Blending wheat varieties can have positive yield and reduce disease impacts

Background:

In 2019, I applied to host a trial on our farm via the Rothamsted FarmInn initiative after seeing it advertised in the Farmers Weekly. I had read a Nuffield Scholar report about the benefits of mixing varieties, so this was something I was interested in seeing if worked on the farm at home, with the benefit of Rothamsted's scientific procedure and protocols.

The project specifically considered the question: *What impact does blending wheat varieties have on yield, disease resistance, GAI and competitiveness against weeds?*

Why use wheat blends?

In theory, blending varieties can add increased resilience to the crop rotation by choosing varieties that have specific traits that complement each other, for example mixing a variety with a high yield potential, but lesser disease resistance score, with a variety with a higher disease resistance score but lower yield potential from the AHDB Recommended List. The concept is that blending can produce effects that are greater than the sum of the individual parts e.g. if the varieties were grown individually. This effect is complex to predict, with the AHDB producing a variety blending tool that allows growers to see the estimated impacts of blending different wheat varieties and their parentage for trial on farm. However, the effect is complicated and trialling blends on farm is recommended.

There has been recent interest in blending wheat varieties, for example, in France it is estimated that the area of bread-making wheat varieties grown in mixtures has more than doubled recently – from around 5% in 2017 to around 12% in 2020 (source: FranceAgriMer). In the UK, there have been farmer led trials looking at blends, and a small CPM survey found 60% of respondents to their survey were already growing blends or intended to start.

The main benefit of varietal blends is to increase crop resilience as part of a risk management strategy. Mixed varieties with different traits can increase pest and disease resistance which can provide more flexibility with timing of pesticide applications, particularly useful when trying to get round large blocks of land or if weather constraints are narrowing the spraying window. Having more disease resistant varieties in the blend may increase grower confidence to reduce fungicide intensities (and costs), or reduce the risk of significant yield losses in high disease risk seasons. Weather resilience is an important benefit to UK agriculture, as the MET Office forecasts climate change to lead to summers in 2070 to be up to 60% drier than those in 1990, and between 1 and 6°C warmer. In contrast, winters in 2070, compared to the climate in 1990 are predicted to be up to 30% wetter, with an increase in rain intensity by up to 25% (MET Office, undated).

Trial Method

To test varietal mixing, 15 treatments were sown in 2m x 12 m plots, repeated four times using randomised block design. Four varieties were selected for this experiment due to their range of disease resistance and yield traits. Each these varieties were sown singly, as a two way mix, as a three way mix and as a four way mix.

The varieties tested were:

- Graham
- Mowtown
- Sundance
- Theodore

Results:

In terms of **yield**, this trial showed that mixing varieties has an overall positive effect on yield, with an average yield benefit of 0.3t/ha across all varietal mixtures compared to growing the varieties separately. Some mixtures had higher yields than others, with the Graham x Mowtown x Theodore mix yielding 0.7t/ha more than these varieties grown individually. Overall 9 out of the 11 varietal mixtures, returned a higher yield than would be predicted from the individual variety performance. Mixtures of three or more different varieties showed a trend for higher yields than those mixtures containing just two varieties.

This is really promising, as it shows that you can mix varieties and there is no yield penalty in most cases, and in fact the yield benefits seen in the field are greater than what could be predicted in theory. This means varieties could be picked that have different strengths such as one variety picked for its disease resistance and one variety picked for its yield and one for vigour for example and sown together as a mix, so that you would get the benefits of these traits together in the field.

This is not new science, the benefits of varietal mixing have been shown in the scientific literature before, however, it is useful to see these benefits are still being demonstrated with modern varieties. The downside is the practicality of mixing varieties either on farm or by the seed companies, and this challenge is likely to have slowed the adoption of this method.

