SEEDROW NITROGEN PLACEMENT GUIDELINES

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INTRODUCTION

Introduction of no-till and direct seeding practices in the western Canadian prairies has resulted in expansion of the practice of placing N fertilizer with the seed. Almost fifty percent (49.5%) of the total seeded acres in western Canada were in no-till according to the 2006 census (Statistics Canada 2006). Greatest percentages were in Saskatchewan and Alberta, where no-till systems accounted for 60 and 48 % of the seeded area, respectively.

Application of nitrogen directly in the seedrow can result in very efficient crop uptake of the applied nutrients. However, in most cases, the amount of nitrogen that can be applied in this manner is insufficient to obtain high yields. Excessive amounts of seedrow-applied nitrogen cause seed and seedling damage that can result in a delay in crop maturity and reduced yields. Current guidelines for seed-row placement of nitrogen in general and urea in particular to avert seedling damage (Bremner 1995) are based on seedbed utilization, soil texture (Saskatchewan Agriculture, Food and Rural Revitalization 2001) and seedbed moisture (Western Cooperative Fertilizers Limited 2002).

It has now become apparent that the suggested guidelines are considered to be excessively restrictive by many farmers. In fact, these guidelines are frequently exceeded by some cereal growers who apply their total N requirement (40 - 70 lbs. N/acre) in this manner with excellent results. However, the farmers who are presently applying higher rates of seedrow N fertilizer have gained a great deal of experience and expertise with this practice.

Current guidelines (Fig. 1) are offered based on “favorable conditions”, i.e., excellent seedbed moisture, free of lime and salts, uniform soil, good organic matter, seeding depth not excessive, good seed quality.

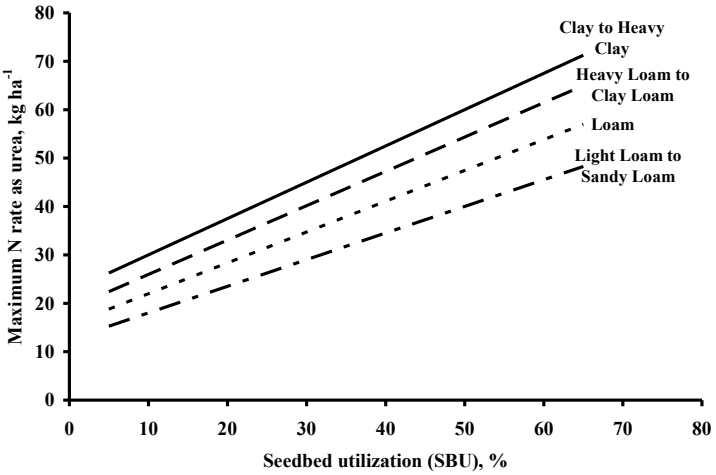

Figure 1. Maximum allowable seedrow placed urea N for cereal crops under favorable conditions (Western Cooperative Fertilizers Limited 2002).

The guidelines in Fig .1 are maximum rates of N seedrow placed N as urea and it is commonly accepted that they should be significantly reduced on soils that are low in organic matter or in soils that contain free lime and/or salts in the surface layer; furthermore, that if the seedbed is relatively dry, the maximum amount of seedrow urea-N must be drastically reduced to avoid serious germination damage. However, none of the above recommendations have been quantified for the farmers. Hence, the objective of this study was to attempt to further refine existing N seedrow guidelines, expand them to non-favorable conditions and develop a simple tool for the farmer to assess the risk of applying N with the seed. Only the spring wheat data are presented here.

