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TITLE Evaluation of nitrogen application methods, rates, and algorithm on corn under different soil electrical conductivity (EC) zones.

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OBJECTIVES

The main objective of this project was to evaluate the application methods, rates, and algorithm on corn under different soil electrical conductivity (EC) zones to improve nitrogen use efficiency and yields.

MATERIALS AND METHODS

This study was conducted on Dothan loamy sand (fine loamy, kaolinitic, thermic Plinthic Kandiudult) in a production field at Clemson University, Edisto Research and Education Center (REC) near Blackville, SC in 2012. Winter wheat cover crop was killed in early spring. The experimental area was divided into four soil texture zones, based on the soil electrical (EC) conductivity measurements, which were derived from Veris system measurements (Veris Technologies 3100), global positioning system (GPS), and geographic information system (GIS). Soil zone 1 (lowest soil EC readings) was very sandy with low water and nutrient holding capacity and soil zone 3 (highest soil EC readings) was mostly clay with high water and nutrient holding capacity in this experiment.

Each soil EC zone consisted of two nitrogen application methods (all at once at planting and as split application), and five different N application rates (0, 40, 80, 120, and 160 lb N/A) under strip-tillage system. The total number of plots was 120 (3 soil zones x 2 methods of N application x 5 N rates x 4 replications). The methods and rates for corn were randomized within each soil zone.

To validate the Clemson algorithm for variable site-specific application N rates were calculated using the Clemson N-prediction algorithm and compared to conventional practice for the region. The conventional practice consisted applying about 40 lb N/acre at planting and 120 lb N/acre as side-dress at V6 corn stage with the total of 160 lb N/acre. The side-dress N treatments were replicated four times in each zone of the test fields using a RCB design arrangement. Nitrogen Rich Strips (plots with highest N rates) were established in each EC zone, to determine the response index (RI) for predicting yield potential when N was applied. All test plots received 40 lbs/acre N at planting followed by side-dress nitrogen application rates: 1) based on Clemson algorithm separately for each zone, 2) averaged across soil zones, and 3) conventional rate at about V6 corn growth stage. Additionally, rates 25% below and above the averaged predicted rate across zones were also calculated and applied at V6 stage.

On 14 March, Pioneer 31G71 corn was planted in strip-till at 28,000 seeds/acre using a 4-row Univerferth Ripper-Stripper implement and John Deere 1700 MaxEmerge XP Vacuum planters. The plot size was 4 rows wide by 20 ft long and 38 inch row spacing. Corn was broadcast sprayed with Atrazine @ 1 qt/acre following planting the same day. Using a Reddick liquid fertilizer applicator, nitrogen (25-S - liquid formulation of 25% nitrogen and 3.5% sulfur) was side-dress applied to selected corn plots on March 21. On May 6, Roundup @ 1 qt/acre + Atrazine @ 1 qt/acre + Status @ 5 oz/acre were broadcast sprayed on corn. Selected corn plots including algorithm testing were side-dressed with remaining N on May 9. Weed control was based on the South Carolina Extension recommendations.

During corn vegetation, corn was evaluated for Normalized Difference Vegetation Index (NDVI), total N in corn ear-leaves, grain yields and yield parameters (grain moisture, test weight, kernel weight), total N in grain, and soil NO_3-N. Plant NDVI was measured in the center two rows using a GreenSeeker, which uses the following formula to calculate NDVI: (NIR – RED) / (NIR + RED), where NIR and RED are the wavelengths of the light spectrum. Higher NDVI number indicates higher biomass and/or greener plants. The NDVI ranges between -1 and +1. On August 13, corn was harvested using a Kinkaid 8XP small grain combine and grain samples were analyzed for moisture, test weight, and kernel weight. Grain yields and kernel weight were adjusted to 15.5% moisture. Soil samples were collected from depth of 36 inches and divided into 6 inch increments for NO_3-N content and movements in soil following corn harvest.

Data were analyzed using the general linear models (SAS, 1999), and means were separated using Fisher's Protected Least Significant Difference (LSD) Test ($P \leq 0.05$).

