The Effect of Soybean Row Placement Relative to Old Corn Rows for Soil Potassium and Yield.

(17-716)

Introduction:

Information about soil potassium carryover dynamics can assist soybean producers with the optimal management of potassium (K) fertilizer. Optimal K management promotes soybean plant health, may decrease input costs, and increase soybean yields. Soil sampling and testing approach were followed to determine optimal K application rates and economic returns under different soil information scenarios based on soil testing, soybean yield response to K fertilizer and fertilizer carryover estimates from 2017 trial in NCRS 17-716. Our research was based on the detailed study carried out in NCRS- 16-1206 on the Impact of soil type, soil moisture, and carryover row potassium on dissolved potassium (detailed in 2016 NCRS annual report, pp: 38- 40). Results suggest that soil test data could provide important information about K carryover potential, which may lead to more efficient fertilizer use and higher profit margins for soybeans producers.

Objective

Studies examining net returns from managing soil nutrient dynamics using soil test information to determine optimal fertilizer application rates have been conducted for soybean. These were the research introduction to correlate ex-post (actual) research with ex-ante (predicted) changes in profitability after managing fertilizer inputs based on soil test information.

Therefore, our main goal focused on managing potassium (K) fertilizer with information about K carryover capacity to calibrate the soybean requirement for potassium and increase soybean profitability.

Methods:

1. On May 27 2017, soybean rows were planted in two different placements: On-Row on the old corn and Between-Row in the middle way between the old corn rows in 10 treatments of each placement method (Table 1).
2. On 2016, the experimental field was planted with corn to compare AgroLiquid sulfur sources and their effects on corn yields. All the treatments received 3 gal/A of Sure- K at planting and 6 gal/A of Kalibrate at sidedressing.
3. A comprehensive randomized soil sampling dates was carried out at 0-6” 10 days after planting, and at the harvest. Soil samples were taken On-Row and Between-Row in each treatment.
4. Such long period between two soil sampling processes proposed as a criterion to gauge the carryover uptake extent of K by soybean.
5. Em50 Decagon digital data loggers were attached with 10HS sensors inserted in soil at 8” and 16” to measure the volumetric moisture content of the soil by measuring the dielectric constant of the soil, which is a strong function of water content.
6. Average of stand counts taken on June 20, 2017 showed an average of 124,001 plants/A for On-Row and 113,837 for Between-Row treatments.
7. Soybeans planted on May 27 and harvested in October 22, 2017. Yield reported in bushel/ acre for all the treatments of the study.

Results and discussion:

K recommendations level of fertilization mix applied at planting soybeans on May 27, 2017 was based on the value of K (71 ppm) of soil testing results following the overall field soil sampling procedure that took place on October 16, 2015.

Our results in 2016 showed that K fertilizer carries over as residual soil K between seasons. However, in 2017, K was applied at different rates suggested by NCRS agronomists for further recommendation to soybean growers willing to maintain profit-maximizing production levels (Table 1).

Randomized soil analyses at 0-6” taken on May 03, 2017 before planting On-Row and Between-Row treatments reported 124 and 81 ppm, respectively, showing that the overall soil K in the projected On-Row treatments of soybean was 50% higher than Between-Row treatments. The soybean K soil testing indicated the need for pre-planting sampling and soil testing to identify the optimal fertilizer application rates for an economic return of soybean.

A precise soil sampling procedure carried on July 5th, 2017 showed an overall increase of soil K (116 ppm) On-Row treatments compared with (87 ppm) Between-Row treatments. It means that the On-Row treatments had higher values of available K due to the application of K at planting and the residual effect of the potassium placed On-Row of old corn (Table 1) after 40 days of planting.

Despite large differences in soil K values between On-Row and Between-Row (116 and 87 ppm) on July 5th, 2017, the average values were nearly equal in October 12, 2017 (76 and 79 ppm). This is indicating a significant carryover and usability of K by soybean plants followed On-Row old corn crop up to (40 ppm) of K removed by soybean plants. The carryover Between-Row treatments was limited to approximately, of what was available in the soil of residual K on July 5th, 2017. Application of K did not help too much to improve the soybean yield (Table 2) proving that On-Row carryover represent a rich and active rhizosphere not only with K, but of a plenty of awarded soil biota and nutrients residues from the previous corn plant.