MATERIALS AND METHODS

Twenty-seven site-years of experiments were conducted at 15 different locations in the Canadian Prairie Provinces over four years from 1992 to 1995. The experimental design was a randomized complete block with six replicates that included three seedbed utilization rates, 10, 20 and 40% (seedbed utilization is defined as the percentage of the row space that is occupied by the seedrow and is calculated as follows: SBU, % = 100 × seed spread/seedrow distance), and five N rates (0, 20, 40, 60 and 80 kg N ha^{-1}). In 1992 and 1994 wheat was seeded at all with a five-row Bander at 20.3-cm (8 inch) spacing whereas in 1995 with a six-row airseeder at 22.5-cm. In all cases, phosphate was applied in the seedrow at a rate of 30 kg P_2O_5 ha^{-1}. Each plot was 1.02 m (5 rows) wide and 5.8 m long in 1992-94 and 1.37 m (6 rows) and 6.1 m long in 1995. At maturity, the plots were combined using a Wintersteiger Nurserymaster Elite experimental combine and the grain samples were dried at 60 C by forced air and weighed to determine grain yield.

The experimental results were analyzed statistically with ANOVA procedures using SYSTAT 8.0 (SPSS 1998).

RESULTS AND DISCUSSION

Analysis of the population of the twenty-seven experiments revealed that the results fell into three categories (Types), as follows:

Type A (Fig. 2):

Essentially there was no impact of fertilizer N rate on the yield of wheat at wide (40%) SBU, however, application of N at narrow SBU (10 and 20%) resulted in grain yield decreases. Relative plan stand was reduced with application of N in all cases, however, at 40% SBU the reduction was within the limits that no grain yield penalty is anticipated (Karamanos et al. 2004). Eight of the 27 experiments were included in this type.

Type B (Fig. 3):

Essentially there was no impact of fertilizer N rate on the yield of wheat at narrow (10%) SBU, however, application of N at wide SBU (20 and 40%) resulted in grain yield increases up to a point. Relative plan stand essentially remained unaffected at 40% SBU and low N rates, whereas at higher N rates the relative stands of both wider and narrow SBU were gradually reduced. Eleven of 27 experiments were included in this type.

Type C (Fig. 4):

In this Type, application of N resulted in grain yield increases independently of SBU. Relative plan stand remained unaffected at 40% SBU and declined at narrower SBU with high N rates, however, again they remained within the limits that no grain yield penalty is anticipated (Karamanos et al. 2004). Eight of the 27 experiments were included in this type.

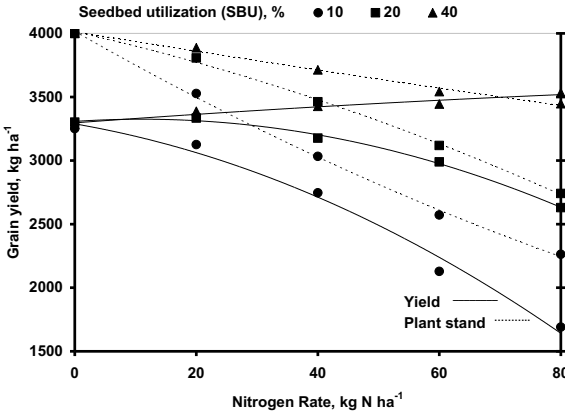

Figure 2. Yield and relative plant stand in Type A experiments.

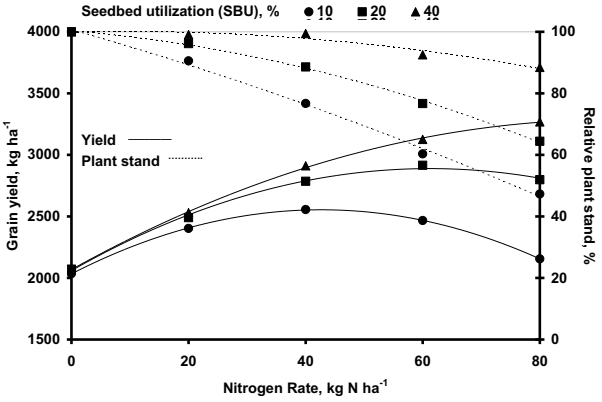

Figure 3. Yield and relative plant stand in Type B experiments.