RESULTS

Generally, higher than average rainfall during the vegetation season, compared to 30-year average, contributed to higher plant growth and yields. The influence of soil zone, N method, N rates, and interactions on plant normalized difference vegetation index (NDVI) is shown in Table 1. Significantly higher plant NDVI was recorded from soil zones 2 and 3 than zone 1, and from split than all at plant N application rate on June 7, 20, and 29. Plant NDVI was also significantly greater from 80, 120, and 160 lb N/acre than the control and 40 lb N/acre.

Table 2 shows the influence of soil zone, N method, N rates, and interactions on N content in ear-leaf at R1 stage, grain moisture, weight, test weight, yield, and grain N content. The N content in corn ear-leaf, grain moisture at harvest, kernel weight and grain yields were significantly higher in more productive soil zones 2 and 3 compared less productive sandy soil zone 1. Also, N in corn ear-leaves, test weight, grain yield, and grain were greater from split N application than all at plant N application for corn. Compared to control and low N rates, N application at 160 lb N/acre significantly increased N content in corn ear-leaves, grain yield, and grain N, and rates of 120 and 160 lb N/acre increased grain test weight and kernel weight.

The influence of soil zone, N method, N rates, and interactions on NO_3-N content in soil samples at 6 inches increments and up to 36 inches soil depth is shown in Table 3. Significantly higher N concentration was recorded from soil zone 2 and 3 than soil zone 1 and greater with higher N rates for 18-24, 24-30, and 30-36 inches soil depth.

Table 4 shows the results from testing algorithm for predicting sidedress N rates on corn grain yields. Predicted N rates were at 40 lb N/acre for soil zone 1, 140 lb N/acre for soil zone 2 and 3, 120 lb N/acre for across soil zones, and compared to fixed rate of 120 lb N/acre and to 25% above and below the average across zones. Grain yields from plots with predicted sidedress rate of 90 lb N rate (predicted rate across soil zones and decreased by 25%) was 30 lb N/acre less than the fixed N rate and did not significantly lower yields compared to higher N rates for soil zones 1, 2, and 3.

In summary, grain yields were significantly higher for soil zones 2 and 3, than zone 1, higher from split than all at plant, and higher from highest rate of 160 lb N/acre compared to other N treatments for corn. Higher grain yields were mostly due to greater plant NDVI, N content in corn leaves, test and grain weight, and grain N content. The soil nitrate-nitrogen concentration was higher from zones 2 and 3 due to higher holding capacity of these zones compared to zone 1, and higher with high N rates at 18-24, 24-30, and 30-36 inches soil depth indicating N movement into lower soil profile with high N rates. The predicted rate of 90 lb N/acre using Clemson algorithm and NDVI readings did not significantly decrease grain yields compared to the fixed sidedress N rate of 120 lb N/acre. Therefore, sidedress N rates could be decreased by 30 lb N/acre without significant yield decreases for soil zones 1, 2, 3 indicating that Clemson algorithm could be efficiently used in predicting sidedress N rates and improving N use efficiency and profitability of corn production.

Table 1. Influence of soil zone, N method, N rates, and interactions on plant normalized difference vegetation index (NDVI).

		NDVI						
		May 17	May 22	May 30	June 7	June 15	June 20	June 29
	Zone							
	1	0.766	0.787	0.748	0.784	0.766	0.554	0.661
	2	0.822	0.836	0.807	**0.829**	0.822	**0.700**	**0.737**
	3	0.819	0.827	0.780	**0.825**	0.819	**0.681**	**0.737**
	LSD(0.05)	NS	NS	NS	0.035	NS	0.0808	0.0297
	N method							
	At plant	0.801	0.812	0.776	0.806	0.801	0.626	0.700
	Split	0.804	0.821	0.781	**0.819**	0.804	**0.664**	**0.723**
	LSD(0.05)	NS	NS	NS	0.0104	NS	0.0297	0.0223
	N rate (lb/A)							
	0	0.752	0.754	0.744	0.767	0.752	0.567	0.653
	40	0.769	0.789	0.769	0.798	0.769	0.619	0.698
	80	**0.826**	**0.846**	**0.800**	**0.827**	**0.826**	**0.659**	0.716
	120	**0.827**	**0.846**	**0.789**	**0.831**	**0.827**	**0.672**	**0.730**
	160	**0.837**	**0.849**	**0.790**	**0.840**	**0.837**	**0.709**	**0.762**
	LSD(0.05)	0.0443	0.041	0.0237	0.0178	0.0443	0.0554	0.037
Zone	N method							
1	At plant	0.755	0.773	0.741	0.774	0.755	0.519	0.643
	Split	0.777	0.801	0.755	0.794	0.777	0.588	0.678
2	At plant	0.808	0.821	0.801	0.820	0.808	0.689	0.717
	Split	0.836	0.851	0.814	0.838	0.836	0.711	0.757
3	At plant	0.840	0.842	0.785	0.825	0.840	0.670	0.740
	Split	0.797	0.812	0.774	0.825	0.797	0.692	0.734
	P > F	NS	NS	NS	NS	NS	NS	NS

