazed crops were also the crops with the lowest black grass headcounts. Crop height reduction might be due to both a physical shortening and a delaying effect on crop development. The straw length at harvest retained much of this effect, resulting in a weakly significant 5% shorter straw in both early (p=0.09) and normal sown (p=0.07) crops (Figure 4). This effect might be relevant to the risk of lodging, which is associated with practices aimed at improving crop competition against weeds, such as increased sowing rates, use of taller varieties, and early sowing itself.

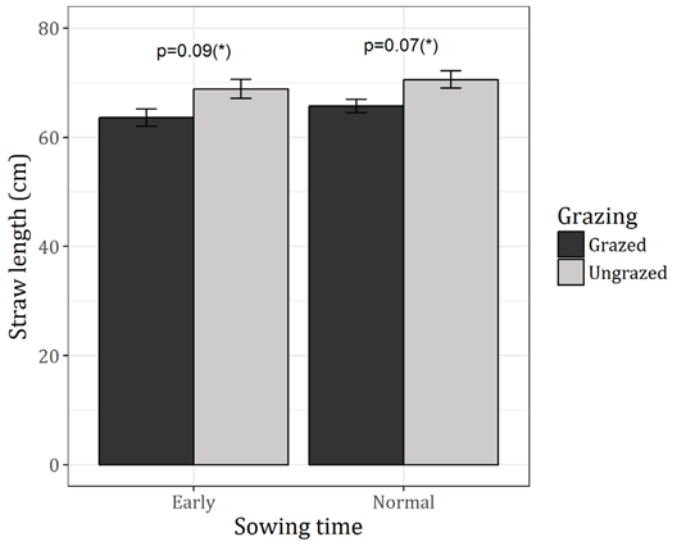

Figure 4: Effect of sheep grazing on mean straw height in July for two sowing timings. Bars are mean values over the two years (tot. 6 observations) ± standard error of the means. ANOVA p-values for the effect of grazing are shown.

Sowing date effects?

The trial design in year one allowed a comparison of sowing timings to be performed.

Year one data showed a 47% reduction in black grass head numbers from the later sowing date (early/mid-October). This figure is similar to data from a recent AHDB report[2] which showed a 33% reduction in black grass infestations from delayed sowing (though the study was conducted in non-organic cropping systems). The same study showed a 92% reduction in black grass numbers from spring sowing, highlighting the importance of moving away from autumn

only rotations in intensive arable cropping systems where black grass is an issue.

Year one data also showed a significant increase in grain yield (p= 0.00) by 71% from 2.11t/ha to 3.61 t/ha, with reduced black grass density the most likely cause of this yield difference.

The other interesting result from the analysis of variance for year one data was a significant (p=0.05) interaction between sowing timing and grazing, which shows that the efficacy of grazing depends on the sowing date, with the biggest effect observed for the early sowing timing. Grazing is much less effective for black grass control on normal sown wheat.

Further rotational benefits from sheep grazing?

Beyond any possible weed control benefits of integrating sheep into an arable rotation there may be additional benefits that are harder to quantify and were beyond the scope of this study. These include but are not limited to: diversity of mixed farming systems, improved livestock nutrition (extra forage making the most of cereals as both forage and grain crops), added fertility from sheep, decreased soil weed seed bank and improved economics of making the grass ley phase of the rotation more profitable.

For those who might be interested in trying this practice an Australian review by Harrison *et al.*[1] lists the key management strategies (in order of importance) as;

1. Terminating grazing at or before BBCH 30
2. Matching crop phenology to environment type
3. Sowing crops to be grazed 2-4 weeks early
4. Ensuring good crop establishment prior to grazing.

Although point 3 is at odds with the findings of this study and many others suggesting that a later sowing date is preferable for black grass control (and a subsequent improvement in yield) in areas of high black grass pressure, the dual purpose technique may still be successful in farming systems where black grass is not a major issue.

Further investigation is needed in different cropping systems with different weed burdens to establish how and where the technique of sheep grazing winter cereals in spring can best be applied but it would appear from our findings and from other research that, if early sowing is a prerequisite of the technique, that it is probably not best suited to farms with a lot of black grass.

Interestingly the traditional technique may be more useful for those non-organic farmers taking an integrated approach as not only is blackgrass more of an issue in more intensive arable cropping systems that don't contain grass leys and are winter crop heavy, but it may have some extra benefits for those applying synthetic nitrogen by reducing crop height and therefore lodging risk.

The practice may also be tested on more traditional heritage varieties that may be better suited to the practice and to organic cropping systems, such as Maris Widgeon, which is taller than modern varieties and may therefore benefit from the reduced risk of lodging while still maintaining its competitiveness with weeds.

Conclusions

In terms of black grass control in winter wheat it wouldn't appear to make much sense to introduce sheep onto the crop since the data from both years show that sheep grazing is only effective at reducing black grass in a mid-September sown crop, and it is inadvisable in an area of high black grass pressure to sow your crop 'early'. Data from year one show that drilling date is far more important as a factor for black grass control (47% reduction in black grass ear numbers from an early/mid-October sowing) than grazing (21% reduction in black grass ear numbers).

This does not mean to say that the technique of cereal grazing can't be used to good effect for supplying extra forage during the winter feed gap or that it may not be useful in controlling other weeds and providing some of the other rotational and system benefits discussed.

References;

1. Harrison MT, Evans JR, Dove, H and Moore AD (2011). Dual-purpose cereals: can the relative influences of management and environment on crop recovery and grain yield be dissected? Crop Pasture Sci 62:930–946.
2. Moss S, Hull R, Knight S, Cussans J, Project Report No. 560: Sustaining winter cropping under threat from herbicide-resistant black-grass (*Alopecurus myosuroides*). AHDB