Research Report: Creeping Bentgrass response to a stabilized amine form of nitrogen fertilizer (PiNT+K)

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INTRODUCTION

PiNT+potassium (PiNT+K) (Plant Impact Inc., Preston, UK) is a uniquely controlled uptake nitrogen /potassium fertilizer formulated to support plant quality, yield, root promotion and stress tolerance. PiNT+K contains 13.7% cation-stabilized amine, 1.3% NO_3, 7% K_2O, and 0.17% patented Speedo chemistry (Plant Impact Inc., Preston, UK). Compared to nitrate fertilizers, the cation-stabilzed amine in PiNT should resist leaching and remain available for plant uptake longer than nitrate, thereby increasing nitrogen use efficiency.

Objectives: On a creeping bentgrass (*Penn A-1/A-4*) putting green, compare fertilizer burn (osmotic desiccation), shoot growth, nitrogen (N) uptake, N recovery rate, and unused N (potentially subject to leaching) in response to selected N fertilizer application rates using PiNT+K versus a soluble analogue fertilizer (KNO_3 and NH_4NO_3 mix).

MATERIALS AND METHODS

In one trial in 2009 and two trials in 2010, PiNT+K and analogue fertilizers were applied to deliver 37.5 or 50 kg N ha^{-1}.

Plots (0.9 x 2.1 m) were mowed 6-7 times weekly at a height of 3.1 mm (⅛”). Clippings were collected for N content analysis and were not returned to the putting greens. Potable irrigation was applied to prevent plant wilt, but fertilizer treatments were not watered in. Clippings were dried, weighed, and analyzed for total Kjeldahl nitrogen (TKN) content. N uptake is the product of above-ground biomass and TKN content. Unused N (kg ha^{-1}) is N applied minus N uptake.

Simultaneous measures of 660– and 850–nm light reflectance from the canopy of each bentgrass putting green plot were recorded (in duplicate) 2–6 days per week using an ambient light-excluding FieldScout TCM–500 turfgrass chlorophyll meter (Spectrum Technologies Inc., Plainfield, IL). Reflectance data were used to calculate normalized differential vegetative indices (NDVI). Likewise, a turfgrass color meter (FieldScout TCM-500-RGB) collected duplicate measures of percent green, red, and blue canopy reflectance. Data were converted to hue, saturation, and brightness levels to determine dark green color index (DGCI). The NDVI and DGCI indices are reproducible measures of turfgrass canopy density and color, respectively. Five to ten days following fertilizer treatments, NDVI and DGCI values measuring less than control indicate fertilizer burn (osmotic desiccation).

Within trials and for each sampling date, treatment effects on NDVI, DGCI, above-ground biomass, TKN, N uptake, and unused N were determined by T-test (P<0.05) and ANOVA. The Mixed Model (SAS Institute, v. 8.2) was applied to the pooled data (above-ground biomass, N uptake, NDVI and DGCI) of all three trials.

