Twin N on Winter Wheat

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SUMMARY

A field experiment was run by ADAS Rosemaund, Herefordshire, England in 2008 to investigate the effectiveness of the microbial product TwinN, at supplying nitrogen to a crop of winter wheat. TwinN claims to increase populations of nitrogen fixing organisms both in the soil and within the plant, enabling the provision of part of the nitrogen requirement normally provided by mineral nitrogen fertiliser. TwinN was tested alongside a range of fertiliser nitrogen rates used to demonstrate the nitrogen response for the crop at this site. Treatment effects were assessed by measuring crop yield and grain nitrogen content at harvest.

The experiment demonstrated an excellent nitrogen response curve with the mineral nitrogen fertiliser, and was ideal for analysing the effectiveness of TwinN. The optimum nitrogen dressing was about 200kgN/ha giving a yield of 9t/ha of the feed wheat, cv. Ambrosia, measuring a grain nitrogen content of 1.8% (10.3% protein).

Two applications of TwinN gave a statistically significant *(P=0.05)* yield response of 0.5t/ha over and above an application of 100kgN/ha, as mineral nitrogen fertiliser. This increase in yield was equivalent to a nitrogen fertiliser application of about 50kgN/ha. Although there was a tendency for all the other TwinN applications to give small yield increases, none of these was statistically significant. This suggests that the activity of TwinN was in part dependent upon both an initial supply of available soil nitrogen and a later timing of application, when growing conditions were warmer.

There was a clear and significant response of Grain Nitrogen content to mineral fertiliser. There were also small increases in Grain N% measured in all but one of the TwinN treatments, but these were not statistically significant.

Further work is needed to identify the most favourable conditions for utilising the potential of TwinN in cereal crops, and it would be of benefit to clarify conditions that may be limiting to TwinN organisms. More work on the timing of applications of TwinN in cereal crops may also be useful.

OBJECTIVE

To investigate the effectiveness of the microbial product TwinN at supplying nitrogen to a crop of winter wheat, by comparing treatments to a range of mineral fertiliser rates demonstrating a nitrogen response, measuring harvest yield and grain nitrogen.

MATERIALS & METHODS

Site Details

The experiment was done at an ADAS off-site field station in Breinton, Herefordshire, England in a typical argillic brown earth of the Bromyard series; a well drained reddish fine silty clay loam soil over silty shale and soft siltstone.

Experimental design

The experiment was a fully randomised complete block design, with 11 treatments, including an untreated control, and replicated four times (44 plots in total). A discard plot was sown in between each experimental plot to prevent the scavenging of nitrogen from adjacent plots. The trial was sown on 28th September 2007 at a seed rate of 275 seeds/m^2 using 2m x 24m plots of cv. Ambrosia, a soft milling Group 4 high yielding feed wheat, suited to growing as a second wheat and in late seasons. The soil mineral nitrogen level for the trial area measured in February was 79 kgN/ha and the crop was measured to contain a further 30 kgN/ha.

Treatments

Nitrogen Fertiliser and TwinN treatments.

	Nitrogen Fertiliser applications (kg N/ha)		TwinN applications (in litres per hectare of Rehydration Solution from 1 ha pack total of 100ml)		Total nitrogen rate in kgN/ha
Trt	17 April	21 May	28 April GS31-32	28 May GS39	
1	-	-	-	-	0
2	50	0	-	-	50
3	50	50	-	-	100
4	50	100	-	-	150
5	50	150	-	-	200
6	-	-	0.2		0
7	50	-	0.2		50
8	50	50	0.2		100
9	-	-	0.2	0.2	0
10	50	-	0.2	0.2	50
11	50	50	0.2	0.2	100

Application details

TwinN sprays were applied to plots using an OPS sprayer. All batch numbers and dates of manufacture were recorded for each spray with calculations of quantities required. Spraying equipment was calibrated on each spray date and recorded. At each of the spray application timings, a new vial of TwinN (1 ha pack) was re-hydrated according to product directions, and made up to 100mls using non-chlorinated water at room temperature and left to stand for 3 to 4 hours before use. The spray boom and spray canisters were first cleaned with 'All Clear' proprietary tank cleaner, and then triple rinsed with tap water and then triple rinsed again with the non-chlorinated water from the farm lake used for spraying.

The TwinN Rehydration Solution concentrate was then measured out and mixed with the spray water to give a field spray rate of 0.2 litres of Rehydration Solution of a 1 ha TwinN pack per hectare; (twice the recommended rates on the pack supplied, as instructed by the customer). Sprays were applied to field plots using a 2-metre carbon fibre spray boom with flat fan nozzles (LD02 F110) at 0.5 metre spacings. The system was pressurised using CO_2 gas bottles to achieve an operating pressure of 2.5 bar.

The first spray was applied between 1600 and 1710 hours on 28th April 2008 at Growth Stage 29 to 30. Wind speed was 10 to 11mph, air temperature rose from 7 to 8°C during spraying, and ground conditions were damp. The general weather conditions during application were overcast, damp and cool, the previous 24 hours being cool and showery. The following day was warm and dry.

The second TwinN spray was applied between 1400 and 1530 on 28th May 2008, at Growth Stage 39. Wind speed ranged from 4 to 6 mph, air temperature fell from 11 to 10°C during spraying, and ground conditions were again damp. The general weather conditions during application were overcast and mild, the previous 24 hours being warm and showery and it was dry and warm the day afterwards.

General site details and spraying conditions can be found in Appendices 1 & 2.

Fertiliser Nitrogen

All fertiliser nitrogen applied to this trial was prilled Ammonium Nitrate (34.5%N). This was spread onto plots by hand; by weighing out the required amount for each plot and dividing it into three, and applying a third of the total over the total plot area as three separate acts to ensure an even application. The first application was made on 17th April at crop Growth Stage 31 (first node detectable). The second application was made on 21st May at Growth Stage 33 (3rd node detectable).