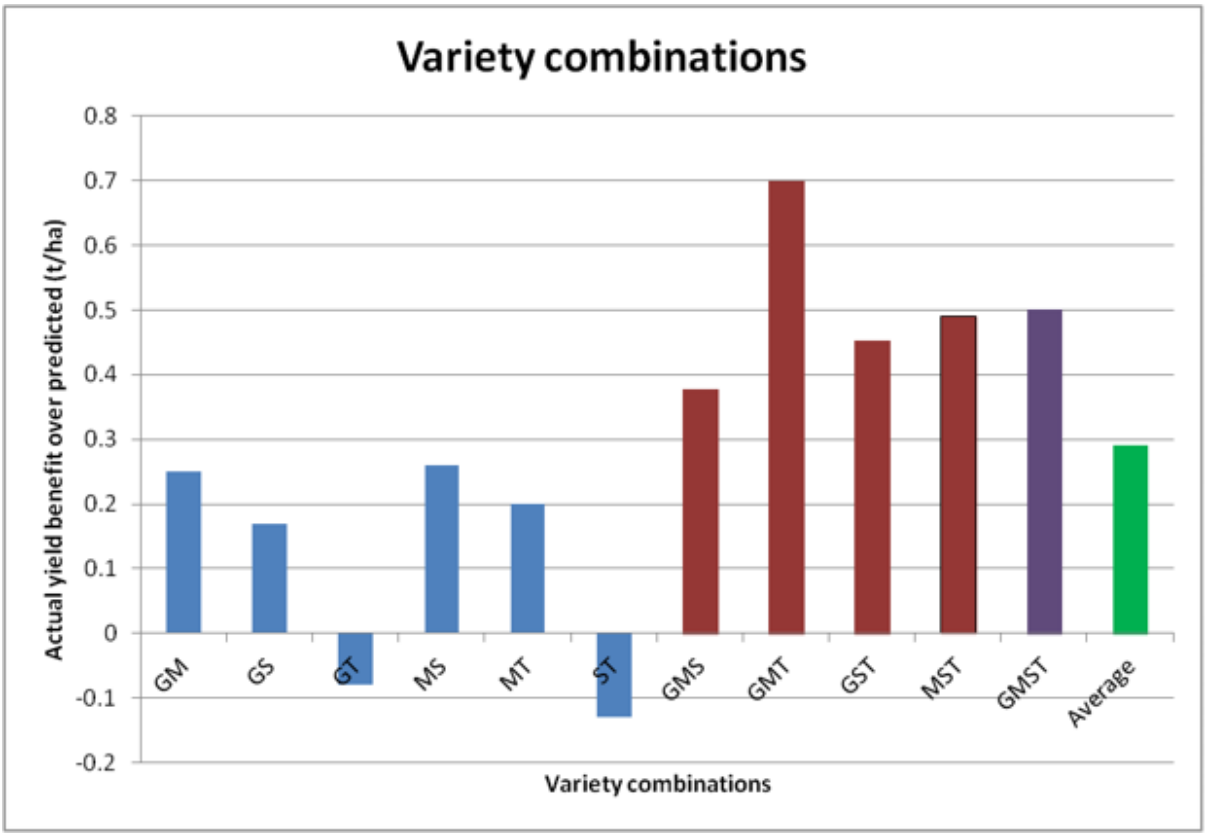

Figure 1 – Comparison of actual and predicted yield differences (t/ha) from different variety blend combinations. The average bar chart on the graph shows the predicted yield benefit from varietal mixing. The bars of each varietal mixture show the actual result from the trial. The bars coloured in blue show 2 way varietal mixes. The bars in red show three way varietal mixtures. The bar coloured in purple shows the four way varietal mix.

