EVALUATION OF DIFFERENT N MANAGEMENT STRATEGIES USING A TOOL FOR FUZZY MULTI ATTRIBUTIVE COMPARISON OF ALTERNATIVES

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Application of precision agriculture is related with choosing optimal agrotechnilogy and, in particular, the best alternative for nitrogen (N) management strategy when it comes to N management for crop production. To address this issue we used a tool for fuzzy multi attributive comparison of alternatives (Kurtener and Shvetsova, 2007). This technique provides a means to achieve an optimal decision for real world problems which involve multiple alternatives and criteria in qualitative and quantitative domains. The tool is based on JAVA technology.

In this study the following N management strategies evaluated:

1. Uniform N application with a constant yield goal (CYG).
2. Variable N application based on grid soil sampling with a constant yield goal. The variable-rate N was determined using recommendation algorithm for irrigated corn (Mortvedt et al., 1996), as driven by the residual soil NO_3 and organic matter (OM) content obtained at each grid soil-sampling location.
3. Variable N application based on SSMZ using a constant yield goal (SSMZ-CYG). Soil NO_3 and OM levels were determined for each management zone by averaging soil NO_3 and OM values at all grid points that fell within a management zone. Recommendation algorithm for irrigated corn (Mortvedt et al., 1996) was used to determine N-rate for respective zones using a constant yield goal across the management zones.
4. Variable N application based on SSMZ using a variable yield goal (SSMZ-VYG). Soil N rates were determined similar to Strategy no. 3 above, except that a different yield goal was assigned for each management zone.

For comparison of the above mentioned N management strategies, we used 3 attributes: a) Weighted mean N rate, b) Weighted mean yield, and c) Farmer-applied scenario of net return.

In this study weighted mean yield and net returns are interpreted as benefit indicators, whereas, weighted mean N rate is interpreted as cost indicator.

Comparison of alternatives N management strategies was carried out in two variants: 1) Identification of the best alternative when the price of corn was based on actual prices, and 2) Identification of the best alternative when the price of corn was variable.

For computations, we used experimental data from Koch, et al. (2004). Results of computations in the first variant of this study are presented in Table 1.

Table 1. Alternative ranking in the first variant of study for Site-Years 1

Site-Year	Alternative ranking
1	4 < 1 < 3 < 2
2	3 < 1 < 4 < 2
3	3 < 1 < 4 < 2

It is easy to see that for Site-Years 1 the 4 alternative is the best. For Site-Year 2 and Site-Year 3 the 3 alternative is the best.

Alternative ranking in the second variant of study is given in Table 2.

Table 2. Alternative ranking in the second variant of study

Site-Year	Alternative ranking
1	4 < 1 < 3 < 2
3	3 < 1 < 4 < 2

Output of computations in the second variant of study shows that for Site-Year 1 the 4^{th} alternative is the best. For Site-Year 3 the 3rd alternative is the best.

Results of this study agree with inference of previous researches (Koch, et al., 2004).

Application of the tool for comparison of different N management strategies illustrates its potential for utilization in precision agricultural practices.

REFERENCES

Koch, B., R. Khosla, W. M. Frasier, D. G. Westfall and D. Inman (2004) Economic Feasibility of Variable-Rate Nitrogen Application Utilizing Site-Specific Management Zones. Agron. J. 96:1572-1580.

Kurtener, D., E. Shvetsova. 2007. Multicriteria analysis of agrotechnologies on the basis of theory of decisions in uncertainty conditions (in Russian), In Transactions of Agrophysics Institute “Methodological and experimental support of adaptive-landscape systems of agriculture”, St. Petersburg, Russia, 193 - 208.

Mortvedt, J.J., D.G. Westfall, and R.L. Croissant. 1996. Fertilizing corn [Online]. Available at http://www.ext.colostate.edu/pubs/crops/00538.html (verified 13 July 2004). No. 0.538. Colorado State Univ. Coop. Ext., Fort Collins.