Vegetable Section

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Optimizing Nitrogen Rates with Surfactant for Chipping Potato Production in Florida

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Nitrogen (N) fertilization is the major cost for fertilizers for commercial potato production. A field trial for chipping (var. 'Atlantic') potatoes was conducted to maximize N use efficiency in the Hastings area in the 2014 growing season. Triple superphosphate and muriate of potash were used at 100 lb/acre P_2O_5 and 260 lb/acre K_2O with four replicates. The trial had six different N rates: 0, 120, 160, 200, 240, and 280 lb/acre. In the treatments without applying a surfactant (SFT), N fertilizer as ammonium nitrate was applied: 1) preplant (30%); 2) at emergence (30%); and 3) 6- to 8-inch tall potato plants (40%), while those with the SFT were applied 100% N preplant. Marketable yields for 0, 120, 160, 200, 240, and 280 lb/acre N without applying the SFT were 10,817, 32,067, 34,959, 37,458, 36,527, and 37,688 lb/acre, respectively. The yields for 120, 160, 200, and 240 lb/acre N plus 30 lb/acre SFT were 22,144, 26,726, 30,563, and 30,831 lb/acre, respectively. The yields for 160 lb N plus 10 or 20 lb/acre SFT were 25,100 and 27,662 lb/acre, respectively. This growing season had heavy rain events in the early growing season. At the same N rate, three-split N applications without SFT were better than a single N application with SFT for tuber yields. The SFT did not increase tuber yields with heavy rains in the early growing season.

Potato is a major vegetable crop in Florida. Most soils used for potato production in Florida are sandy by nature. These sandy soils are water repellent when they are dry (Liu, Ozores-Hampton, et al., 2013). Water repellency of these soils can pose a major challenge to potato growers trying to manage nutrients such as nitrogen. A surfactant is a chemical with both hydrophobic and hydrophilic properties which can help alleviate water repellency in sandy soils (Hallett, 2008). The data from a preliminary trial conducted in Hastings, Florida were positive (Liu, Hogue, et al., 2013). To confirm the effects of applying surfactant on tuber yields of potato grown on sandy soils, this follow-up trial was conducted on the IFAS Research Farm and a private farm in the Hastings area in the 2014 growing season. The objectives of this trial were to: 1) re-evaluate the effects of the applied surfactant on tuber yields of potato and 2) optimize nitrogen rates for potato production in the Hastings area.

Materials and Methods

This field trial was conducted with 'Atlantic' grown on the Institute of Food and Agricultural Sciences (IFAS) Research Farm in Hastings, FL, from 3 Feb. to 16 May 2014. A randomized complete-block design was used on a total of 48 plots. The plot size was 533.3 ft^2 (40 x 13.3 ft) with four rows. There were 12 treatments with different nitrogen (N) rates [pounds per acre (lb/acre)] and surfactant (SFT) rates (lb/acre) with four replications: 1) 0 N; 2) 120 N as ammonium nitrate; 3) 120 N + 30 SFT as Stockosorb 660; 4) 160 N; 5) 160 N + 10 SFT; 6) 160 N + 20 SFT; 7) 160 N + 30 SFT; 8) 200 N; 9) 200 N + 30 SFT; 10) 240 N; 11) 240 N + 30 SFT; and 12) 280 N. For the treatments without applying SFT, nitrogen was applied in three-split applications: 30% pre-plant, 30% at emergence, and 40% when potato vines were 6–8 inches tall, whereas those treatments with SFT were applied 100% pre-plant. One-hundred pounds per acre of phosphorus pentoxide (P_2O_5) as triple superphosphate was applied pre-plant and 260 lb potassium oxide (K_2O) as potassium sulfate was used: 38.5% pre-plant and 61.5% at emergence. At harvest, the central 20 feet of the two middle rows were dug for tuber yield measurements. Precipitation and rainfall data were downloaded from Florida Automated Weather Network (FAWN, <http://fawn.ifas.ufl.edu/>) for the Hastings station. Data were analyzed using one-way ANOVA method (SAS Institute, 2009), and was considered significant at $P < 0.05$. After running the SAS program, the critical ranges ($LSD_{2, 0.05}$) of Duncan's Multiple Range Test were used to detect the difference significance between two means (Hubbard, 2001).