Table 1 (cont.). Influence of soil zone, N method, N rate interactions on plant normalized difference vegetation index (NDVI).

		NDVI						
		May 17	May 22	May 30	June 7	June 15	June 20	June 29
Zone	N rate (lb/A)							
1	0	0.652	0.653	0.651	0.695	0.652	0.427	0.565
	40	0.747	0.758	0.756	0.776	0.747	0.540	0.664
	80	0.782	0.837	0.768	0.800	0.782	0.565	0.670
	120	0.818	0.832	0.778	0.816	0.818	0.596	0.681
	160	0.831	0.857	0.787	0.832	0.831	0.640	0.724
2	0	0.788	0.791	0.794	0.805	0.788	0.656	0.692
	40	0.761	0.796	0.786	0.795	0.761	0.664	0.700
	80	0.845	0.838	0.818	0.849	0.845	0.699	0.737
	120	0.846	0.862	0.824	0.843	0.846	0.725	0.763
	160	0.870	0.891	0.814	0.855	0.870	0.757	0.794
3	0	0.818	0.817	0.787	0.802	0.818	0.619	0.702
	40	0.798	0.811	0.766	0.824	0.798	0.652	0.731
	80	0.852	0.864	0.814	0.831	0.852	0.713	0.740
	120	0.816	0.843	0.764	0.835	0.816	0.694	0.747
	160	0.811	0.800	0.769	0.833	0.811	0.729	0.767
	$P > F$	0.0482	0.0065	<.0001	0.0001	0.0482	NS	NS
N method	N rate (lb/A)							
At plant	0	0.737	0.745	0.739	0.757	0.737	0.552	0.644
	40	0.782	0.776	0.771	0.785	0.782	0.582	0.689
	80	0.821	0.840	0.793	0.822	0.821	0.664	0.709
	120	0.813	0.834	0.777	0.821	0.813	0.653	0.718
	160	0.851	0.866	0.798	0.847	0.851	0.681	0.741
Split	0	0.768	0.763	0.749	0.778	0.768	0.582	0.662
	40	0.755	0.801	0.767	0.812	0.755	0.656	0.707
	80	0.831	0.853	0.807	0.831	0.831	0.654	0.722
	120	0.840	0.858	0.801	0.842	0.840	0.690	0.743
	160	0.824	0.832	0.782	0.833	0.824	0.737	0.782
	$P > F$	NS	NS	NS	NS	NS	NS	NS

Table 1 (cont.). Influence of soil zone, N method, N rate interactions on plant normalized difference vegetation index (NDVI).

