# Updates on K and S fertilization of corn and soybeans

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### Thank you!







### Nutrien





## Traditional soil test-based approach to K fertilization in IN, OH, MI

- Build-up/maintain philosophy
- Fertilizer applied to soils with optimal soil test are designed to maintain soil test at optimal levels
- Adding fertilizer may increase yield below the critical level
- The further below the critical level the more likely and larger the response



### Critical levels and maintenance limits for corn and soybean

Mehlich-3 extract	Critical level	Maintenance limit
K, ppm; CEC<5	100	130
K, ppm; CEC≥5	120	170

If soil test is reported in lb/acre multiply ppm by 2



## Build-up/maintain approach to K fertilization in IN, OH, MI

- Maintenance fertilizer recommendations are crop removal +20 lb K<sub>2</sub>O/acre
- When soil test is deficient, recommended rates also include additional K<sub>2</sub>O to build-up soil test K over a 4year time frame



### Evaluation of K critical levels in corn, soybean, and wheat (4% of trials) - Ohio

M3 soil test range, ppm	Number of trials	Response rate, %	Median relative yield
>160	92	3	98
130-160	62	5	100
100-130	59	22	96
70-100	136	38	89
<70	91	47	86

Current critical level 120 - 170 ppm

Culman et al., 2023. SSSAJ 87:1207-1220

### Build-up K recommended depends on initial soil test level and CEC (applied for 4 years!)



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### Why chose build-up/maintain philosophy?

- Developed when farmers owned a higher % of the land they farmed and had more stable leases
- Flexibility to <u>not apply</u> <u>fertilizer</u> when soils aren't fit, fertilizer is scarce or expensive, commodity prices are low, etc.



### Another K recommendation philosophy -Sufficiency Approach

- Add enough K<sub>2</sub>O to maximize return to K application (not yield) at below optimal soil test levels
  - Cash rents
  - Expensive fertilizer, low commodity prices
  - Limited availability of fertilizer



### How much $K_2O/a$ is needed to max. return to K?



#### SEPAC BOTH CROPS FERTILIZED-SOY YIELD



 Build-up recommendation is excessive after 1<sup>st</sup> year

#### SEPAC BOTH CROPS FERTILIZED-CORN YIELD



100

90

80

70

60

50

40

30

20

10

**OF MAXIMUM YIELD** 



- Crop removal plus 20 lb K<sub>2</sub>O is too low when fertilizing corn crop even after 4<sup>th</sup> annual application
- Build-up recommendation is excessive

#### SEPAC SOY FERT. BUT NOT CORN-CORN YLD







### Average 2 crop CR+20 and build-up rec. compared to optimum (both soy/corn fertilized)

	Soil	CR+20	Build-Up	Opt. K <sub>2</sub> O
Location	STK-ppm/CEC		· Ib K <sub>2</sub> O/acre	
SEPAC	30/7	80	201	125-180+
DPAC	73/12	76	151	90-135
NEPAC	74/11	75	146	90-135

### Conceptual sufficiency recommendation

- Optimal K<sub>2</sub>O rates will be less than the buildup rec., with the difference getting smaller at lower STK
- Optimal K<sub>2</sub>O rates will be greater than the maintenance rec. at very low STK, but less than the maint. rec. as STK approaches the CL



\*CR+20 lb K<sub>2</sub>O/a/yr of 230 bu/a corn and 60 bu/a soybean

### Corn response to sulfur fertilization in Indiana



- Optimum S rate ≤15 lb S/acre in 12 trials where rate was examined
- No difference between splitting the application between at-plant and sidedress vs sidedress alone

#### Evidence of carryover effects of S



#### Iowa recommendations for S fertilization of corn



For confirmed S deficiencies in corn, on fine-textured soils apply approximately 15 lb S/acre and on coarse-textured soils 25 lb S/acre. Application at suggested rates should be adequate for corn <u>and</u> <u>the next corn or soybean crop.</u>

Sawyer, Lang, and Barker. 2015 Sulfur Management for Iowa Crop Production. Crop 3072.

