CHAFF ROWS AND NITROGEN FERTILIZER APPLICATION IN STRIP TILLAGE – YEAR 1

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INTRODUCTION

The introduction of strip-tillage to sugar beet production in Southern Idaho has brought challenges as well as opportunities to local sugar beet growers. One challenge is dealing with the chaff (residue) rows left behind by combines. These rows create uneven distribution of residue throughout the field, which can be a challenge for crop production with strip-tillage. Specifically, growers are concerned that the areas will little residue will be droughty and will be more susceptible to weed growth, while areas with heavy residue coverage may have more fertilizer and herbicide binding in the residue and more soil-borne disease pressure under cooler, moister, and higher carbon soil environment.

Another major hurdle in strip-tillage systems is nitrogen application. Because broadcasted fertilizers can no longer be incorporated into the soil, growers have to either broadcast nitrogen fertilizers and rely on irrigation to move the fertilizer into the soil, or the nitrogen fertilizer can be shanked (knifed, banded) in simultaneously during spring strip-tillage. Surface-applying nitrogen fertilizers increase the potential for volatilization losses (conversion of fertilizer ammonium to ammonia gas) and binding with surface residues. Shanking is effective for avoiding these issues, but may be costly for the grower to outfit tillage equipment for fertilizer applications. Using recommended rates of fertilizer may also be problematic for shanking, as the concentrated band of nitrogen fertilizer can potentially burn roots.

MATERIALS AND METHODS

To address the concerns, we developed a study with varying amounts of wheat residue cover, nitrogen application methods, and nitrogen application rates on various aspects of sugar beet production. Crop residue levels in this study ranged from 0.8 to 7.7 ton/A. Nitrogen application methods used were: 1) broadcast granular urea fertilizer without incorporation and 2) shanked liquid urea-ammonium-nitrate (UAN) to a depth of 4 inches using strip-tillage equipment, and 3) no N applied. A four row Strip Cat implement manufactured by Twin Diamond Industries was used for fertilizer application and seedbed preparation. Nitrogen application rates of 71 and 142 lb N/acre were based on an application goal of 4 and 6 lb N/beet ton.

RESULTS AND DISCUSSION

Averaging over residue level, beet yield did not increase significantly with added broadcast urea up to 142 lb N/acre (Table 1). However, emergence and beet count decreased significantly while beet weight trended higher with increasing broadcast urea rates, suggesting that seed burn caused by contact with granular urea prevented seed germination. The surviving plants on the broadcast urea plots increased in beet weight with increasing fertilizer rates, suggesting that if the seeds can make it past germination, they do very well. Plants receiving 71 lb N/acre as shanked UAN increased in yield to 33 tons/acre compared to 26 tons/acre with no nitrogen added, but decreased to 27 tons/acre when N rates were increased to 142 lb/acre (Table 1). It is likely that the concentrated

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UAN in the soil is burning the roots of the plant, thus lowering beet weights. Excluding controls, stunting rates were also the highest for the high shank N treatment (data not shown). Sugar content was not affected by application method, but did drop significantly as nitrogen rates increased (Table 1).

Table 1. Yield, beet quality, and emergence response of sugar beets cultivated in a strip-tillage system in Kimberly, Idaho. Data is averaged over residue levels ranging from 0.8 to 7.7 tons/acre.

N applic. Method	N rate	Soil N + fert. N	Beet yield	ERS	Sugar content	Brei nitrate	Emerg-ence	Beet weight
	--(lb N/acre)---		ton/acre	lb/acre	%	ppm	%	lb/beet
Control	0	69	26	7248	15.9	56	55	6.8
Broadcast	71	140	25	6780	15.6	86	45	7.4
	142	211	26	6989	15.4	120	31	8.3
p value, linear			*ns*	*ns*	*0.0569*	*0.0002*	*<0.0001*	*ns*
Control	0	69	26	7248	15.9	56	55	6.8
Shank	71	140	33	9109	15.7	69	60	9.3
	142	211	27	7301	15.3	142	57	8.6
p value, linear			*ns*	*ns*	*0.011*	*0.0046*	*ns*	*ns*
p value, quadratic			*0.0008*	*0.0003*	*ns*	*ns*	*ns*	*ns*

As residue levels increased from 0.8 to 7.7 tons/acre beet yields for broadcast urea treatments and the 142 lb N/acre rate for shanked UAN decreased. However, yields increased slightly for the 71 lb N/acre treatment with increasing residue (data not shown). For the broadcast treatment, it is likely the higher carbon amount in the residue would immobilize the surface applied N. For the low and high N shanked treatments, the cause for contrasting yield responses has not yet been determined.

At a depth of 0 to 12 inches, soil bulk density did not appear to be affected by residue level. This was expected, as tillage effects often take several years before impacting soil density. Gravimetric and volumetric soil moisture content trended 1% higher in mid-April for high residue plots (3.9 to 7.7 ton/acre) in comparison to low residue plots (0.77 to 1.71 ton/acre), but were equal at harvest in mid-October. This suggests that greater crop residue cover prevents some evaporation of soil water earlier in the season, likely before row closure. At the 3 inch depth, maximum soil temperatures appeared to decrease from 83 to 81 degrees and minimum temperatures increase from 44 to 46 with increasing residue levels (0.8 – 7.7 ton/acre), indicating that greater residue coverage has a buffering effect on soil temperature. However, average soil temperature did not appear to change with residue level.

No stand reduction or root diseases, caused by soil-borne pathogens, were observed during the growing season. The absence of soil-borne pathogens was probably related to water management. The plots were irrigated at optimum levels and not over-irrigated, which would have increased disease potential. In addition, no effects of residue levels and weed densities in regard to increased pathogen pressure or disease occurrence were observed. Seedlings emergence was uneven and stretched out over multiple weeks, and was probably more related to the shank treatment than to soil-borne pathogens or residue levels. As mentioned previously, the plots were strip tilled when the soil was wetter than it should have been. This sometimes left a visible crack in the soil 3 to 4 inches deep, where some of the seeds were deposited during planting.

Weed control was not greatly affected by crop residue level, nitrogen rate, or application method (broadcast versus shanked). Weed species growing in this study included common lambsquarters, redroot pigweed, kochia, common mallow, annual sowthistle, green foxtail and barnyardgrass. The study area was overseeded in late fall with Russian thistle, hairy nightshade and all of the species previously mentioned with the exception of annual sowthistle and common mallow. Even though the study site was sprayed with glyphosate in the fall to control volunteer wheat, common mallow that had survived through the summer was not controlled and we anticipated problems controlling this weed the following spring. Glyphosate was applied three times at 22 fl oz/a (0.75 lb ae/A) with ammonium sulfate at 17 lb/100 gallons of spray mixture (3.5 lb/A). The first in-crop glyphosate application was made May 23 when the sugar beets were in the 2-leaf stage. Subsequent applications were made June 3 and June 30. Weed seedling emergence was counted June 23 to see if any differences in weed populations by species and density could be seen among the crop residue levels and nitrogen application rates and methods. The only differences observed in weed seedling emergence was with redroot pigweed. Redroot pigweed densities were higher in the low crop residue treatments compared to the high residue treatments.

Plans are underway to repeat this study in 2010 to further evaluate the interactions between residue cover and nitrogen application in a strip-till system.