Harvest

The trial was harvested on 28th August 2008 using a specialised plot combine harvester. Yield, grain moisture, and grain nitrogen content were recorded for each plot. Yields were calculated as tonnes per hectare (t/ha) adjusted to the trials standard of 15% moisture (85% dry matter), and compared to the untreated control. Plot data can be found in Appendix 3.

Statistical Analysis

All data was analysed using randomised block analysis of variance (ANOVA) and treatments means were compared using the least significant difference (LSD) at a probability of 5% *(P = 0.05*); referred to as the 95% level of confidence. Also, a selection of treatments were analysed using a factorial design to strengthen comparisons between TwinN and fertiliser N strategies.

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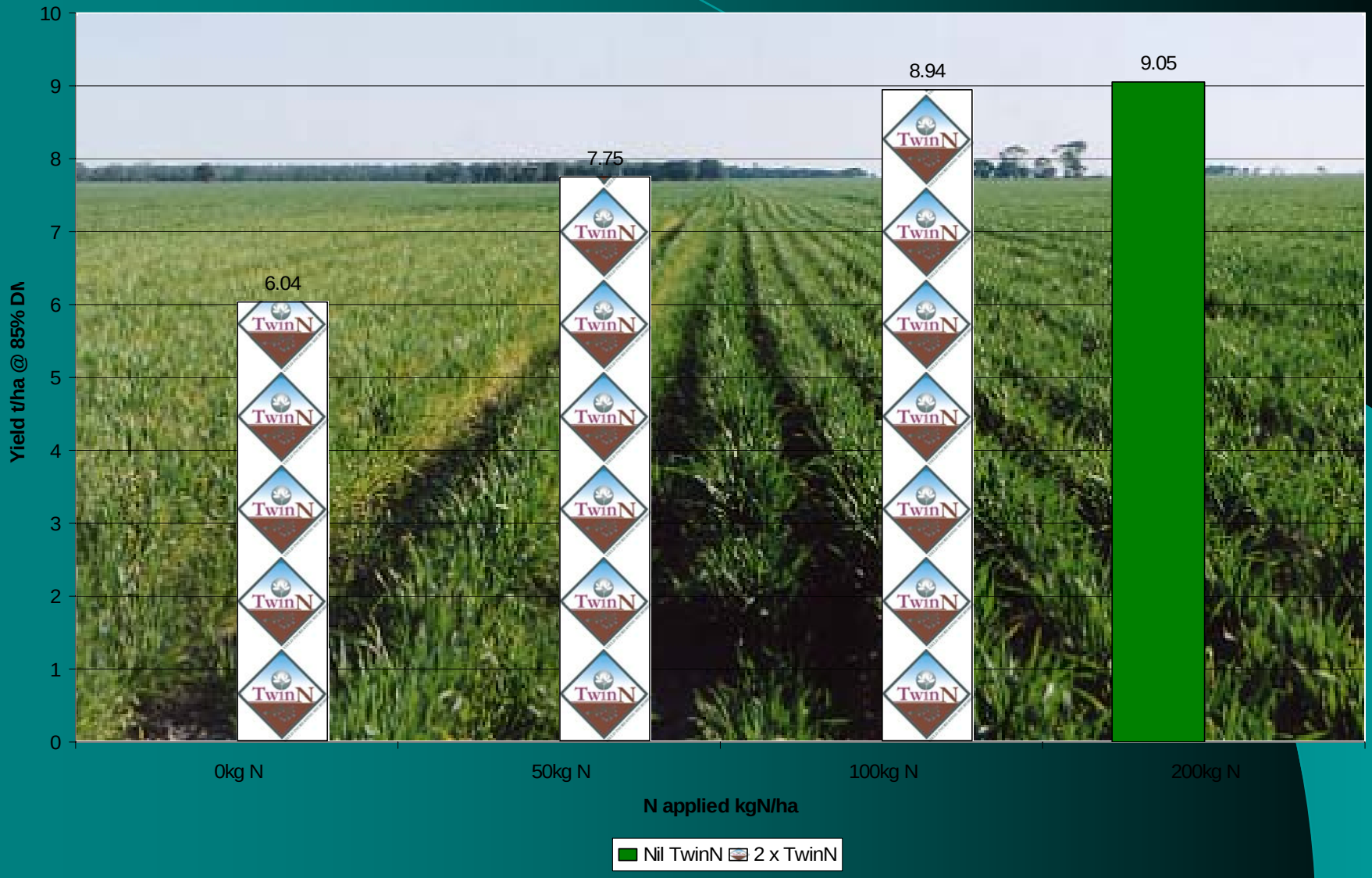

CONCLUSIONS

1. This field experiment demonstrated clear positive yield responses to nitrogen fertiliser, with an optimum yield of 9t/ha from 200kgN/ha.

2. Two applications of TwinN gave a statistically significant *(P=0.05)* yield increase of 0.5 t/ha over and above an application of 100 kgN/ha, as mineral nitrogen fertiliser. This yield response was equivalent to a fertiliser application of about 50 kgN/ha.

3. Provided that some nitrogen fertiliser had first been applied, either 50 or 100kgN/ha, two sprays of TwinN increased Grain Nitrogen Uptake by more than 10%, equivalent to applying about 20 kgN/ha as fertiliser. This was statistically significant, at the 90% level of confidence, for two sprays of TwinN following a fertiliser application of 100 kgN/ha, increasing Grain Nitrogen Uptake by 14kgN/ha.

4. Yield responses from TwinN may have been subdued due the late growing season and cool weather conditions during the grain filling.