### Indiana is wetter than Iowa in Oct. through April (2013-2014 through 2022-2023)





Data compiled by Austin Pearson, Midwest Regional Climate Center

Set-up for evaluating impacts of S applications to soybean on the following corn crop...

Sulfur applied to soy in Year 1 in alternating strips...

- \* AMS spread near planting
- \* ATS through planter

Sulfur applied to corn in Year 2 in alternating strips within Year 1 soybean S treatments...

\* ATS with UAN28 at sidedressing



## Evaluation of corn response to carryover of S applied to soybean

- Was the corn crop responsive to S fertilizer? 0/0 vs 0/15
- Did S applied to soybean impact yield of corn? 20/0 vs 0/0

• Did carryover of S applied to soybean produce yield equivalent to applying 15 lb S/a directly to corn? **20/0 vs 20/15** 

### Carryover effects of S applied to soybean on the next corn crop – completely or partially adequate

S treat.	Randolph	Jennings	Blackford1	Whitely	Blackford2	
Soy. Resp.	3.5	-1.5	0.9	0.6	5.4	
0/0	185	246	229	217	197	
0/15	208	250	244	225	213	
20/0	203	248	245	222	213	L
20/15	212	250	247	229	214	
0/0 v 0/15	<0.0001	0.01	<0.0001	0.002	<0.0001	
20/0 v 0/0	<0.0001	0.23	<0.0001	0.05	<0.0001	
20/0 v 20/15	0.008	0.19	0.28	0.003	0.16	

#### S carryover to a 3<sup>rd</sup> season

Soy. fert.	Soy. yield	Corn fert.	Corn yield	Soy. yield
lb S/a	bu/a	lb S/a	bu/a	bu/a
0	70.3	0	197	66.1
		15	213	69.1
20	75.7	0	213	69.8
		15	214	71.0
Pr>F	0.02	0/0,	0.09 *	
		20/0	0.04 *	
		20/0/0	0.48 *	

Blackford Co. 2, Aeric Epiaqualfs/Typic Endoaquolls – 2.7 - 3.7% OM, SiCL

#### Carryover from corn to soybean approach

-					
15					
No soybean S					
0 0					

• Warning! No conclusion on S carryover can be made if soybean yield does not respond to previous corn S treatments since we did not apply S directly to the soybean crop to ascertain if S was limiting

#### Soybean response to previous year S on corn

	Whitely Co.		Tipp. Co. 1		Tipp. Co. 2	
Corn S rate	Corn	Soy.	Corn	Soy.	Corn	Soy.
- Ib/acre -			bu/acre			
0	217	67.2	202	58.5	207	71.3
15	225	69.3	212	61.2	214	79.4
Pr>F	0.0003	0.05	<0.0001	0.0001	<0.0001	<0.0001

#### Sulfur carryover to a 3<sup>rd</sup> season

Corn fert.	Corn yield	Soy. yield	Corn fert.	Corn yield
lb S/a	bu/a	bu/a	lb S/a	bu/a
0	202	58.5	0	227
			15*	235
15	212	61.2	0	237
			15 <b>*</b>	236
Pr>F	<0.0001	0.0001	0/0/0 vs 0/0/15	0.07
			15/0/0 vs 0/0/0	0.01
			15/0/0 vs 15/0/15	0.67

Tippecanoe Co. 1, Typic Endoaquolls – 4.6% OM, SiCL, \*average of 10, 15, and 20 lb S/a rates

### Summary

- Corn and soybean response to S fertilization is not uncommon throughout Indiana, on soils varying substantially in texture, OM, and drainage class
- Several instances of carryover of S from one crop to the next (and the next) occurred on soils varying in texture from loam to clay

### Summary

- Carryover of S applied to soybean to the next corn crop occurred on 4 of 5 S responsive sites and in 2 of the 4 sites, carryover S produced yields equivalent to direct fertilization of the corn
- Further research is needed to determine the nature of the carryover effect and the interaction of soil properties and fall/winter weather on the magnitude of carryover