Table 1. Analyses of soil potassium K (ppm) at 0-6" sampled on July 05 and October 12, 2017, in all the treatments of the

Treatments	Soil K^+ (ppm) at 0-6" (sampled on July 05, 2017)		Soil K^+ (ppm) at 0-6" (sampled on Oct. 12, 2017)		Soil K^+ uptake (ppm)	
	On-Row	Between-Row	On-Row	Between-Row	On-Row	Between-Row
1	84	86	63	73	21	13
2	102	78	67	73	35	5
3	108	84	86	72	22	12
4	109	90	68	68	41	22
5	95	98	71	68	24	30
6	140	88	78	90	62	-2
7	160	99	100	80	60	19
8	116	78	83	80	33	-2
9	119	73	78	72	41	1
10	126	92	69	115	57	-23
Averages	116	87	76	79	40	8
Correl. (R)	0.74	0.06	0.80	0.31		

Soybean yields (Table 2), were reported in the same sequences of treatments where detailed and precise soil sampling procedures carried out to On-Row and Between-Rows treatments.

Overall yield of On-Row treatments was 33% higher than Between-Row treatments (50.6 vs. 37.8 (lb/A). Despite the row placement, the applied rate of K and other fertilizers mix were equal for each treatment and different between treatments, the residual K of previous crop and/ or the soil K testing information aids in the adjustment of potassium fertilizer to reflect carryover capacity.

Table 2. Soybean yields ((b/A) in treatments received the K recommendations of different fertilization mix and applied to On-Row and Between-Row treatments.

Trt No	Treatments	Yield (lb/A)	
		On-Row	Between-Row
1	3 gal Sure-K + 1 qt Micro 500 (IF Keeton)	**39.2**	**37.1**
2	3 gal Sure-K + 1 qt Micro 500 (2x2)	**43.4**	**33.6**
3	3 gal Pro-Germ. + 3 gal Sure-K + 1 qt Micro 500 (2x2)	**48.3**	**36.4**
4	6 gal Sure-K + 1 qt Micro 500 (2x2)	**49.0**	**39.9**
5	3 gal Kalibrate + 1 qt Micro 500 (IF Keeton)	**52.5**	**34.2**
6	3 gal Kalibrate + 1 qt Micro 500 (2x2)	**55.3**	**41.3**
7	3 gal Pro-Germ. + 3 gal Kalibrate+ 1 qt Micro 500 (2x2)	**60.8**	**39.5**
8	6 gal Kalibrate + 1 qt Micro 500 (2x2)	**58.0**	**37.6**
9	Check (2016 Potassium)	**53.9**	**39.7**
10	Check (2016 No Potassium)	**46.2**	**38.3**
Average yield (b/A)		**50.6**	**37.8**

To understand the K carryover process we have incorporated the yield of each treatment of On-Row and Between-Row vs. soil testing values at the harvest time. As discussed above, the average values of On-Row K are higher than Between-Row K, due to K residual and application. Therefore, the results of K soil testing information taken on October 12, 2017, i.e., few days before the soybean harvest are plotted in Figure 1.

Figure 1 shows a significant correlation (R= 0.61) between soybean yield and K soil testing values up to 160 ppm of On-Row treatments. The polynomial curve of On-Row treatments expresses a significant potential of soybean yield to be increased when soil testing increases. The soil testing of Between-Row treatments showed a degraded potential of yield increases and was limited to soil K values between 73- 92 ppm. Fortunately, higher soil testing K determined higher the potential of soybean yield increases, with high probability to greater yield increase of soil K residual and application managed properly.

Soil testing K carryover and soybean yield data were collected in 2017 season comes along with the data of 2016 collected in Farm 12 and proved that the residual fertilizer K from previous seasons and current-period K application of high importance.

