

# Potential of wheat cultivars in optimizing seed yield for organic crop production on a P-deficient soil

S. S. Malhi<sup>1,2\*</sup>, C. L. Vera<sup>1</sup>, S. A. Brandt<sup>2</sup> and D. Leach<sup>1</sup>

<sup>1</sup>Agriculture and Agri-Food Canada, Melfort, Saskatchewan;

<sup>2</sup>Northeast Agriculture Research Foundation (NARF), Melfort, Saskatchewan (E-mail: [ssmalhica@yahoo.ca](mailto:ssmalhica@yahoo.ca))

## Rationale

- In the Canadian Prairies, many soils on organic farms are low in available P for optimum crop yields.
- If soils are deficient in available P, the only alternative is to use external sources (allowed on organic farms) to prevent P nutrient deficiency.
- Previous research in Pakistan has shown that wheat species/cultivars vary in their sensitivity to P deficiency and seed yield response to P fertilizer on P-deficient soils (Yaseen and Malhi 2009a, 2009b, 2009c, 2010, 2011).
- However, the information on the potential of wheat cultivars in tolerating P deficiency is lacking in Canada, especially under prairie soil-climatic conditions.

## Objective

- The objective of the study was to determine the potential of five wheat cultivars with zero-P and with P fertilizer.
- Spelt, Kamut, Red fife, Unity and Goodeve, representing “old” and “modern” wheat cultivars for seed yield.

## Materials & Methods

- A field experiment was established in spring 2012 on a thin Black Chernozem (TypicCryoboroll) loam near Kelvington, Saskatchewan, Canada.
- Soil at this site has shown severe P deficiency in alfalfa and forage yield of alfalfa was increased dramatically with P fertilizer application in 2011 (personal communication).
- In this experiment, a randomized complete block design was used to lay out the treatments in four replications.
- In P treatments, triple superphosphate (0-45-0) was side-banded at seeding every year.
- All plots received blanket application (surface broadcast) of N (34-0-0 at 120 kg N ha<sup>-1</sup>) and S (K<sub>2</sub>SO<sub>4</sub> at 20 kg S ha<sup>-1</sup>) in spring prior to seeding.

- All plots were tilled to incorporate the surface-broadcast blanket N and S fertilizers into the soil prior to seeding.

**The 10 treatments in a 5 x 2 factorial were:**

*Without P = 0 kg P ha<sup>-1</sup>      With P = 20 kg P ha<sup>-1</sup>*

- |                       |                         |
|-----------------------|-------------------------|
| 1. Spelt without P    | 6. Red Fife with P      |
| 2. Spelt with P       | 7. Unity VB without P   |
| 3. Kamut without P    | 8. Unity VB with P      |
| 4. Kamut with P       | 9. Goodeve VB without P |
| 5. Red Fife without P | 10. Goodeve VB with P   |

**Summary of Results (Figures 1, 2, 3, 4, 5 and 6)**

- In 2012, there was a significant response of seed yield, total N uptake and total P uptake of all wheat cultivars to P fertilizer, but the actual seed yield, total N uptake and total P uptake without P and with P fertilizer applied varied with cultivar.
- The order of seed yield was Unity >= Goodeve >= Red Fife > Spelt > Kamut in zero-P treatment, and Unity >= Goodeve >= Red Fife > Spelt > Kamut in P fertilizer treatment.
- Seed yield increases from applied P were 241, 391, 662, 1191 and 1274 kg ha<sup>-1</sup> for Kamut, Spelt, Red Fife, Unity and Goodeve, respectively.
- In 2013, there was also a significant response of seed yield without P and with P fertilizer applied varied with cultivar.
- The order of seed yield was Unity > Red Fife >= Kamut = Spelt = Goodeve in zero-P treatment, and Unity > Good Eve >= Spelt = Kamut >= Red Fife in P fertilizer treatment.
- Seed yield increases from applied P were 1042, 1390, 1457, 2118 and 2157 kg ha<sup>-1</sup>, respectively, for Red Fife, Kamut, Spelt, Unity and Goodeve.
- In 2014, as in 2012 and 2013, there was a significant response of seed yield without P and with P fertilizer applied varied with cultivar.
- The order of seed yield was Red Fife >= Spelt >= Unity >= Red Fife > Goodeve in zero-P treatment, and Unity > Goodeve > Spelt > Red Fife > Kamut in the P fertilizer treatment.
- Seed yield increases from applied P were 688, 969, 1485, 2120 and 2643 kg ha<sup>-1</sup>, respectively, for Kamut, Red Fife, Spelt, Unity and Goodeve.