			NDVI						
			May 17	May 22	May 30	June 7	June 15	June 20	June 29
Zone	Method	N rate (lb/A)							
1	At plant	0	0.651	0.659	0.663	0.697	0.651	0.436	0.577
		40	0.747	0.712	0.722	0.752	0.747	0.455	0.628
		80	0.787	0.838	0.764	0.798	0.787	0.562	0.668
		120	0.786	0.822	0.774	0.804	0.786	0.580	0.685
		160	0.804	0.836	0.780	0.820	0.804	0.564	0.658
	Split	0	0.652	0.647	0.639	0.693	0.652	0.418	0.552
		40	0.748	0.804	0.789	0.799	0.748	0.626	0.699
		80	0.778	0.836	0.772	0.803	0.778	0.569	0.671
		120	0.850	0.842	0.783	0.828	0.850	0.613	0.678
		160	0.858	0.877	0.794	0.845	0.858	0.716	0.790
2	At plant	0	0.742	0.761	0.778	0.777	0.742	0.617	0.655
		40	0.775	0.792	0.786	0.780	0.775	0.659	0.684
		80	0.816	0.816	0.808	0.847	0.816	0.708	0.718
		120	0.827	0.840	0.813	0.831	0.827	0.703	0.748
		160	0.878	0.896	0.819	0.867	0.878	0.760	0.781
	Split	0	0.834	0.821	0.809	0.833	0.834	0.694	0.729
		40	0.747	0.801	0.785	0.809	0.747	0.670	0.716
		80	0.873	0.861	0.829	0.852	0.873	0.689	0.757
		120	0.865	0.884	0.835	0.855	0.865	0.748	0.778
		160	0.863	0.885	0.809	0.844	0.863	0.755	0.807
3	At plant	0	0.820	0.814	0.775	0.797	0.820	0.603	0.698
		40	0.825	0.825	0.804	0.823	0.825	0.633	0.756
		80	0.861	0.867	0.808	0.822	0.861	0.721	0.741
		120	0.825	0.839	0.743	0.828	0.825	0.677	0.721
		160	0.871	0.865	0.795	0.854	0.871	0.718	0.785
	Split	0	0.817	0.820	0.798	0.807	0.817	0.634	0.706
		40	0.770	0.797	0.727	0.826	0.770	0.672	0.707
		80	0.842	0.861	0.820	0.839	0.842	0.705	0.738
		120	0.807	0.847	0.784	0.843	0.807	0.710	0.773
		160	0.751	0.734	0.743	0.811	0.751	0.741	0.748
		160	NS	NS	NS	NS	NS	NS	NS

Table 2. Influence of soil zone, N method, N rates, and interactions on N content in ear-leaf at R1 stage, grain moisture, weight, test weight, yield, and N content.

		N in ear-leaf R1	Grain moisture	Test weight	100 kernel weight	Grain yield	Grain N
	Zone	%	%	lb/Bu	gms	Bu/acre	%
	1	2.200	13.00	51.9	17.700	40.0	1.00
	2	**2.400**	**14.30**	53.5	**22.200**	**81.0**	0.97
	3	**2.300**	**14.40**	53.3	**21.900**	**88.2**	0.99
	LSD(0.05)	0.162	1.09	NS	1.666	22.5	NS
	N method						
	At plant	2.100	13.90	52.3	20.300	60.0	0.96
	Split	**2.400**	13.80	**53.5**	20.900	**79.5**	**1.02**
	LSD(0.05)	0.058	NS	1.1	NS	4.7	0.04
	N rate (lb/A)						
	0	1.800	13.70	51.6	18.400	32.6	0.92
	40	2.000	13.50	51.4	19.100	47.5	0.90
	80	2.400	14.10	52.9	20.500	66.1	0.97
	120	2.600	14.30	**54.0**	**22.400**	88.5	1.04
	160	**2.700**	13.90	**54.5**	**22.700**	**114.1**	**1.09**
	LSD(0.05)	0.131	NS	1.6	1.984	17.9	0.05
Zone	N method						
1	At plant	1.900	12.80	50.6	17.000	24.6	0.95
	Split	2.400	13.20	53.1	18.500	55.3	1.05
2	At plant	2.300	14.20	53.1	21.700	72.3	0.94
	Split	2.500	14.40	53.8	22.600	89.8	1.00
3	At plant	2.200	14.80	53.2	22.300	83.1	0.97
	Split	2.500	14.00	53.4	21.500	93.4	1.01
	$P > F$	NS	NS	NS	NS	NS	NS

Table 2 (cont.). Influence of soil zone, N method, N rates, and interactions on N content in ear-leaf at R1 stage, grain moisture, weight, test weight, yield, and N content.