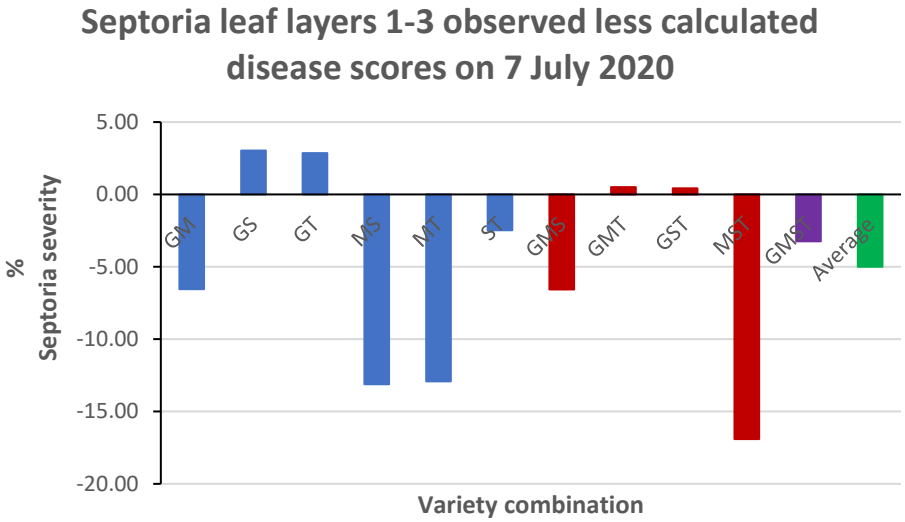

Figure 2- Actual vs predicted disease severity scores for Septoria when different varietal blends were sown

So how does varietal blending affect **septoria resistance?** This trial shows that mixing two or more varieties has a net benefit of reducing Septoria by 5% (leaf area affected) on average compared to growing the varieties as single varieties. Of the mixtures, 7 out of 11 showed a reduction in disease beyond what would be expected by the average performance of the varieties, 2 varieties performed similarly as would be expected by the individual varietal performance, and 2 variety mixtures and slightly more disease than would be expected. The mixtures with the lower Septoria severity was the three way mix of Mowton + Sundance + Theodore and the two way mixtures of Mowton + Sundance and Mowtown + Theodore. This is interesting as Mowtown is the weakest variety for Septoria resistance (AHDB RL rating of 5.7) whilst Sundance had the strongest AHDB RL rating for septoria with 7.9.