**Conclusions**

- The findings suggest that modern cultivars Unity and/or Goodeve may be more suitable for high seed yield for both organic and conventional farming/cropping systems.

### Acknowledgements

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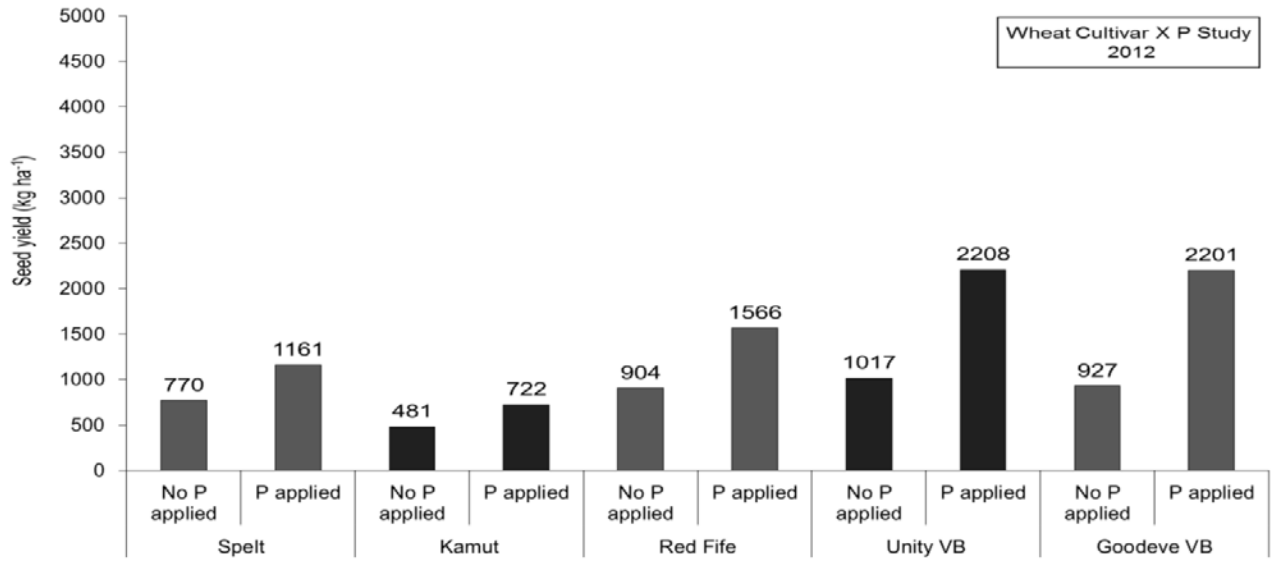


Figure 1. Seed yield of wheat without and with applied P on a P-deficient soil in 2012 in a field experiment with five wheat cultivars and two rates of P fertilizer at Kelvington, Saskatchewan.