Results and Discussion

Table 1 shows: 1) all of the treatments with nitrogen had significantly greater tuber yields than the zero N treatment; 2) all of the treatments with three split applications of nitrogen consistently had greater tuber yields than those with only one application; 3) the more nitrogen applied, the greater the tuber yields without SFT application; and 4) SFT application did not increase potato tuber yields for this trial, even though it did in 2013 (Liu, Hogue et al., 2013). This discrepancy in the results

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Table 1. Potato tuber yields (lb/acre) of different nitrogen rates with or without surfactant application in the Hastings area of Florida, 3 Feb. to 16 May 2014.

Treatment	Number of Applications	Marketable yield (lb/acre) Mean	± SE	Unmarketable yield (lb/acre) Mean	± SE	Total yield (lb/acre) Mean	± SE	Significance[z]
280 N	3	37717	1623	631	162	38348	1714	a
200 N	3	37487	1831	580	217	37556	1787	a
240 N	3	36555	1488	371	113	36926	1399	ab
160 N	3	34986	1278	474	218	35460	1206	abc
120 N	3	32092	1575	386	75	32478	1598	bcd
240 N + 30 SFT	1	30586	2066	330	107	31270	2111	cde
200 N + 30 SFT	1	30855	2428	415	87	30917	2404	cde
160 N + 20 SFT	1	27683	2604	415	131	28098	2716	def
160 N + 30 SFT	1	26746	1943	327	68	27073	1970	efg
160 N + 10 SFT	1	22161	1667	159	62	25370	1693	gf
120 N + 30 SFT	1	25120	3264	250	69	22320	3223	g
0 N	0	10825	854	60	32	10886	847	h

[z]Total tuber yields with the same letter were not significantly different. $P < 0.01$, $LSD_{2, 0.05} = 4604$ lb/acre.

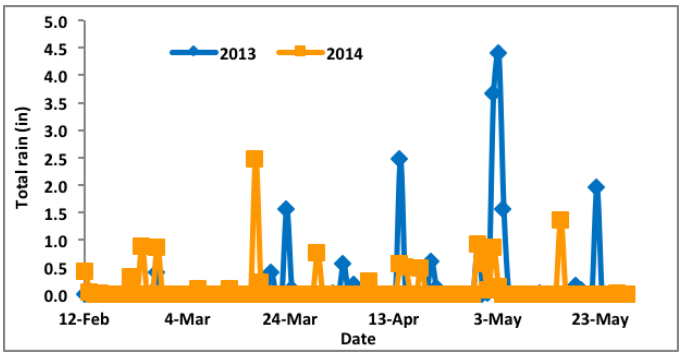

Fig. 1. Comparison of rain events and rainfall in Hastings, Florida in the potato growing seasons for 2013 and 2014.

between these two years may be explained by the difference in the weather, particularly, in rainfall distribution between 2013 and 2014 (Fig. 1). It was dry early in the season in 2013. The treatments with applied surfactant might keep moisture and nutrients such as nitrogen in the root zone longer than those without surfactant. On the other hand, there were a number of heavy rain events early in the 2014 season so the nutrients might have been leached out of the root zone.

Conclusions

Nutrient management is more difficult in sandy soils than in other soils. Based on the positive results of using the SFT to improve nitrogen use efficiency potato production in 2013, this trial was conducted on the same IFAS research farm in Hastings, FL, in 2014. There was little increase in tuber yields when nitrogen application was greater than 200 lb/acre. There were heavy rain events early in the 2014 growing season. Tuber yields were consistently greater for the treatments without a surfactant but with three split applications of nitrogen than for those with the SFT and one application of the corresponding nitrogen rates. The surfactant did not contribute to any tuber yield increase in the 2014 growing season. To make a clear conclusion about the effect of applying the SFT for commercial potato production, more trials are needed.

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