

Within-field protein variation in the northern grains region

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Abstract

We captured yield and protein spatial data between 1999 and 2001 from 23 grain crops, including wheat, barley and sorghum, grown throughout the northern grains region. The extent of yield variation observed was related to season, soil type, and region. Yield variation was higher for sorghum (CV range from 13 to 64%) than for wheat (15 to 42%) or barley (3 to 41%) presumably due to the higher yield values observed in sorghum and their greater dependency on in-crop rainfall as a summer crop. Protein variation was less than yield: fields had CVs <15%. These results confirm the existence of protein and yield variation throughout the northern grains region, and the usefulness of agronomic interpretation in examining whether nitrogen or moisture was yield-limiting.

Key Words

Precision agriculture, spatial variability, nitrogen supplies, grain crops

Introduction

Coincidental analysis of yield and protein of grain crops in the northern region can provide a useful retrospective assessment of yield limitations to grain production (1). A similar methodology can be employed within fields allowing one to locate areas with a high probability of having yield-limiting supplies of nitrogen (N) (2). The recent availability of commercial on-board protein sensors capable of matching protein concentration with grain yield data (3) will allow producers to then identify where these areas of limited N supply are.

However, there is little information on the degree of within-field variation in grain yield and protein concentration which might be expected for a given season or location. Protein sensors will probably be seriously considered when confidence can be gained on the existence of such variation.

We reviewed the grain yield and protein data collected at 23 locations sown to sorghum, wheat or barley throughout the northern grains region, and report the extent of spatial variation observed.

Methods

Site locations and crops

We collected spatial data from three cropping regions in the northern grain region: Southern Queensland centred around the Dalby region, Central Queensland centred in the Callide-Dawson region, and northern New South Wales centred east of Gurley. Data was collected from a total of 23 fields of sorghum, wheat and barley crops across the three centres (Table 1). Field size ranged from 20 to 48 ha.

Table 1. Number of fields sampled for the 3 grain crops at each of the 3 locations.

Site	Sorghum	Wheat	Barley
Southern Qld	6	5	4
Central Qld	2	1	0
New South Wales	2	2	1

Data collection

Yield data was gathered using a grain-flow monitor mounted in the harvester. Positional information was obtained using a differentially corrected global positioning system (DGPS) receiver accurate to 2 m. After harvest, yield data was filtered using a non-spatial technique that removed erroneous data, such as that obtained when the DGPS fix was inaccurate, when ground speed was less than 30 cm/s, or when the grain yield was greater than 3 standard deviations from the mean. Geo-referenced grain samples were captured at harvest every 30-50 m using a harvester-mounted sampling device; protein was determined using a near infra-red spectrophotometer (2).

Results and Discussion

A summary of yield and protein data collected from each field is presented in Figures 1 and 2 (SQ, CQ and NSW indicate fields in southern, central Queensland or New South Wales).