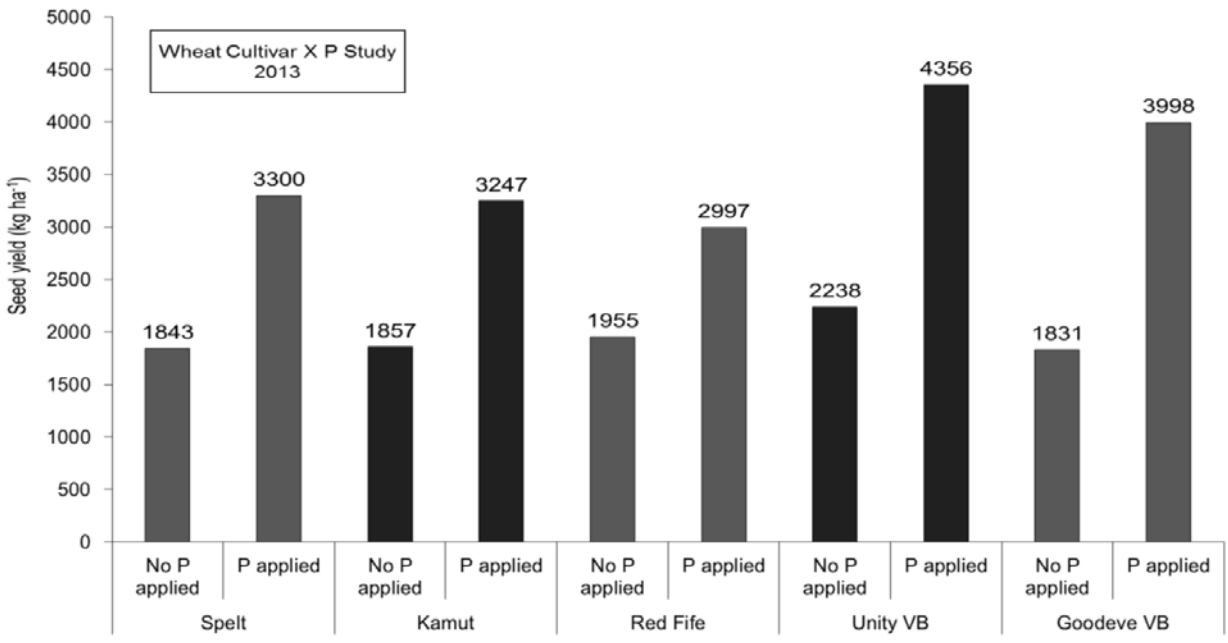


Figure 2. Seed yield of wheat without and with applied P on a P-deficient soil in 2013 in a field experiment with five wheat cultivars and two rates of P fertilizer at Kelvington, Saskatchewan.

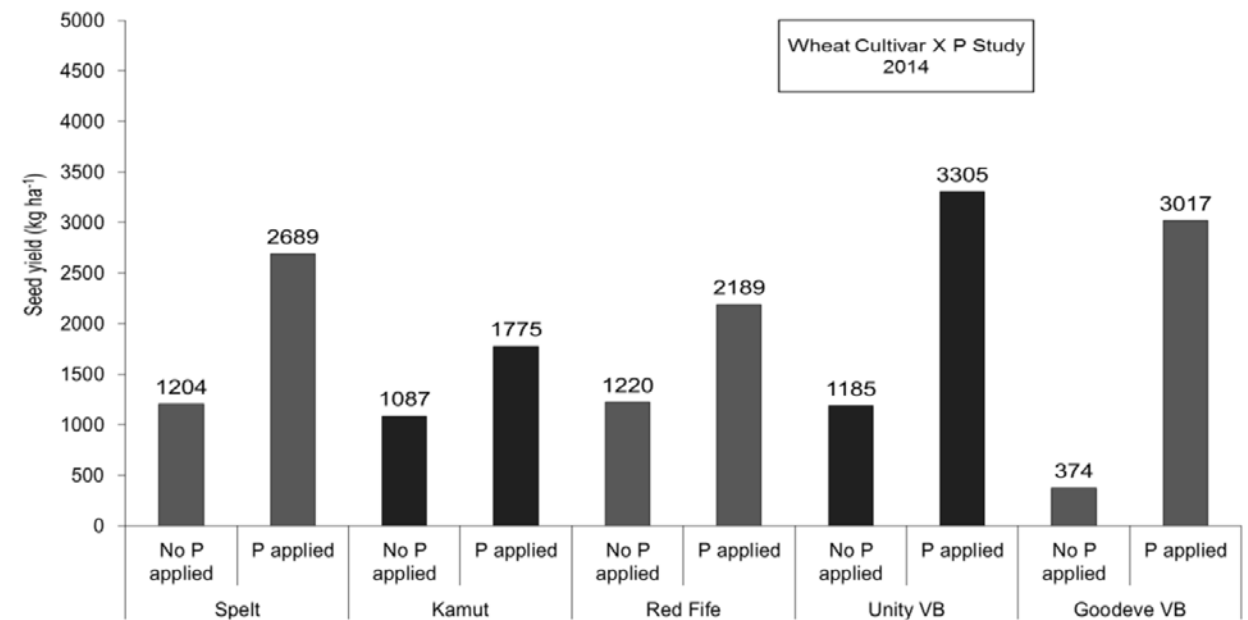


Figure 3. Seed yield of wheat without and with applied P on a P-deficient soil in 2014 in a field experiment with five wheat cultivars and two rates of P fertilizer at Kelvington, Saskatchewan.