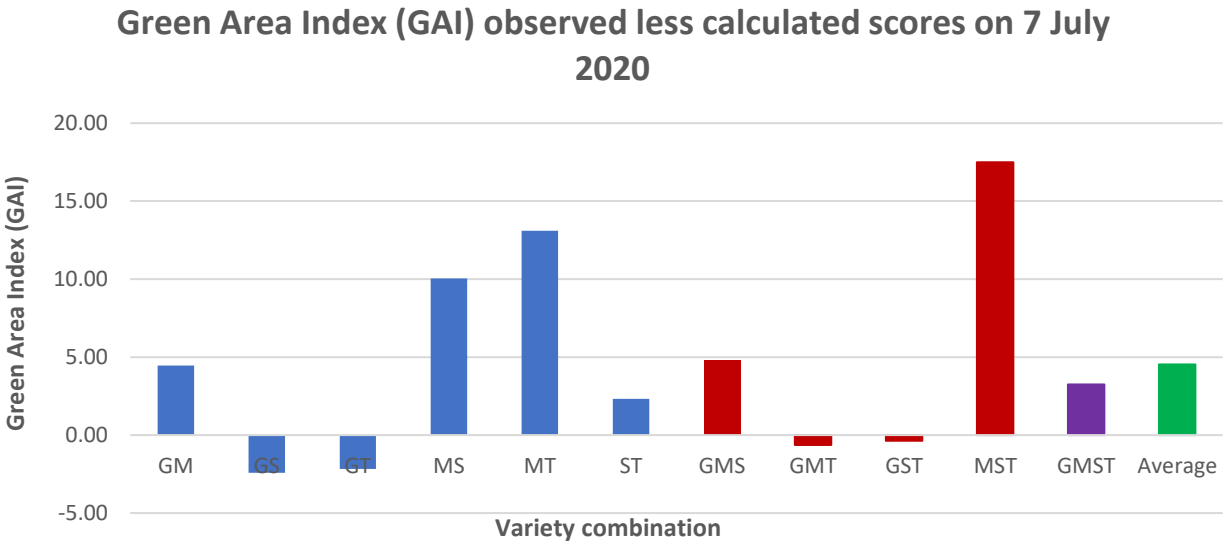

Figure 3- Actual vs predicted disease severity scores for Green Area Index (GAI) when different varietal blends were sown.

Green Area Index (GAI) looks at how green the leaves are. This is an indicator of overall plant health, where the higher the GAI, the more healthy the plant is with less disease or pest damage. Here, five of the varietal mixtures performed much better than the average, with again the three way mix of Mowton, Sundance and Theodore and the two way mixtures of MS and MT performing substantially better than average. Seven of the varietal mixtures had a positive effect on GAI with four having a negative effect. This shows that, on average, in this trial, varietal mixing has an overall positive effect on GAI.

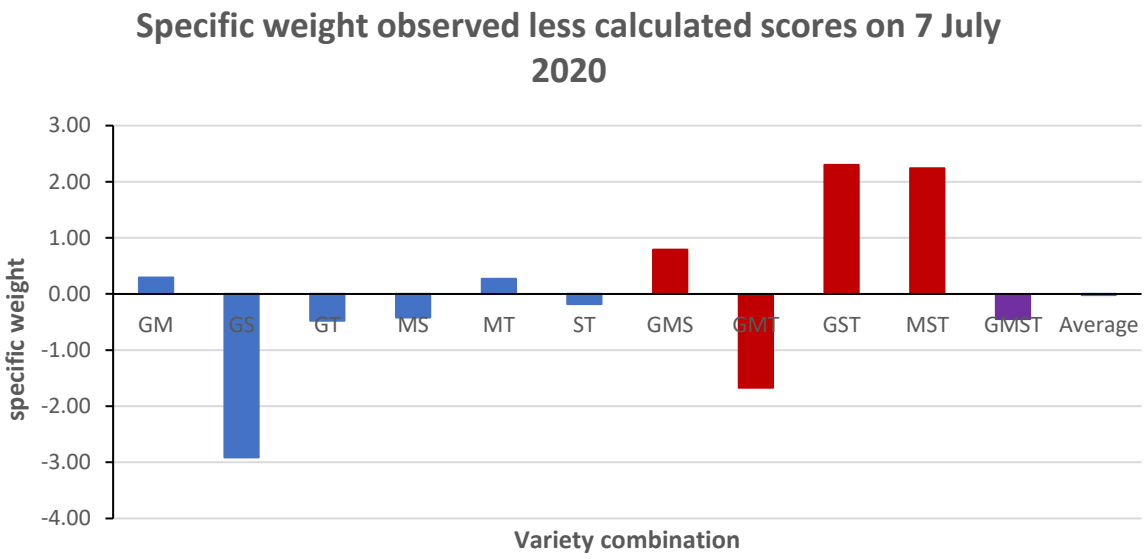

Figure 4- Actual vs predicted disease severity scores for Specific Weight when different varietal blends were sown.

Specific weight was measured for each plot, with an overall neutral effect seen from blending for this parameter across variety mixtures.

Result summary:

- Overall blending varieties has a positive impact on yield, GAI and Septoria incidence.
- The impacts found in reality were greater than what was predicted in theory from the varieties individual performance
- For yield, blending 3 or 4 varieties was optimum for greatest benefit of using blends
- No effect of varietal blending on black-grass counts and soil health was found.

Next steps

- How to mix varieties efficiently on a practical scale
- increasing the number of varieties tested to find optimal blends
- Find out if beneficial blend packages could be designed for different cropping situations, such as for different soil types or for second cereal situations.