Evaluation of separated solid pig manure as a nitrogen source for spring barley (*Hordeum vulgare* L.)

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Introduction Spring barley is the most widely grown cereal crop in Ireland. In recent years cereal farmers have relied almost totally on chemical fertilisers as their main crop nitrogen (N) source. However, with low grain prices and high chemical fertiliser prices the use of a cheaper fertiliser alternative in the form of pig manure must be examined. Recent research studies have shown that organic manures including pig manure can make a significant contribution to the N nutrition of cereal crops (Jackson and Smith, 1997), while Petersen (1996) indicated that satisfactory yields could be achieved from spring barley grown with pig manure alone. Due to the location of many pig farms and the logistics of moving pig manure from pig to tillage farms, manure separation is a potentially viable means of decreasing manure volume for transportation. Techniques for pig manure separation into solid and liquid components have been developed and this process provides a solid pig manure (SPM) product with a high dry matter content containing significant quantities of both nitrogen (N) and phosphorus (P). In this current study SPM was evaluated as a N source for spring barley.

Materials and methods This trial was carried out at Lyons Research Farm on a clay loam soil (N index 2) in the 2008 and 2009 growing seasons on spring barley cv. Wicket (2008) and cv. Magaly (2009). Trials were sown in early May both years with mid-September harvest dates. Each trial was a randomised split plot design in a factorial arrangement with 3 replicates. Four rates of the SPM (Factor 1) were combined with three rates of chemical fertiliser (Factor 2) (Table 1) and examined for their effect on crop nitrogen uptake (CNU), grain yield and quality. The SPM applied consisted of 26.5% DM, 0.6% P and 0.8% N. The SPM was applied to the stubble of the previous crop prior to sowing and ploughed to a depth of 16-18cm. The trial area was cultivated and ploughed in one operation. The chemical N (CN) rates were then applied immediately after sowing with a tractor mounted SISIS fertiliser spreader. The site had a high P status (index 4) so no supplemental P was applied to trials while trace elements were foliar applied. Main plot size (SPM) measured 10m*15m, with sub-plot size measuring 1.6m*15m. Crop nitrogen uptake was measured at crop growth stage (G.S) 37-39. Two 1m lengths of the crop were cut to ground level in each plot, weighed, dried, ground and analysed by use of a combustion analysis device to measure N content by use of the Dumas method. Harvest index samples were taken pre-harvest to calculate straw nitrogen content and grains/m^2. A visual crop lodging score was also noted. During harvest a sub-sample of grain from each plot was collect for grain quality analysis such as hectolitre weight (HL), thousand grain weight (TGW) and grain protein percentage (GP). Statistical analysis was carried out by analysis of variance using the SAS statistical package.

Table 1 SPM Treatments and Results (2008 & 2009)

	SPM (t/ha) (kgN/ha)					Chemical N (kgN/ha)			
2008	0 (0)	4 (32)	8 (64)	16 (128)	L.S.D	0	60	120	L.S.D
Grain Yield (t/ha)	4.51^b	4.94^a	5.06^a	4.86^a	0.28	4.88^a	4.91^a	4.73^a	0.25
CNU (kg N/ha)	98.29^b	108.8^{ab}	116.56^a	112.03^a	11.35	100.2^b	106.72^b	119.83^a	9.83
Lodging (%)	25.89^b	30.89^b	46.67^a	52.11^a	13.00	27.25^b	40.83^a	48.58^a	11.26
2009									
Grain Yield (t/ha)	8.61^a	8.81^a	8.71^a	8.79^a	0.46	7.83^b	9.13^a	9.19^a	0.42
CNU (kg N/ha)	168.91^b	172.18^b	167.22^b	185.36^a	11.01	143.42^b	190.70^a	186.13^a	9.54
Lodging (%)	6.46^b	11.57^b	14.22^{ab}	22.78^a	9.54	2.6^c	13.75^b	24.92^a	8.26

*Means with a common superscript are not significantly (P<0.05) different. LSD = Least significant difference

Results The 2008 and 2009 growing seasons had a high rainfall period during the summer months (June and July). In the absence of a SPM by CN interaction, the results of main effects are presented. In both years increasing levels of SPM (P<0.0008) and CN (P<0.002) significantly increased lodging. The wet weather led to early crop lodging in June 2008 and July 2009 and reduced grain yield and CNU. CNU levels were sub-optimal in 2008 with no treatment exceeding 120kgN/ha. CNU levels increased in both years with higher SPM rates (P<0.02). The zero SPM treatment had lower yields (P<0.0039) in 2008 than treatments receiving SPM, however there is no yield benefit from high vs. low SPM rates. SPM treatments gave no significant yield response in 2009.

Conclusion

Due to adverse climatic conditions during the summer months crop utilisation of both organic N and inorganic N was below expected levels in 2008.The higher rate SPM treatments significantly increased CNU in both years indicating useful N utilisation but the average NUE was still relatively low being <20% in both years. The high incidence of crop lodging in response to SPM use in both years is a serious negative factor which may adversely affect the interest of cereal farmers in using this slurry-based product in spring barley production in the future.

References

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