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Weather Effects On Corn Response to In-Season Nitrogen Rates

Xie, M.[1], N. Tremblay[1]*, G. Tremblay[2], G. Bourgeois[1], M.Y. Bouroubi[1] and Z. Wei[3]

[1] Horticultural Research and Development Centre, Agriculture and Agri-Food Canada, 430 Gouin Blvd, Saint-Jean-sur-Richelieu, QC, Canada J3B 3E6 (nicolas.tremblay@agr.gc.ca)

[2] Centre de recherche sur les grains (CÉROM) inc., 740 chemin Trudeau, Saint-Mathieu-de-Beloeil, QC, Canada J3G 0E2

[3] Water Conservancy and Civil Engineering College, Inner Mongolia Agricultural University, 306 Zhaowu Da Street, Hohhot 010018, China

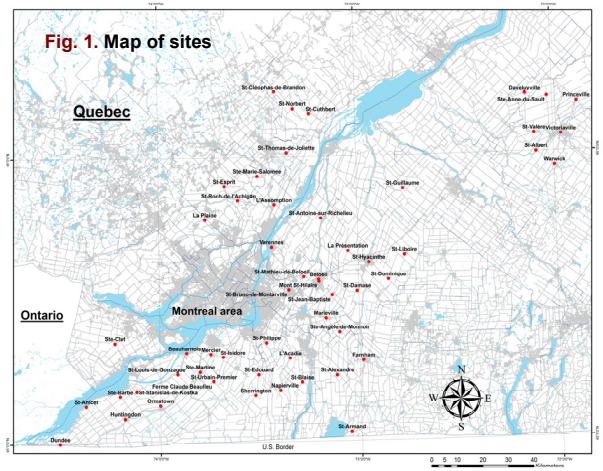

Fig. 1. Map of sites

Introduction

Weather conditions such as temperature and rainfall have also profound effects on the efficiency of nitrogen fertilization (Van Es et al., 2007). Currently, weather characteristics are not really considered for in-season N rate management in Quebec. Opportunities for fertilizer savings and better N use efficiency based on seasonal characteristics at side-dressing N application time are not materialized.

Reviewing and synthesizing datasets may be an appropriate method for determining the effect of several influencing factors on the effectiveness of nitrogen application for corn. **Meta-analysis** is an effective synthetic method for summarizing and reviewing previous quantitative researches.(Tonitto et al. 2006; Valkama et al. 2009).

Materials & methods

The database (from CÉROM) was constituted of nitrogen rate treatments and corresponding corn yields. The database consisted of 685 observations from 1997 to 2008, obtained from 143 trials conducted at 60 locations distributed throughout most of Quebec's corn growing regions (Fig. 1). Five in-season N rate range (**ISNR; 35R, 75R, 115R, 155R and 195R, in kg ha^{-1}**) groups were compared to a control (**CK**). The control was applied as starter N, and the ISNR were applied during the season, at side-dressing. Weather data were obtained from the National Climate Data and Information Archive (Environment Canada, www.climate.weatheroffice.gc.ca), interpolated to 10 x 10 km.

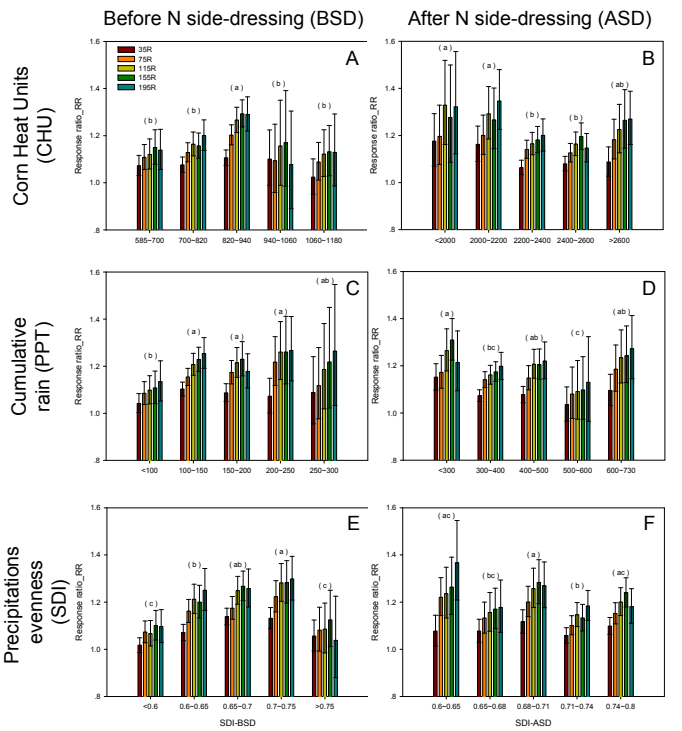

Figure 2. Response ratio of in-season N fertilizer ranges according to defined ranges of weather parameters ($P \leq 0.1$).

The effect size for each observation was calculated as follows: $\ln RR = \ln(X_n/X_0)$ (1) where ln is the natural logarithm, X_n and X_0 represent response mean values for applied nitrogen fertilizer treatments and control nitrogen fertilizer treatments, respectively. **A response ratio (RR) higher than 1 indicates an increase in yield production under nitrogen fertilization** (Valkama et al. 2009). A random effect model (Borenstein et al. 2009). Weather parameters under consideration were Corn Heat Units (**CHU**) accumulation, cumulative precipitations (**PPT**) and rain distribution (Shannon Diversity Index; **SDI**). An SDI equal to one implies complete evenness (i.e., equivalent amounts of rain in each day of the period). An index equal to zero implies complete unevenness (i.e., all rain in 1 day). Calculations were made for the period before in-season N application (side-dressing; **BSD**) and after side-dressing (**ASD**).

Results & discussion

Generally, **in-season N applications** resulted in response ratio (RR) significantly higher than the control (N only at sowing) (Fig. 2). Exceptions can be found within weather ranges where too little observations were available. In-season N applications are therefore effective throughout a wide diversity of weather conditions. **Trends for RR among weather ranges** were more apparent and less variable for the part of the season before side-dressing (BSD; Fig 2 a, c, e) than after side-dressing (ASD; Fig 2 b, d, f). Significantly lower RR can be expected from in-season N applications under weather conditions **before side-dressing** characterized by low or very high CHU, low PPT and very low or very high precipitation evenness (SDI). In-season N applications were less effective under conditions **after side-dressing** characterized by intermediate CHU or PPT. In-season N applications were particularly effective at intermediate SDI. Globally, **increases in ISNR** resulted in increased RR within weather ranges, although not to significant extents. Cases can be found occasionally where 35R presented RR significantly lower than the higher ISNR.

Conclusions

Weather effects on the effectiveness of in-season N applications can be identified and quantified. These effects are stronger for the period before side-dressing as compared to after side-dressing, even if the later period is longer. This offers opportunities to optimize in-season N applications based on known weather conditions. The relationships established can be used, for example, in fuzzy inference systems to achieve optimal N rates.

References

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