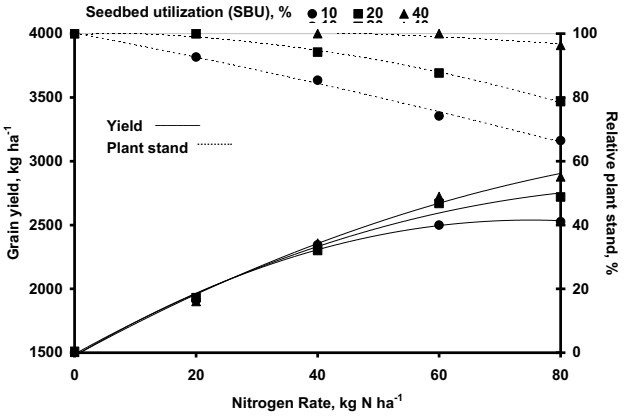

Figure 4. Yield and relative plant stand in Type B experiment.

An attempt was made to identify common characteristics in the experiments belonging to each group. The major characteristics are shown in Table 1.

Table 1. Common characteristics in the experiments belonging to each of the three Types.

	Spring soil moisture	Soil test N	Mean Soil test N kg N ha^{-1} (0-60 cm)	Rainfall, mm within 48 hours before seeding	Rainfall, mm within 48 hours after seeding
Type A	Dry	High	90±40	3±3	2±2
Type B	Borderline	Low-Medium	22±32	4±7	4±4
Type C	Moist	Low-Medium	26±26	4±3	7±7

Within each type, experiments were separated based on soil organic matter (SOM) percentage into three categories, those with SOM less than 3.5 %, between 3.5 and 6% and greater than 6%. Although experiments in these three SOM categories of Types A and B exhibited different response patterns based on SOM (Fig. 5 and 6), the pattern of responses to N in Type C were independent of SOM (Fig. 7)