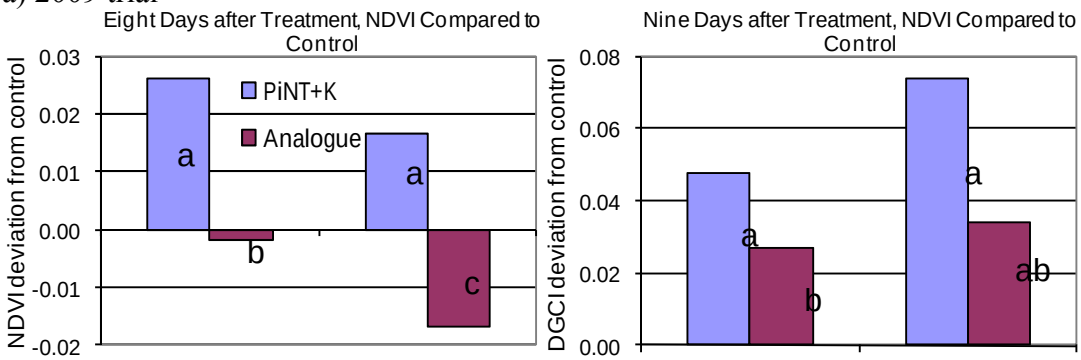
RESULTS AND DISCUSSION

NDVI and DGCI

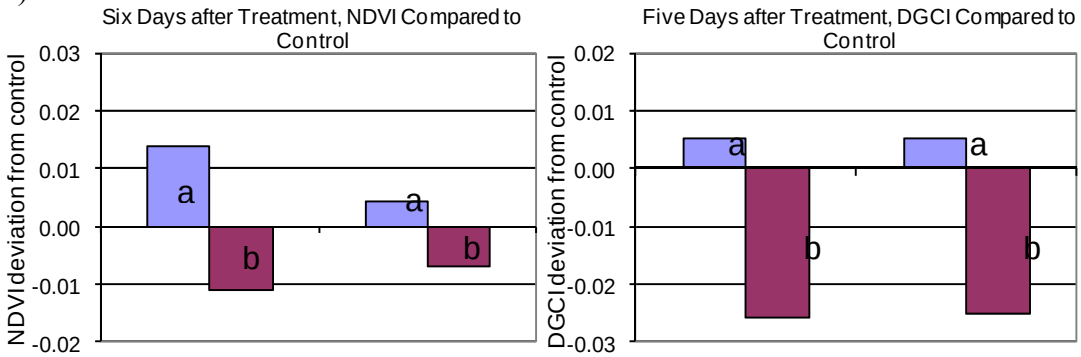
Approximately one week after application, fertilizer burn was observed on analogue N fertilizer treatments as indicated by NDVI and DGCI values less than control values. All NDVI and DGCI values measured on PiNT+K treated plots were greater than control values (Fig. 1). NDVI and DGCI values on PiNT treatments were generally greater than those on the analogue N fertilizer treatments throughout the duration of all three trials.

Figure 1. The deviations of NDVI and DGCI of fertilized treatments from control in a) 2009 trial, b) 2010 trial A, and c) 2010 trial B. In each graphic, bars with the same letter are not significantly different at $p<0.05$.

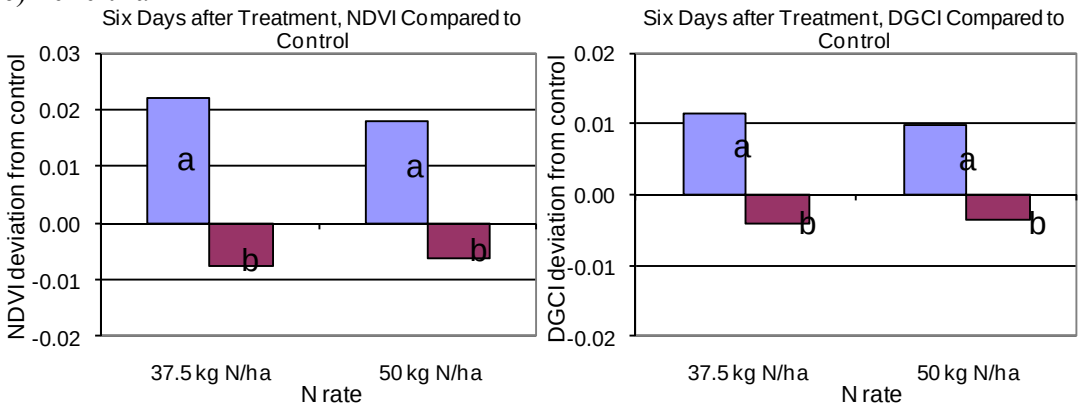
a) 2009 trial



b) 2010 trial A



c) 2010 trial B



Above-ground biomass, N uptake, N recovery, and unused N

At the same N rate, generally similar or slightly greater above-ground biomass was observed in the PiNT+K treatments than the analogue fertilizer treatments in all trials (Table 1). When contrasting PiNT+K versus the analogue in the global analysis, PiNT+K treatments had significantly greater above-ground biomass. Similar to above-ground biomass, generally slightly greater cumulative N uptakes were observed in PiNT+K treatments than analogue treatments in all trials. Contrasting PiNT+K at the N rate of 37.5 kg ha^{-1} vs. the analogue at the N rate of 50 kg ha^{-1} in each trial, PiNT+K treatments had similar N uptake (Table 1).