		N in ear-leaf R1	Grain moisture	Test weight	100 kernel weight	Grain yield	Grain N
Zone	N rate (lb/A)	%	%	Lb/Bu	gms	Bu/acre	%
1	0	1.600	12.50	51.7	16.200	6.6	0.96
	40	1.800	12.80	48.7	16.600	26.2	0.91
	80	2.200	12.90	51.4	16.700	25.3	0.93
	120	2.500	13.30	53.3	19.400	56.6	1.08
	160	2.600	13.50	54.2	19.800	85.2	1.09
2	0	1.900	14.40	51.8	19.800	45.3	0.91
	40	2.100	13.70	52.9	20.300	52.6	0.91
	80	2.500	14.70	53.6	22.400	80.3	1.03
	120	2.600	14.50	54.4	24.200	101.6	0.97
	160	2.800	14.30	54.6	24.100	125.4	1.03
3	0	1.800	14.20	51.3	19.300	45.8	0.90
	40	2.200	14.10	52.5	20.200	63.7	0.89
	80	2.400	14.90	53.8	22.300	92.8	0.96
	120	2.500	15.00	54.2	23.700	107.2	1.05
	160	2.800	14.00	54.8	24.100	131.8	1.16
	P > F	NS	NS	NS	NS	NS	0.01
N method	N rate (lb/A)						
At plant	0	1.800	13.70	51.4	18.400	27.7	0.90
	40	1.900	13.40	49.9	18.900	37.8	0.89
	80	2.200	14.40	52.6	20.200	61.5	0.96
	120	2.300	14.30	53.4	21.800	78.9	0.96
	160	2.600	13.80	54.3	22.400	94.2	1.06
Split	0	1.800	13.60	51.8	18.400	37.5	0.94
	40	2.200	13.60	52.8	19.200	57.1	0.92
	80	2.600	13.80	53.3	20.700	70.8	0.99
	120	2.800	14.20	54.6	23.100	98.1	1.11
	160	2.900	14.00	54.8	23.000	134.0	1.12
	P > F	0.001	NS	NS	NS	NS	NS

Table 2 (cont.). Influence of soil zone, N method, N rates, and interactions on N content in ear-leaf at R1 stage, grain moisture, weight, test weight, yield, and N content.

			N in ear-leaf R1	Grain moisture	Test weight	100 kernel weight	Grain yield	Grain N
Zone	Method	N rate (lb/A)	%	%	Lb/Bu	gms	Bu/acre	%
1	At plant	0	1.700	12.30	51.4	17.000	4.8	0.93
		40	1.600	11.70	44.8	15.100	12.4	0.89
		80	1.900	13.30	51.4	17.300	24.4	0.96
		120	2.100	13.30	52.5	18.600	48.1	0.94
		160	2.300	13.20	53.2	16.800	33.4	1.02
	Split	0	1.600	12.60	51.9	15.300	8.4	0.99
		40	2.100	13.90	52.6	18.000	40.0	0.95
		80	2.500	12.40	51.5	16.100	26.1	0.90
		120	3.000	13.20	54.2	20.100	65.1	1.22
		160	3.000	13.70	55.3	22.800	136.9	1.15
2	At plant	0	1.900	14.50	51.5	18.800	37.9	0.89
		40	2.000	13.10	52.4	20.100	36.9	0.88
		80	2.400	15.30	52.9	21.300	71.8	0.97
		120	2.400	14.20	54.2	23.900	92.7	0.95
		160	2.700	14.00	54.5	24.200	122.1	1.02
	Split	0	1.900	14.30	52.1	20.700	52.7	0.93
		40	2.200	14.30	53.4	20.500	68.2	0.94
		80	2.600	14.00	54.3	23.400	88.8	1.09
		120	2.800	14.80	54.7	24.500	110.5	1.00
		160	2.800	14.50	54.7	24.000	128.6	1.04
3	At plant	0	1.800	14.30	51.2	19.500	40.4	0.89
		40	2.100	15.50	52.5	21.600	64.1	0.90
		80	2.200	14.70	53.5	21.900	88.1	0.94
		120	2.300	15.50	53.6	22.700	95.7	1.00
		160	2.700	14.20	55.2	26.100	127.1	1.14
	Split	0	1.800	14.10	51.4	19.100	51.3	0.90
		40	2.200	12.70	52.5	18.900	63.2	0.88
		80	2.600	15.10	54.1	22.700	97.6	0.99
		120	2.800	14.50	54.9	24.700	118.6	1.11
		160	2.900	13.70	54.4	22.000	136.4	1.17
		160	NS	NS	NS	NS	NS	NS

Table 3. Influence of soil zone, N method, N rates, and interactions on NO_3-N content in soil samples at 6 inches increments and up to 36 inches soil depth.

