

Trial title: Crop organic carbon returns – Straw incorporation and the effects on soil quality.

Centre: Morley

Trial Code: WW14 - 067

Variety: JB Diego

Objective: To provide an improved understanding of the processes and linkages through which organic carbon additions influence soil bio-physical and physicochemical properties.

NAC theme; Long-term monitoring

Summary

This report outlines the findings of National Agronomy Centre (NAC) research examining the incorporation of crop residue returns in response to differential rates of fertiliser nitrogen (N) applications. In 2013/14 the study was in winter wheat and the maximum crop yield peaked at 11.62 t/ha with the optimum N being 200 kg/ha. Noticeable differences in soil structure and root growth between untreated (N1) and the full nitrogen dose (N6) were noted. The full nitrogen dose visually improved the crumb structure with a greater proportion of finer crumbs with a mixture of porous, rounded aggregates from 2 mm to 70 mm. Improvements to crop Green Area Index (GAI) at around flag leaf emergence (GS 39) were seen between untreated and the full nitrogen dose.

Table 1. Treatments list

Trt		First application (kg/ha) Mid- February/early March	Second application (kg/ha) early stem extension	Total (kg/ha)
1	N1	0	0	0
2	N2	20	30	50
3	N3	40	60	100
4	N4	40	110	150
5	N5	40	160	200
6	N6	40	210	250

Table 2. Soil nutrient status

Total N dose (Treatment)	Soil pH	Available P (mg/l)	Available K (mg/l)	Available Mg (mg/l)	Organic matter (%) 0-10cm	Organic matter (%) 10-20cm
Untreated (N1)	7.6	60	109	29	2.2	2.3
200 kg/ha N (N6)	7.1	53	107	28	2.5	2.5

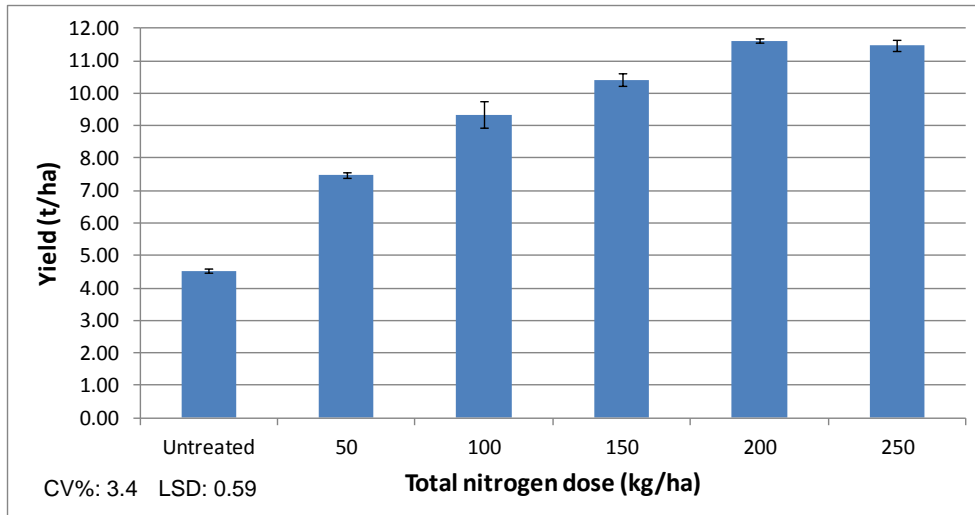
This trial was funded by NIAB TAG National Agronomy Centre Initiative

NIAB TAG National Agronomy Centre, Huntingdon Road, Cambridge, CB3 0LE

Tel 01223 342200, Fax 01223 277602, Email info@niab.com

Copyright 2013: NIAB TAG National Agronomy Centre initiative information and reports should only be passed on to third parties with the expressed permission of NIAB and, where required, any relevant external funders.

Figure 1: Nitrogen response, Morley 2014 (crop yield t/ha)



Error bars are the standard error of the mean (SEM)

Figure 2: Visual Evaluation of Soil Structure

Untreated (N1)

- Sq 3.2



250 kg N/ha (N6)

- Sq 2.6



This trial was funded by NIAB TAG National Agronomy Centre Initiative

NIAB TAG National Agronomy Centre, Huntingdon Road, Cambridge, CB3 0LE

Tel 01223 342200, Fax 01223 277602, Email info@niab.com

Copyright 2013: NIAB TAG National Agronomy Centre initiative information and reports should only be passed on to third parties with the expressed permission of NIAB and, where required, any relevant external funders.