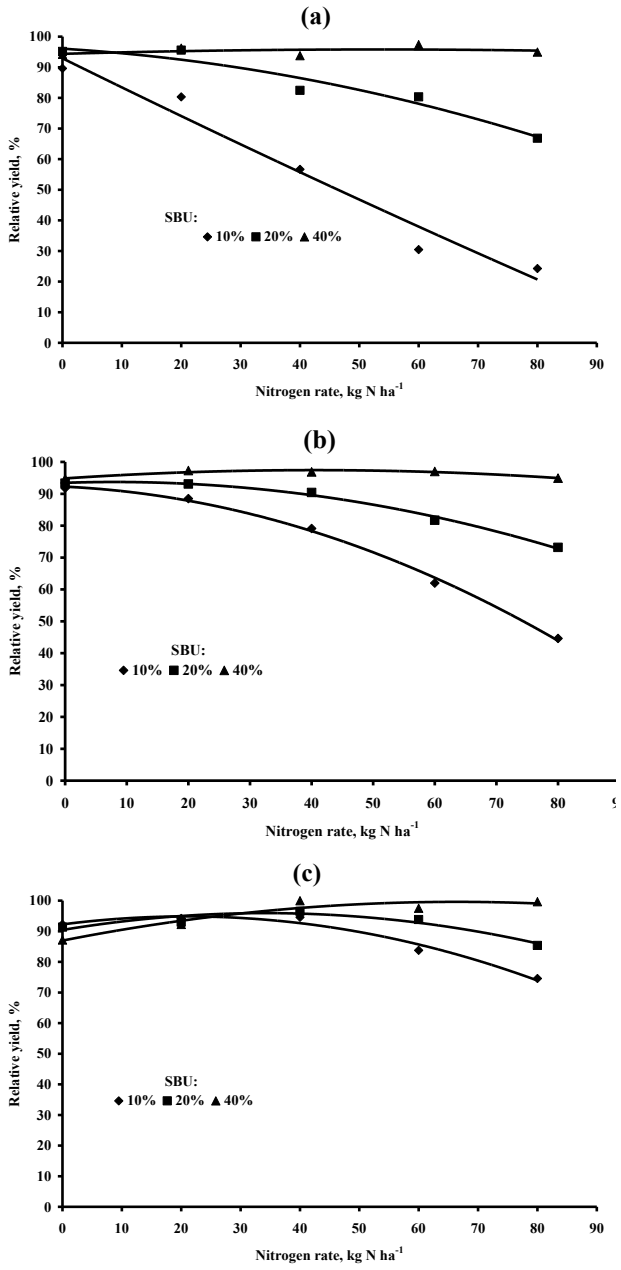

Figure 5. Pattern of responses to seedrow applied N on soils containing <3.5% (a), 3.5 to 6% (b) and greater than 6% (c) SOM of Type A experiments.

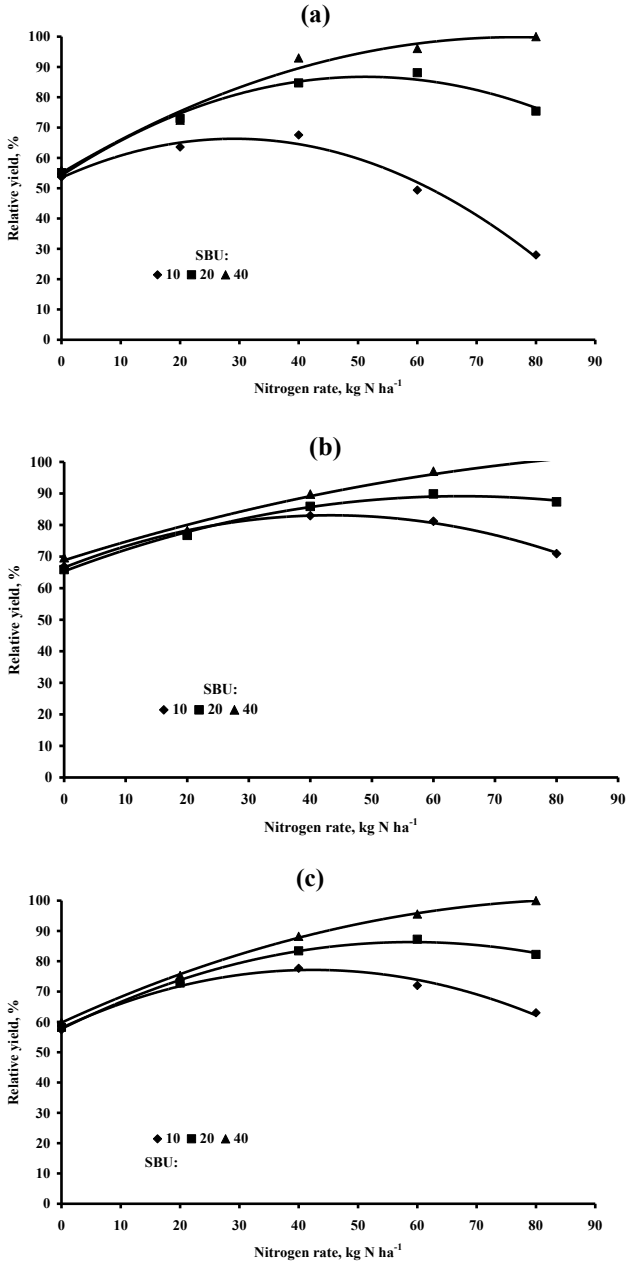

Figure 6. Pattern of responses to seedrow applied N on soils containing <3.5% (a), 3.5 to 6% (b) and greater than 6% (c) SOM of Type B experiments.