		0-6	6-12	12-18	18-24	24-30	30-36
	Zone						
	1	1.97	1.79	1.93	2.96	3.11	3.53
	2	**3.43**	2.96	2.74	2.51	3.39	4.16
	3	**4.57**	3.89	3.37	3.42	3.24	3.87
	LSD(0.05)	1.5483	NS	NS	NS	NS	NS
	N method						
	At plant	3.33	2.93	2.73	2.69	2.8	3.54
	Split	3.32	2.83	2.63	3.26	3.68	4.15
	LSD(0.05)	NS	NS	NS	NS	NS	NS
	N rate (lb/A)						
	0	2.65	2.13	2.17	2.45	2.05	1.87
	40	2.93	2.42	2.35	2.14	2.79	2.46
	80	3.59	3.21	2.26	**3.04**	2.23	3.18
	120	3.88	3.5	3.03	**3.09**	3.31	3.94
	160	3.59	3.14	3.58	**4.12**	**5.77**	**7.7**
	LSD(0.05)	NS	NS	NS	2.0129	1.7239	2.4835
Zone	N method						
1	At plant	1.7	1.68	1.66	2.6	2.75	3.67
	Split	2.25	1.91	2.2	3.33	3.48	3.39
2	At plant	3.88	3.39	2.9	2.15	3.02	3.46
	Split	2.99	2.54	2.57	2.86	3.74	4.86
3	At plant	4.45	3.74	3.63	3.29	2.65	3.48
	Split	4.7	4.03	3.1	3.56	3.83	4.25
	$P > F$	NS	NS	NS	NS	NS	NS

Table 3 (cont). Influence of soil zone, N method, N rates, and interactions on NO_3-N content in soil samples at 6 inches increments and up to 36 inches soil depth.

		0-6	6-12	12-18	18-24	24-30	30-36
Zone	N rate (lb/A)						
1	0	1.38	1.62	1.64	1.88	1.69	1.69
	40	1.86	1.59	1.85	2.12	2.39	1.74
	80	2.22	2.24	2.04	3.12	2.22	3.44
	120	1.89	2.46	1.89	3.38	4.32	5.19
	160	2.52	1.07	2.23	4.32	4.97	5.59
2	0	2.96	2.48	2.36	2.21	2.17	1.58
	40	2.63	2.20	1.80	1.98	4.20	3.94
	80	3.74	3.03	2.00	2.65	1.97	3.05
	120	5.74	3.83	4.19	2.96	2.51	3.18
	160	2.35	3.31	3.41	2.72	5.90	8.85
3	0	3.60	2.29	2.52	3.25	2.31	2.35
	40	4.26	3.44	3.30	2.29	2.01	1.95
	80	4.81	4.37	2.74	3.36	2.51	3.05
	120	4.31	4.28	3.20	2.91	2.96	3.32
	160	5.89	5.06	5.09	5.31	6.43	8.67
	$P > F$	NS	NS	NS	NS	NS	NS
N method	N rate (lb/A)						
At plant	0	3.09	2.58	2.42	2.15	1.76	2.05
	40	2.83	2.29	2.42	1.83	2.86	2.54
	80	4.00	3.36	2.42	3.23	2.29	3.83
	120	4.22	3.74	3.55	2.83	2.61	3.67
	160	2.44	2.59	2.78	3.33	4.37	5.49
Split	0	2.21	1.68	1.93	2.74	2.31	1.69
	40	3.02	2.54	2.28	2.41	2.73	2.39
	80	3.17	3.06	2.1	2.85	2.18	2.53
	120	3.49	3.24	2.44	3.39	4.09	4.24
	160	4.74	3.70	4.37	4.91	7.17	9.91
	$P > F$	NS	NS	NS	NS	NS	NS

Table 3 (cont). Influence of soil zone, N method, N rates, and interactions on NO_3-N content in soil samples at 6 inches increments and up to 36 inches soil depth.