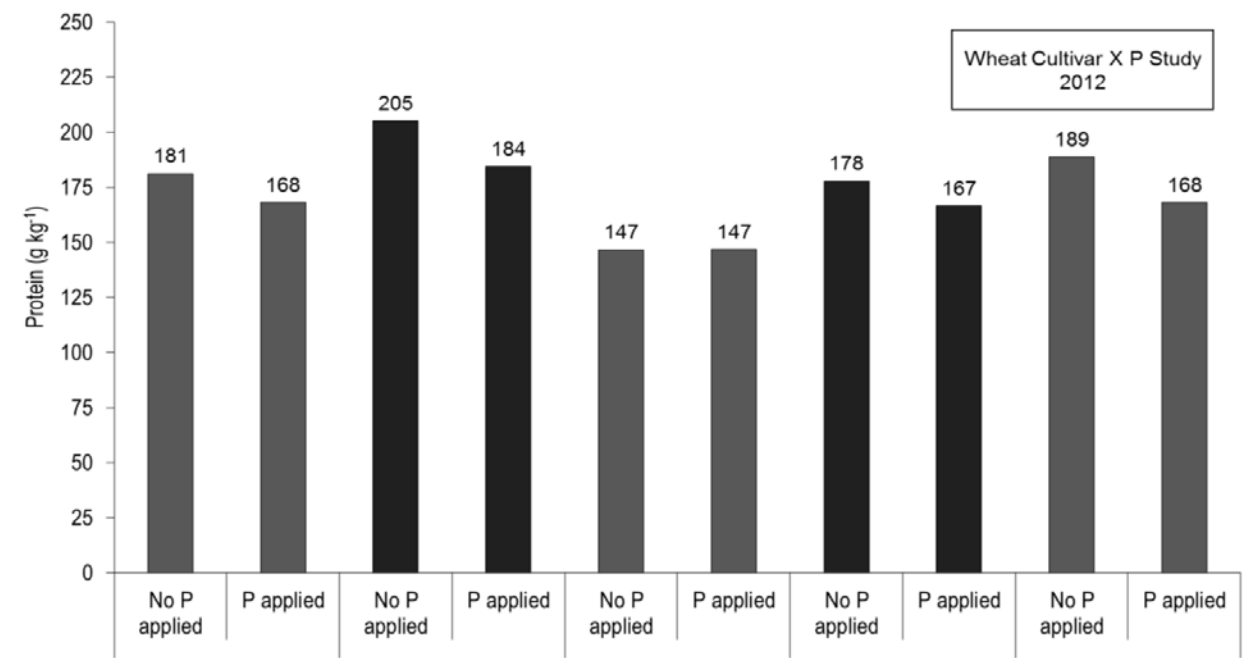


Figure 4. Protein concentration (g PC kg<sup>-1</sup>) in seed of wheat without and with applied P on a P-deficient soil in 2012 in a field experiment with five wheat cultivars and two rates of P fertilizer at Kelvington, Saskatchewan.