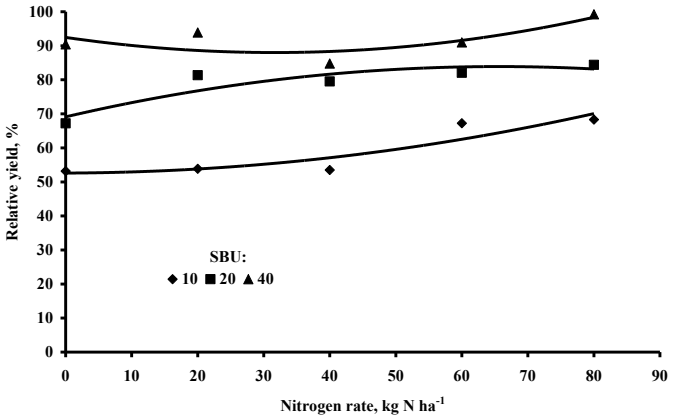

Figure 7. Pattern of responses to seedrow applied N on soils containing <3.5% (a), 3.5 to 6% (b) and greater than 6% (c) SOM of Type A experiments.

Multiple regression equations developed from all the above relationships were utilized to develop a simple excel spreadsheet that allows assessment of seedrow N application based on spring moisture conditions, soil organic matter, precipitation within 48 hours of seeding and spring soil test N (Fig. 8).

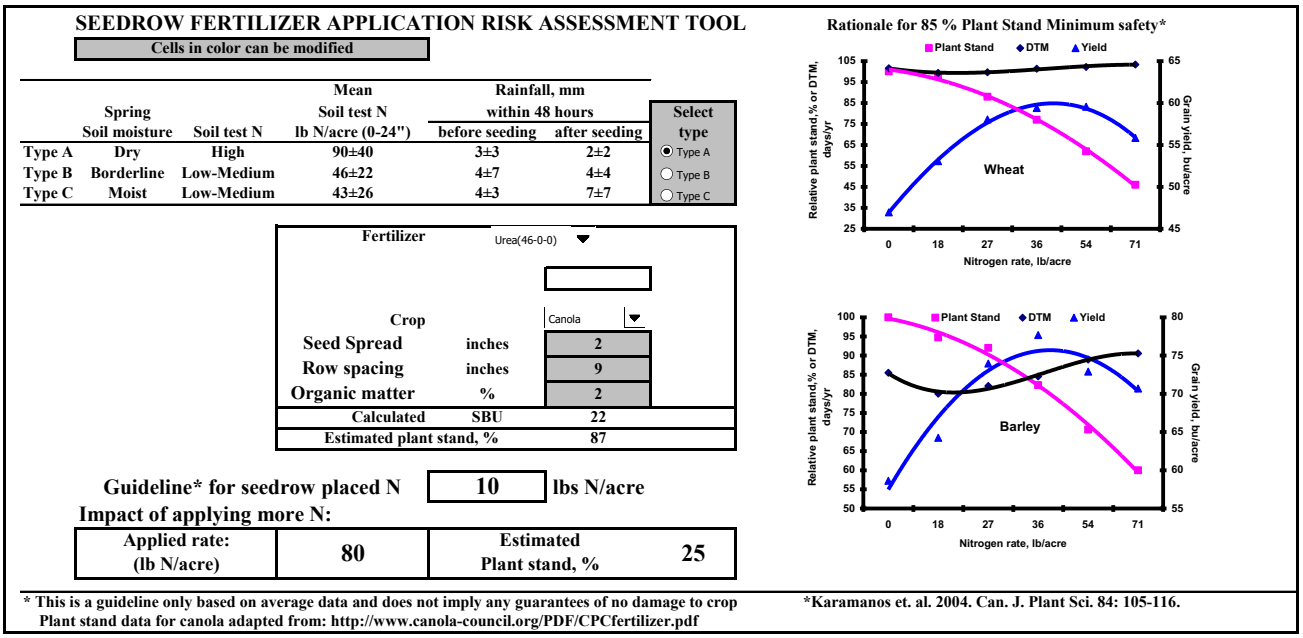

Figure. 8. View of an simple excel spreadsheet that allows estimation of seedrow applied N based on spring moisture conditions, soil organic matter, precipitation within 48 hours of seeding and spring soil test N.

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