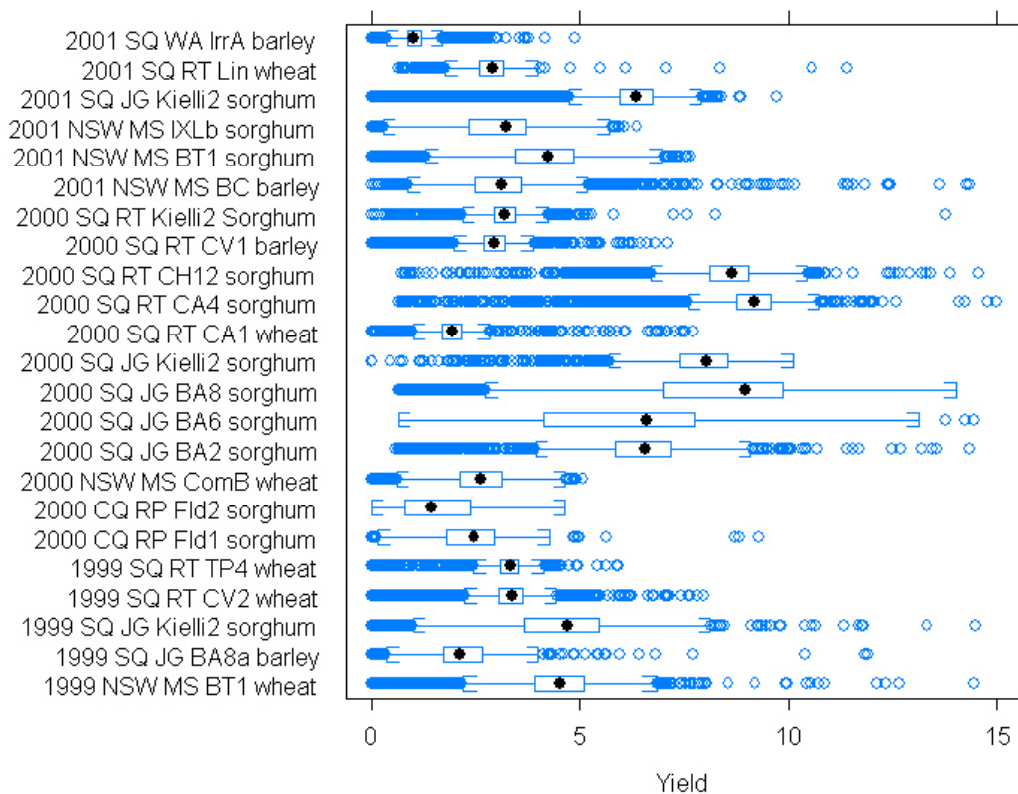


Figure 1: Yield data, presented as box plots, from grain fields in the northern grains region^A.

^A Fields are labelled with the cropping year (1999-2001), location (SQ=southern Qld, CQ=central Qld, NSW=Gurley, NSW), farm manager initials, field name, and grain crop.

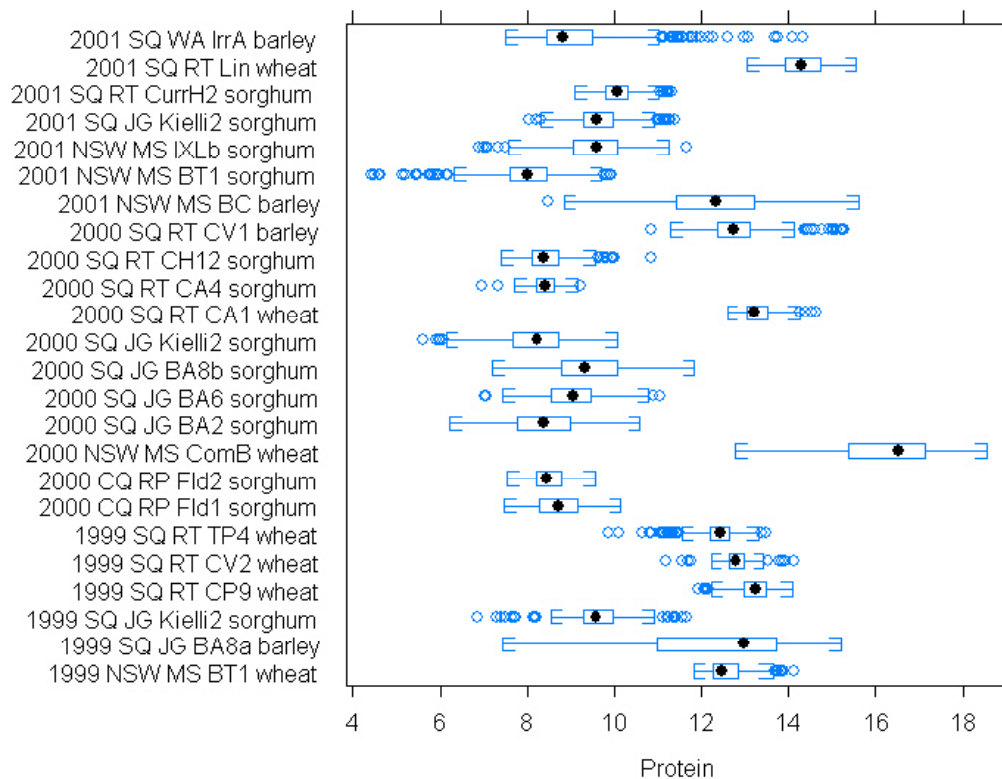


Figure 2: Protein data, presented as box plots, from grain fields in the northern grains region^A.

^A Fields are labelled with the cropping year (1999-2001), location (SQ=southern Qld, CQ=central Qld, NSW=Gurley, NSW), farm manager initials, field name, and grain crop.

The extent of yield variation observed was related to season, soil type, and region. Yield variation observed within a single field, as indicated by coefficient of variation (CV), tended to be higher for sorghum (CV range from 13 to 64%) than for wheat (15 to 42%) or barley (3 to 41%). In part, this was due to the higher yield values observed in sorghum crops (whole field means ranged from 1.7 to 9 t/ha), which in turn were heavily reliant on in-crop rainfall for growth. Protein variation was smaller in magnitude to that of yield with fields tending to have a moderate degree of variation (CV<15%). Protein values within a single field ranged from 2-5% for sorghum, 2-4% for wheat, and 3-7% for barley. Variation in protein appears to be more related to variation in moisture supplies; where N was yield-limiting, any protein variation was minimal. These results confirm the existence of within-field variation in yield and protein throughout the northern grains region. Interpretation of these results will enable farmers to elucidate whether N or water might have been yield-limiting in any given season.

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References

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