Treatment			0-6	6-12	12-18	18-24	24-30	30-36
Zone	Method	N rate (lb/A)						
1	At plant	0	1.81	1.66	1.56	1.52	2.00	2.46
		40	1.95	2.00	1.47	1.73	0.95	1.1
		80	2.06	2.62	1.41	3.49	2.56	4.59
		120	0.58	1.44	2.05	2.49	4.31	4.98
		160	2.08	0.70	1.8	3.75	3.92	5.24
	Split	0	0.95	1.57	1.72	2.24	1.37	0.92
		40	1.77	1.19	2.22	2.51	3.82	2.37
		80	2.37	1.86	2.68	2.75	1.88	2.28
		120	3.2	3.47	1.72	4.28	4.32	5.41
		160	2.95	1.44	2.66	4.89	6.02	5.94
2	At plant	0	3.32	2.89	2.64	1.66	1.48	1.63
		40	2.03	2.02	2.31	0.83	6.55	4.22
		80	4.38	3.44	2.59	2.56	1.92	4.06
		120	7.73	5.67	5.39	3.81	2.80	3.7
		160	1.32	2.46	1.38	1.46	3.03	3.96
	Split	0	2.61	2.06	2.09	2.75	2.64	1.53
		40	3.03	2.32	1.47	2.75	2.64	3.76
		80	3.1	2.61	1.41	2.73	2.01	2.04
		120	2.77	1.07	2.40	1.69	2.09	2.40
		160	3.38	4.15	5.44	3.98	8.77	13.73
3	At plant	0	4.14	3.18	3.07	3.26	1.70	2.08
		40	4.26	2.77	3.45	2.6	2.30	2.86
		80	5.58	4.03	3.26	3.64	2.38	2.85
		120	4.37	4.11	3.21	2.19	0.73	2.35
		160	3.9	4.6	5.17	4.77	6.16	7.27
	Split	0	3.06	1.4	1.98	3.24	2.91	2.62
		40	4.26	4.11	3.14	1.97	1.72	1.05
		80	4.04	4.7	2.21	3.08	2.65	3.26
		120	4.25	4.45	3.19	3.64	5.18	4.29
		160	7.88	5.51	5.00	5.85	6.71	10.06
		160	NS	NS	NS	NS	NS	NS

Table 4. Testing predicted sidedress N rates based on Clemson algorithm for each zone and across zones in comparison to a fixed N rate of 120 lb N/acre.

Treatment	N rate/acre
Individually for each zone:	
1	40
2	140
3	140
Across soil zones	120
Fixed N rate	120
Increased by 25% compared to predicted across zones	150
Decreased by 25% compared to predicted N rates across zones.	90

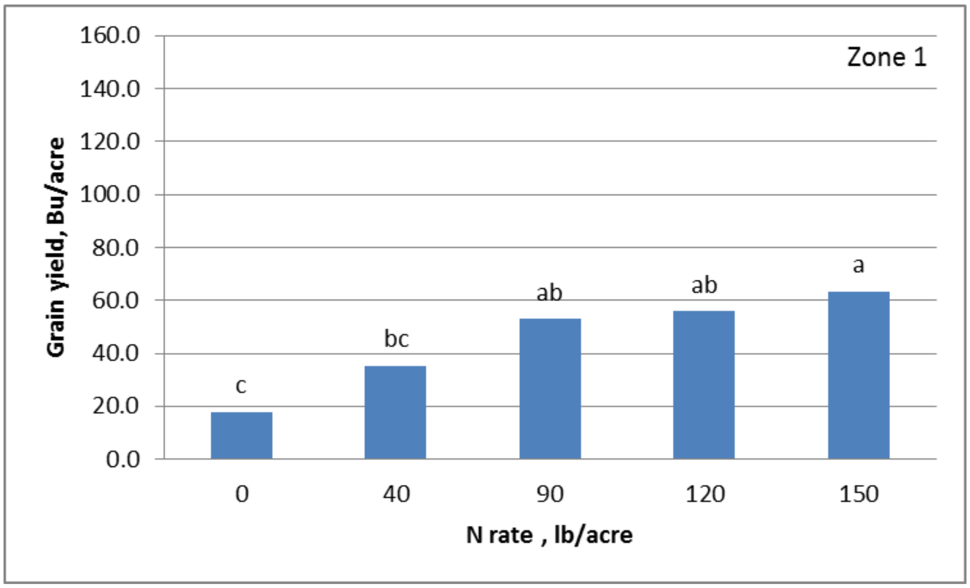

Fig. 1. Influence of algorithm predicted sidedress N rates for each zone and across zones in comparison to a fixed rate of 120 lb N/acre on corn grain yields in soil zone 1.

