

# Nitrogen, Phosphorus and KCl Management for Oat

Ramona Mohr<sup>1</sup>, Cynthia Grant<sup>1</sup> and William May<sup>2</sup>

Agriculture and Agri-Food Canada, Brandon, MB, R7A 5Y3; IHARF/Agriculture and Agri-Food Canada, Indian Head, SK, S0G 2K0



## Introduction

Oats have become an increasingly important crop in western Canada. Demand for high-quality oats for milling markets in western Canada and the northern United States has contributed to increased oat production in Manitoba and Saskatchewan.

Little information was available regarding fertility management strategies for optimizing oat yield and quality in today's production systems.

The objective of this study was to determine the impact of various rates and combinations of N, P and KCl on oat yield and quality under Manitoba conditions.

## Materials and methods

### Sites

- 2 sites/year for 3 years in southwestern Manitoba
- Sites typically had low to moderate soil test N and P levels, and adequate to optimal soil test K levels.
- Sites included sandy loam to clay loam soils.

Soil characteristic	2000		2001		2002	
	Brandon	Brookdale	Brandon	Brookdale	Brandon	Brookdale
Soil name	Newdale	Stockton	Newdale	Wellwood	Newdale	Wellwood
NO <sub>3</sub> -N (kg ha <sup>-1</sup> to 60 cm)	49.8	49.1	33.0	61.1	33.9	38.0
extr. P (kg ha <sup>-1</sup> to 15 cm)	13.5	19.7	9.4	31.4	8.0	18.2
extr. K (kg ha <sup>-1</sup> to 15 cm)	297	227	374	493	409	439

### Treatments

A factorial combination of:

N rates: 0, 40, 80, 120 kg N ha<sup>-1</sup> as side-banded urea

P rates: 0, 30 60 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> as seed-placed MAP

KCl rates: 0, 40 kg K<sub>2</sub>O ha<sup>-1</sup> as side-banded potash

\*each treatment received 13 kg N ha<sup>-1</sup> as MAP and/or urea in addition to the N rate indicated in order to account for the N supplied by MAP for the highest P rate treatment.

At all sites, AC Assiniboia oat was established using a ConservaPak seeder (plot size = 3.7 x 14 m). Generally accepted agronomic practices were used.

### Measurements

- Plant growth, plant nutrient uptake/status, grain yield and grain quality were assessed.
- Yield and quality data are reported in this poster.
- P ≤ 0.05 was considered to be statistically significant.

## Results and discussion

### Grain yield

#### Nitrogen

- Low rates of N fertilizer increased grain yield at all sites. Yields leveled off or declined at higher N rates (Fig. 1).
- At individual sites, optimum yields were typically achieved with rates of 40 to 80 kg N ha<sup>-1</sup> (Fig. 1).
- When all sites were considered together, optimum relative yield appeared to be achieved with a total soil + fertilizer N level of approximately 100 kg N ha<sup>-1</sup> (Fig. 2).

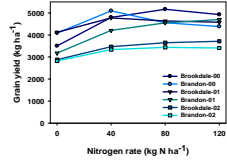


Fig. 1. Effect of N fertilizer rate on grain yield at six field sites (2000-02). (Reported yield is the mean of all P and KCl rates within a given N rate treatment.)

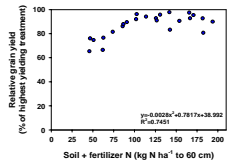


Fig. 2. Effect of soil NO<sub>3</sub>-N level (to 60 cm) + fertilizer N on relative yield of oats at six field sites. (Treatments not receiving P were not included in the calculation of the means.)

#### Phosphorus

- P application increased grain yield at 2 of 6 sites (Fig. 3), despite having increased early-season crop growth at all sites in all years (data not presented).
- Observed crop responses to P application did not appear to be closely linked to soil test P level in all cases.
- In 2002, very dry spring conditions may have reduced the availability of P to the plant, contributing to the positive P response observed at both sites in that year.

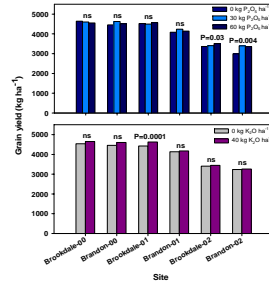


Fig. 3. Effect of P and KCl application on grain yield of AC Assiniboia oat (ns indicates that differences among treatments within a site were not statistically significant at P ≤ 0.05).

#### Potash

- KCl application resulted in a small but statistically significant increase in grain yield at Brookdale-01, and tended to increase grain yield at Brookdale-00 (P=0.1) and Brandon-00 (P=0.13) (Fig. 3).
- No interactions were evident among the nutrients applied suggesting that the pattern of yield response to a given nutrient was not influenced by the other nutrients present.

#### Grain quality

- Interactions among the nutrients applied sometimes occurred but no strong and consistent pattern was apparent across all sites.

#### Nitrogen

- Under the conditions of this study, N application had the most consistent effect on grain quality of the nutrients assessed.
- Increasing N rate resulted in statistically significant declines in test weight, kernel weight and the percentage of plump kernels for all sites in all years (Fig. 4).

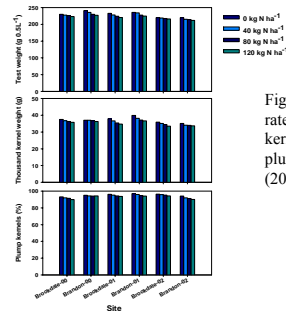


Fig. 4. Effect of N fertilizer rate on test weight, thousand kernel weight and percentage of plump kernels at six field sites (2000-02).

#### Phosphorus

- P application appeared to have inconsistent effects on grain quality (data not presented).

#### Potash

- KCl application resulted in statistically significant increases in percent plump kernels at 3 of 6 sites, kernel weight at 3 of 6 sites, and test weight at 1 of 6 sites (Fig. 5). Observed effects were usually relatively small.
- A small but statistically significant decline in test weight resulted from KCl addition at 1 of 6 sites.

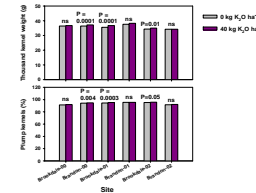


Fig. 5. Effect of KCl fertilizer on thousand kernel weight and percent plump kernels at six field sites (ns indicates that differences between treatments within a site were not statistically significant at P ≤ 0.05).

## Conclusions

- Nitrogen management may strongly influence oat yield and quality.

- At N responsive sites, the addition of N fertilizer significantly increased grain yield.
- However, declines in grain quality were also associated with increasing N fertilizer rates.
- Nitrogen fertilizer rates in excess of that required to optimize yield may reduce grain yield and quality, and thus should be avoided.
- Soil testing provides one tool for assessing the potential for crop responses to N application. Results of this study appear to be in agreement with the existing Manitoba guidelines for N fertilization of oats:

Fertilizer N (lb/ac) = 100 lb N/ac - soil test nitrate-N (lb/ac to 2')

- Phosphorus fertilization consistently enhanced early-season growth in oat and, at one-third of sites, significantly increased grain yield. Effects of P on grain quality appeared to be inconsistent, however.

- Various factors including soil P level and environmental conditions may influence the probability of crop yield responses to P application.

- Potash application sometimes resulted in small improvements in grain yield and quality.

- The observed improvements in oat yield and quality with KCl application were small and inconsistent, therefore application of KCl on high K soils did not usually provide an economic benefit.

## Acknowledgements

Funding for this project was provided by Western Grains Research Foundation, Potash and Phosphate Institute of Canada, and Agriculture and Agri-Food Canada's Matching Investment Initiative.