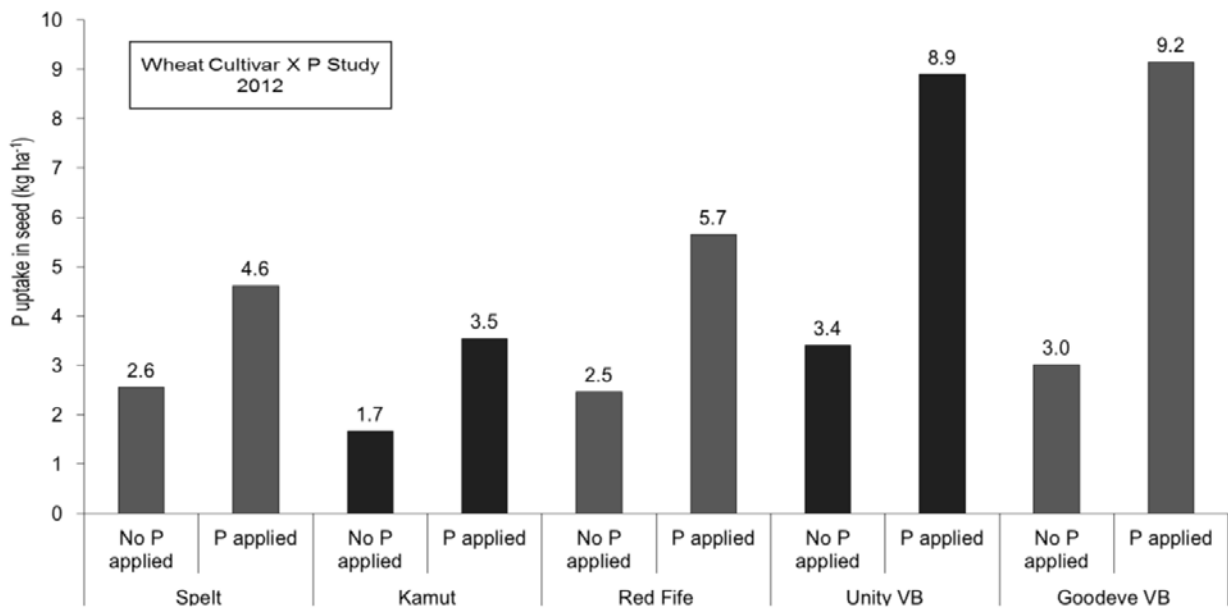


Figure 5. Total P uptake ( $\text{kg P ha}^{-1}$ ) in seed of wheat without and with applied P on a P-deficient soil in 2012 in a field experiment with five wheat cultivars and two rates of P fertilizer at Kelvington, Saskatchewan.

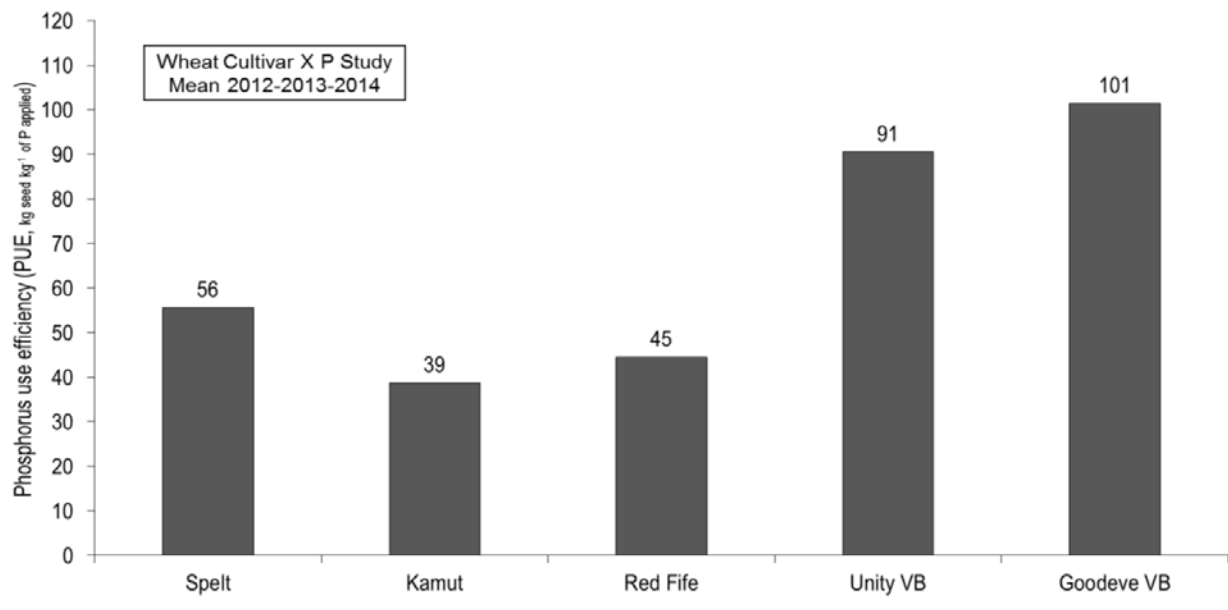


Figure 6. Mean PUE ( $\text{kg seed kg}^{-1}$  of P applied) of seed yield of wheat with  $20 \text{ kg P ha}^{-1}$  applied on a P-deficient soil in 2012, 2013 and 2014 in a field experiment with five wheat cultivars and two rates of P fertilizer at Kelvington, Saskatchewan.