When comparing unused N and N recovery among 37.5 and 50 kg N ha^{-1} treatments, the 37.5 kg N ha^{-1} PiNT+K treatment had the best N use efficiency (Table 2), suggesting less potential for NO_3-N leaching losses.

Table 1. Cumulative above-ground biomass and cumulative N uptake of PiNT+K versus analogue fertilizer treatments. Values with same letter are not significantly different at $p<0.05$.

N rate (kg ha^{-1})	Cumulative above-ground biomass (g m^{-2})				Cumulative N uptake on (kg ha^{-1})			
	PiNT+K	Analogue	PiNT+K	Analogue	PiNT+K	Analogue	PiNT+K	Analogue
2009 trial	*8/7*		*8/27*		*8/7*		*8/27*	
37.5	32.2ab	26.5b	58.5ab	51.5b	11.1b	8.2c	19.6ab	15.9b
50	37.6a	35.7a	67.1a	61.4a	13.7a	12.9ab	23.4a	21.3a
2010 trial A	*7/7*		*8/13*		*7/7*		*8/13*	
37.5	45.2a	40.8b	76.8a	70.4b	18.7ab	16.4b	30.8ab	27.7b
50	45.7ab	44.7ab	75.9ab	75.3ab	19.0ab	19.1a	31.0a	30.5ab
2010 trial B	*7/29*		*8/19*		*7/29*		*8/19*	
37.5	47.3ab	45.4ab	69.6ab	66.5b	18.0ab	16.7b	23.3ab	21.6b
50	51.2a	49.5ab	74.8a	71.7ab	19.7a	19.1a	25.5a	24.7a

Table 2. Comparison of N recovery rates (ratio of N uptake over N applied) and unused N (difference between N applied and N uptake) for different treatments. Values with the same letter are not significantly different at $p<0.05$.

N rate (kg ha^{-1})	N recovery rate (%)				Unused N (kg ha^{-1})			
	PiNT+K	Analogue	PiNT+K	Analogue	PiNT+K	Analogue	PiNT+K	Analogue
2009 trial	*8/7*		*8/27*		*8/7*		*8/27*	
37.5	29.7a	21.8c	52.4a	42.5b	26.4b	29.3ab	17.9c	21.6b
50	27.3ab	25.7b	46.9b	42.2b	36.3a	37.2a	26.6ab	28.7a
2010 trial A	*7/7*		*8/13*		*7/7*		*8/13*	
37.5	49.9a	43.8b	82.3a	73.8b	18.8b	21.1b	6.7c	9.8b
50	38.0c	38.3c	62.0c	60.9c	31.0a	30.9a	19.0a	19.5a
2010 trial B	*7/29*		*8/19*		*7/29*		*8/19*	
37.5	48.1a	44.4a	62.0a	57.6b	19.5b	20.8b	14.2b	15.9b
50	39.4b	38.1b	51.1c	48.8c	30.3a	30.9a	24.5a	25.6a

CONCLUSIONS

None of PiNT+K treatments exhibited fertilizer burn (osmotic desiccation), whereas most of the analogue fertilizer treatments did exhibit fertilizer burn within one week of application. The degree of burn varied in relation to climatic conditions (temperature, moisture, and light intensity) following application.

PiNT+K treatments generally exhibited similar or slightly greater cumulative above ground biomass and cumulative N uptake than the analogue fertilizer treatments at comparable rates. However, there was no significant difference between PiNT+K at 37.5 kg N ha^{-1} versus the analogue fertilizer at 50 kg N ha^{-1}. PiNT+K at 37.5 kg N ha^{-1} provided similar plant nutrition over the period of these trials to that of the analogue fertilizer at a rate of 50 kg N ha^{-1}.

When comparing N recovery and unused N among 37.5 and 50 kg N ha^{-1} treatments, the 37.5 kg N ha^{-1} PiNT+K treatment had the best N use efficiency, suggesting less potential for N leaching losses.