- Winter wheat (cv JB Diego) was drilled in good conditions on 19th September 2013. All crop inputs were as the Morley farm crop (as detailed in the input appendix) with the exception of nitrogen (N) fertiliser. Nitrogen fertiliser was applied in two splits; the first on the 11th March 2014 (GS 26) and the second on the 24th April 2014 (early stem elongation) as detailed in Table 1.
- Measurement of available soil N was sampled in early spring. The available nitrogen (0-90 cm profile) in the untreated (N1) was 13 kg/ha and in the full nitrogen treatment (N6) it was 16 kg/ha. There was little effect from crop residue returns increasing soil nutrient levels (P, K and Mg) as shown in Table 2. There is a suggestion of a small increase in total soil organic matter (SOM), with an average SOM in the 0-10 cm profile of 2.2 % in untreated and 2.5 % in the full nitrogen treatment. There was little change in total SOM at 20 cm depth, although at the full nitrogen dose there was a tendency for slightly higher levels, as one might expect from the return of greater quantities of crop residue returns.
- The maximum crop yield peaked at 11.62 t/ha with the optimum N being 200 kg/ha as shown in Figure 1.
- An assessment for the Visual Evaluation of Soil Structure (VESS) was carried out to give an indication of soil condition. Soil condition is ranked by assessment of the appearance and feel of the block of soil dug out with a spade. The block is then given an overall score based on visual scoring. Scores range from 1 to 5; as scores tend toward 5 they indicate a poorer structure, with scores under 3 generally being considered reasonable. Noticeable differences in soil structure and root growth were observed between the untreated (N1) and the full nitrogen dose (N6) as shown in Figure 2; with average scores of 3.2 and 2.6 respectively. The full nitrogen dose had visually improved the crumb structure, with the block made up of finer crumbs with a mixture of porous, rounded aggregates from 2 mm to 70 mm. An increase in macroporosity (a measure of the proportion of large pores in the soil) was also observed.
- Further improvements to soil characteristics were seen at the full nitrogen dose, specifically an increase in water infiltration rates from 0.74 mm min⁻¹ to 0.79 mm min⁻¹ (data not shown). Whilst this is a relatively small increase, it is consistent with the findings from previous seasons where an increase in water infiltration at the full nitrogen dose was seen and would suggest that the water holding capacity of the soil may be increased.
- Differences in crop Green Area Index (GAI) at around flag leaf emergence (GS 39) were also apparent between untreated and the full nitrogen dose, with average scores of 1.3 and 3.1 respectively.
- It is envisaged that the data gathered from this trial series will be used to build up a long term tracking of straw residue returns on soil and crop performance over coming seasons.

This trial was funded by NIAB TAG National Agronomy Centre Initiative

NIAB TAG National Agronomy Centre, Huntingdon Road, Cambridge, CB3 0LE

Tel 01223 342200, Fax 01223 277602, Email info@niab.com

Copyright 2013: NIAB TAG National Agronomy Centre initiative information and reports should only be passed on to third parties with the expressed permission of NIAB and, where required, any relevant external funders.

Input Appendix: Field details & overall applications to crop

Trial name: Crop organic carbon returns – Straw incorporation and the effects on soil quality
Crop: Winter Wheat
Location: Ravens Grove
Trial code: WW14-067
Soil type: Ashley series (sandy loam)
Soil analysis: n/a
Previous crop: Winter Oilseed Rape
Drill date: 19/09/2013
Seed rate: 130 kg/ha
Harvest date: 01/08/2014
Variety: JB Diego
Drilled plot size: 4 m x 16 m
Replicates: 3

Input type	Product	Product rate	Date
Herbicide:	Trooper	2.0 l/ha	19/09/2013
	Herold	0.3 l/ha	05/10/2013
	Atlantis WG	0.4 kg/ha	18/02/2014
Fertiliser:	Liquid N 28%	44 kg N/ha	13/03/2014
	Liquid N 27 + S	119 kg N/ha 9 kg S/ha	16/04/2014
	Liquid N 27 + S	40 kg N/ha 3 kg S/ha	06/05/2014
	Epso Top	5.0 l/ha	17/05/2014
PGR:	Agrovista 3 See 750	2.0 l/ha	09/04/2014
	Optimus	0.15 l/ha	30/04/2014
Fungicide :	Centaur	0.2 l/ha	09/04/2014
	Life Scientific Chlorothalonil	1.0 l/ha	09/04/2014
	Varioano Xpro	1.2 l/ha	30/04/2014
	Fielder	0.5 l/ha	30/04/2014
	Librax	1.0 l/ha	17/05/2014
	Ennobe	0.5 l/ha	17.05.2014
	Monkey	1.0 l/ha	18/06/2014
Life Scientific Azoxystrobin	0.5 l/ha	18/06/2014	
Adjuvant	Biopower	1.0 l/ha	18/02/2014

This trial was funded by NIAB TAG National Agronomy Centre Initiative

NIAB TAG National Agronomy Centre, Huntingdon Road, Cambridge, CB3 0LE

Tel 01223 342200, Fax 01223 277602, Email info@niab.com

Copyright 2013: NIAB TAG National Agronomy Centre initiative information and reports should only be passed on to third parties with the expressed permission of NIAB and, where required, any relevant external funders.