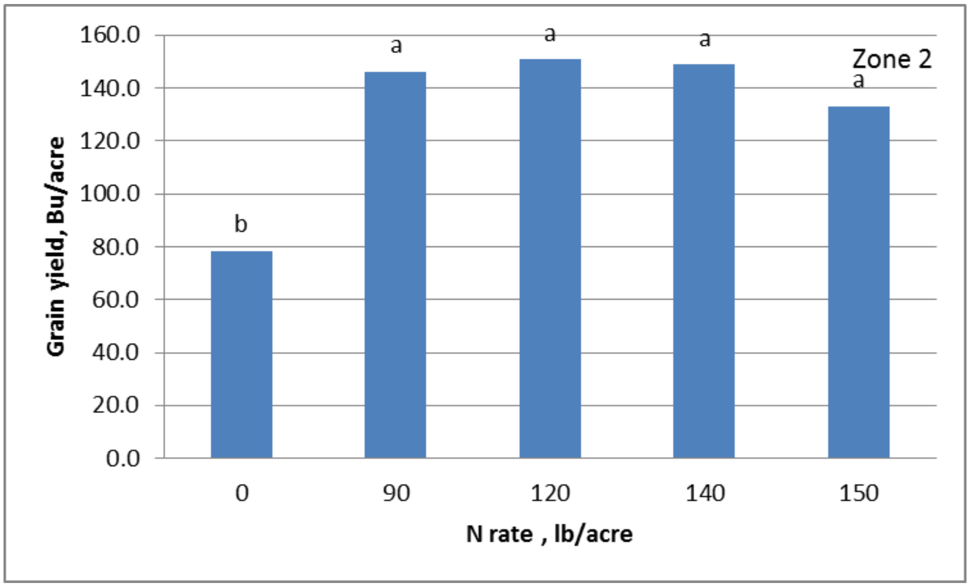

Fig. 2. Influence of algorithm predicted sidedress N rates for each zone and across zones in comparison to a fixed rate of 120 lb N/acre on corn grain yields in soil zone 2.

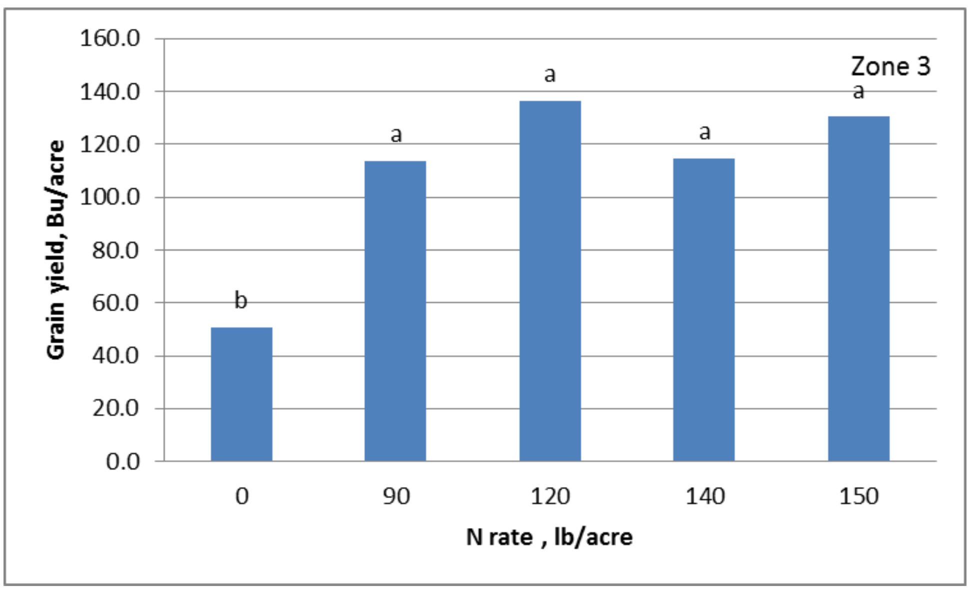

Fig. 3. Influence of algorithm predicted sidedress N rates for each zone and across zones in comparison to a fixed rate of 120 lb N/acre on corn grain yields in soil zone 3.