IN-SEASON DECISION SUPPORT TOOLS FOR ESTIMATING NITROGEN SIDE-DRESS RATES FOR MAIZE (*ZEA MAYS* L.)

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ABSTRACT

Nitrogen fertilizer has been synthetically produced to nourish plants, increase yield and improve harvest quality. One of the way to increase NUE is called split application which is apply portion of N fertilizer from the beginning and apply another portion during vegetative stage (V4-V6). Improving accuracy of corn side dress N rate recommendations can improve profitability and reduce potential negative environmental impacts of over fertilization. The objective of this experiment is to compare yield and NUE of side-dress rates prescribed by: 1) the Virginia Corn Algorithm (VCA); 2) the Maize-N computer simulation model; and 3) the Nutrient Expert (NE) for Maize computer simulation model to the standard rate growers would currently apply. Total of four field experiments were established in 2012 and 2013 with four replications in a randomized complete block design. Treatments evaluated included a complete factorial of four different pre-plant rates (0, 44.8, 89.6 and 134.4 kg ha^{-1}) with the three different simulation model-prescribed rates and the standard Virginia method. In 2012 data showed that NE has the highest Nitrogen Use Efficiency (NUE) which produced 55 kg grain yield with every kilograms of nitrogen fertilizer applied. However data in 2013 showed two locations have the highest NUE by using Virginia Corn Algorithm with GreenSeeker sensor.

Keywords: Nitrogen, Precision agriculture, Maize, Side-dress rate, NUE

INTRODUCTION

Nitrogen is frequently the most limiting factor in cereal crop production and the forms of N generally taken up by plants are nitrate (NO_3^-) and ammonium (NH_4^+) (Havlin et al., 2013). There are about 112 million metric tons of nitrogenous fertilizers applied annually for crop production, according to the United Nations Food and Agriculture Organization (FAO) in 2011. However, the worldwide Nitrogen Use Efficiency (NUE) in cereal grain production is about 33% because of immobilization of applied fertilizer, plant loss, volatilization,

denitrification and surface runoff (Raun and Johnson, 1999). Improving accuracy of corn side-dress N rate recommendations can improve profitability and reduce potential negative environmental impacts of over-fertilization.

OBJECTIVE

The objective of this experiment is to compare yield and NUE of side-dress rates prescribed by: 1) the Virginia Corn Algorithm; 2) the Maize-N simulation model; and 3) the Nutrient Expert for Maize computer simulation model to the standard rate growers would currently apply.

METHODS AND MATERIAL

Experiments were conducted in 2012 in New Kent County (Altavista fine sandy loam), and in 2013 near Virginia Beach (Portsmouth loam) and at Kentland Farm near Blacksburg (Unison and Braddock silt loam) in Virginia. Treatments are four different pre-plant rates (0, 45, 90 and 134 kg N ha^{-1}) in a factorial with the three different simulation model-prescribed rates and the standard Virginia rate. Experimental design is a randomized complete block design (RCBD) with sixteen treatments and four replications with a plot size of 3.1 m x 9.1 m (10 ft x 30 ft) and 0.61 m (2 ft) of alley.

RESULTS

Table 2. Average grain yield (kg ha^{-1}) with different Pre-plant N rate (kg ha^{-1}) with different systems at Kentland, New Kent and Virginia Beach, 2012-2013.

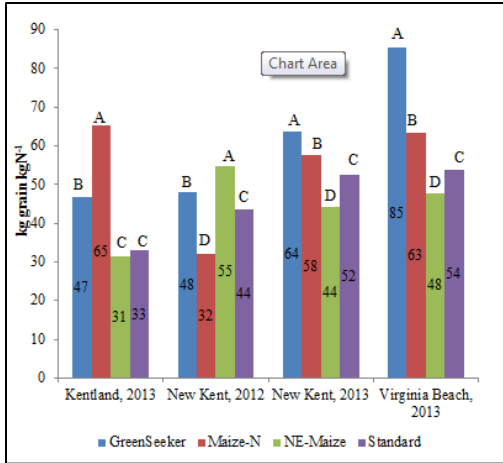| Systems	Pre-plant N rate, kg ha^{-1}	Grain Yield , kg ha^{-1}			
		Kentland, 2013	New Kent, 2012	New Kent, 2013	Virginia Beach, 2013
GreenSeeker	0	6091	7254	9571	9837
GreenSeeker	45	5814	6462	10502	10531
GreenSeeker	90	5550	6604	10542	10335
GreenSeeker	134	5511	7666	9949	10106
Maize-N	0	5869	7030	9968	9876
Maize-N	45	5821	6511	8778	10788
Maize-N	90	6233	7850	9838	10539
Maize-N	134	5732	7180	10194	10648
NE-Maize	0	5633	7267	11124	10226
NE-Maize	45	6026	7439	9167	10302
NE-Maize	90	5847	7983	11361	10617
NE-Maize	134	6244	8093	10364	9965
Standard	0	5875	7843	10217	10198
Standard	45	5271	6904	10292	10472
Standard	90	4865	6741	10548	10660
Standard	134	6075	7745	11174	9634

Fig. 1. Average kg grain yield kg N⁻¹ applied in four different systems at Kentland, New Kent and Virginia Beach, 2012-2013.
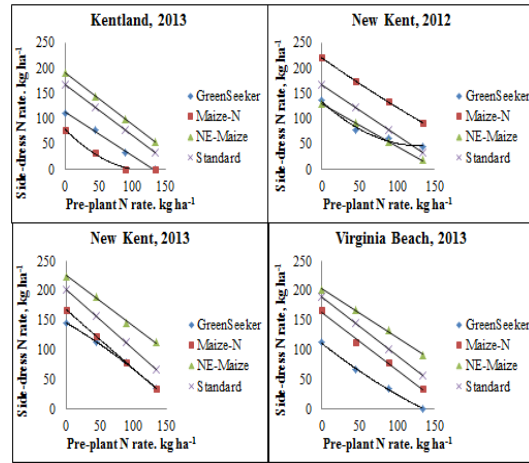

Fig. 2. Average side-dress N rate (kg ha⁻¹) at different pre-plant N rates (kg ha⁻¹) in four different systems at Kentland, New Kent and Virginia Beach, 2012-2013.

CONCLUSION

There was no significant differences yield in between different systems at different pre-plant N rates in all locations. At New Kent country (2012) has the highest efficiency (55 kg grain kg N⁻¹) by using Nutrient Expert simulation. However, GreenSeeker system (Virginia Corn Algorithm) had the highest kg grain yield per kg side-dress N applied (highest efficiency) in New Kent County and Virginia Beach in 2013.

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