Our results suggest that soybean producers should identify nutrient carryover capacity to determine optimal K fertilizer policies, the general applicability of these results may be limited. Soil conditions are unique to each field, and different soil conditions may preclude soil testing. Furthermore, the managerial capacity of each producer and the way in which soil information is used to manage inputs may also influence profitability

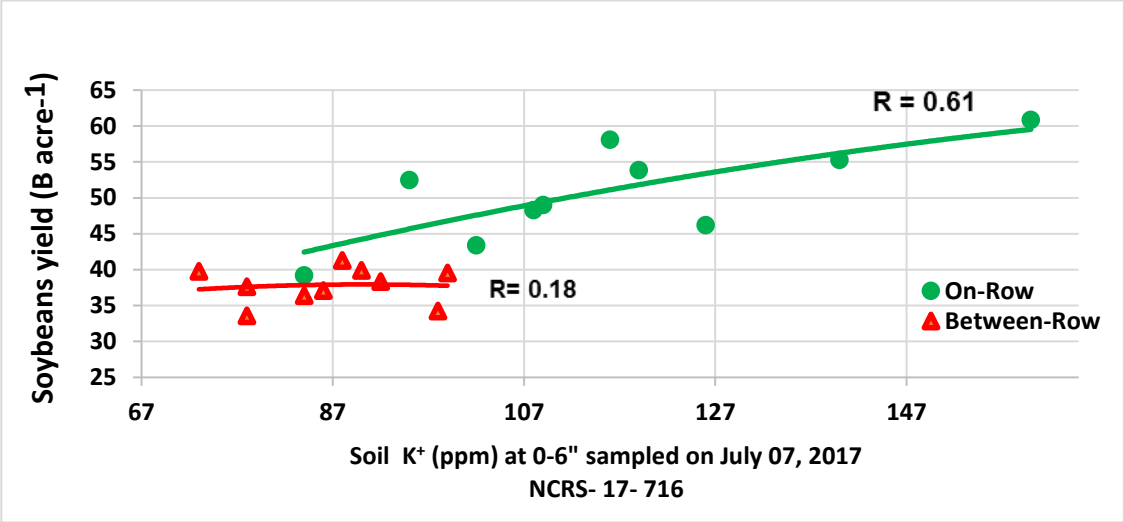

Figure 1. Carryover potassium effects on soybeans of On-Row and Between-Row treatments as compared to yield vs Soil K^+ in soil during the harvest

Volumetric water content

Two graphs of soil moisture content (m^3/m^3) are included to present the available soil moisture in soil during the soybean vegetative growth of On-Row and Between-Row treatments using Em50 Decagon digital data loggers were attached with 10HS ultra-sensitive sensors for accurate volumetric moisture reading. The soil moisture spontaneously calculated by volumetric content that easily presents the availability of soil moisture status (volume/ volume) available to soybeans.

Figure 2 shows the trend of volumetric soil moisture (VSM) content of On-Row treatments varied between 0.26-0.34 (m3/m3) in the rectangular box declines to 0.26- 0.30 in August, 2017. The trend pattern of VSM indicates a high water use by the active root system established by soybean plants of On-Row treatments compared with Between-Row treatments at different soil depths (Figure 2). The trend of VSM of Between-Row treatments (Figure 3) varied between 0.31- 0.38 (m^3/m^3) and indicates lower water use and consequently lower uptake of nutrients by soybean plants, hence lower yield (Table 2).

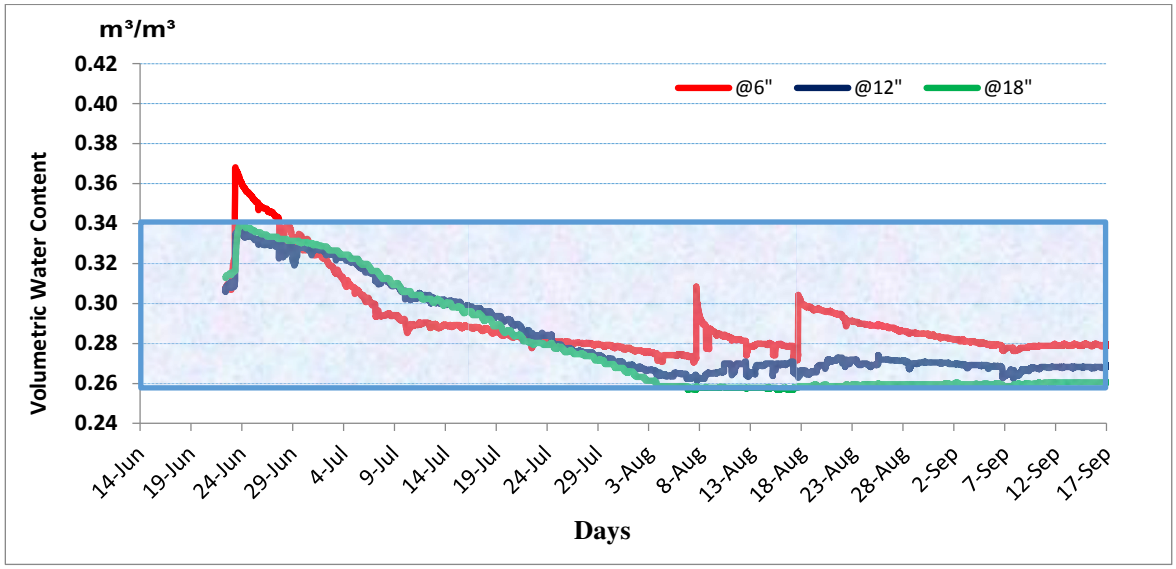

Figure 2. Volumetric water content (m³/m³) on soybeans of On-Row treatments, NCRS, 17- 716.

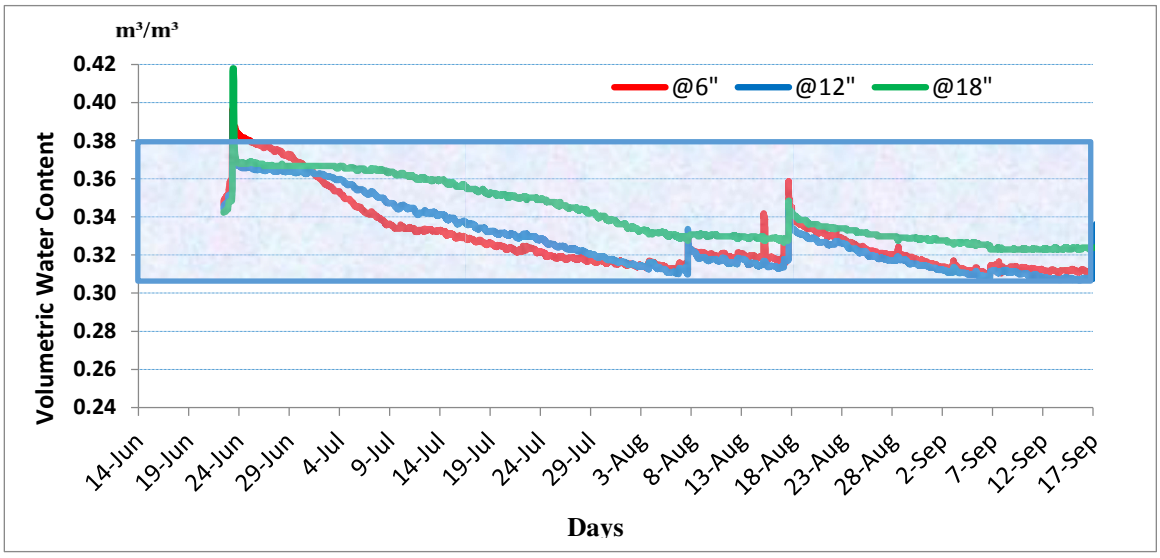

Figure 3. Volumetric water content (m³/m³) on soybeans of Between-Row treatments, NCRS, 17- 716.

Conclusion:

- The soybean K soil testing indicated the need for pre-planting sampling and soil testing to identify optimal fertilizer application rates for an economic return of soybean.
- Soil testing information reflects significant K carryover capacity and aids in the adjustment of potassium fertilizer for K application management.
- Management soil K fertilization should consider K values of previous crop and the soil rhizosphere conditions.
- Correlation of soybeans yield vs. soil testing at the harvest time, helped to estimate the effect of carryover potassium on soybeans which has high potential to be an invented management strategy for K fertilization.
- Our empirical research in 2015, 2016, and 2017 on soybean K carryover and K fertilization might help to explain the soil-plant dynamics and the value of soil test information for describing K interactions.