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| Please use this form to clearly and concisely report on project progress. The information included should reflect quantifiable results that can be used to evaluate and measure project success. Comments should be limited to the designated boxes. Technical reports, no longer than 4 pages, may be attached to this summary report. |
| **Project Number:**  |  |
| **Project Title:**  | Spatial and temporal variation of soil sampling affect phosphorus and potassium recommendations for soybean |
| **Organization:**  | Louisiana State University Agricultural Center |
| **Project Lead Name:** | Md. Rasel Parvej, mrparvej@agcenter.lsu.edu**Collaborators:**Melissa W. Cater, mcater@agcenter.lsu.eduNathan A. Slaton, nslaton@uark.edu Gerson L. Drescher, gldresch@uark.eduJagmandeep Dhillon, jagman.dhillon@msstate.edu |
| **Report Date:** | 3rd Quarter, 2024 |
| In the Progress Summary section below, please provide a brief summary of project progress in lay language that will be shared publicly in the [National Soybean Checkoff Research Database](https://www.soybeanresearchdata.com/). Do not include any confidential or proprietary information. If no lay language is provided, the contents of this entire report will be published in the [National Soybean Checkoff Research Database](https://www.soybeanresearchdata.com/). |
| **Progress Summary (in non-proprietary lay language suitable to be shared publicly):** |
| The project's objective is to characterize the effects of soil sampling time and position, rotational crop, and soil management practices on soil-test phosphorus (P) and potassium (K) concentrations and fertilizer recommendations for soybean production in Mid-South states. We expect to develop research-based soil sampling guidelines for optimum P and K recommendations that maximize soybean yield and profit. Also, we expect to develop a regression model to predict the temporal variation of soil-testing values following summer crop harvest and tillage management practices. In 2024, the research trials are being conducted at the LSU AgCenter – Northeast and Macon Ridge Research Station across different crop rotations, soil types, and soil management practices and will be continued in 2025 in Missouri with the additional research sites incorporated in Arkansas in 2025. |
| **Detailed Progress Status** – Expand upon the above section. What key activities were undertaken and what were the key accomplishments during this reporting period? List each key deliverable from the proposal and describe progress made (or not made) toward achieving it, including metrics were appropriate. |

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| A field trial was established on commerce silt loam soils at the LSU AgCenter – Northeast Research Station for corn, soybean, and cotton as a rotational crop side by side with two P and K rates (0 and 80 lb P2O5 and K2O/acre) and two tillage treatments (no-tillage and conventional tillage) in mid-March 2024. Before applying fertilizer treatments, a composite soil sample consisting of 10 soil cores from 0- to 6-inch soil depth was collected from each no-fertilizer control plot of each replication. Dekalb DKC62-70 corn was planted on April 3, 2024, Progeny 4798XF soybean was on May 21, 2024, and PhytoGen 411 W3FE cotton was planted on May 24, 2024, on 38-inch spaced seed beds. Soybean and cotton were planted late due to a lack of soil moisture from no rain for 3 weeks. Each experimental plot is 35-ft long x 12.67-ft wide and consists of 4 rows. Trial for each rotational crop was designed as a strip-split plot treatment structure with 4 replications including soil tillage practices as a strip plot and fertilizer treatments as a split plot. A separate paddy rice trial with CLL 18 was established in early May at the Macon Ridge Research Station. The rice experimental plot is 24-ft long x 5-ft wide with 7.5-inch spacing. The experimental treatment, design, and soil sampling procedures were the same as mentioned for corn, soybean, and cotton. Corn was harvested on Aug. 19, 2024, and tillage practices – conventional and no-tillage were established and soil samples from 0- to 6-inch depth from each plot of each replication using regular *AMS* soil probe (7/8-inch diameter) were collected from both tillage systems on the same day. The tillage practices for other summer crops were established after each crop harvest. A series of soil sample collections were already collected on a 15-day interval and will be continued until the next summer crop planting. Each composite soil sample consisted of at least 10 soil cores. Soil samples were collected from the top of the bed (around 6-inch apart from the crop row) and the middle of the furrow for the furrow-irrigated system for corn, soybean, and cotton. For flood-irrigated rice – soybean systems with <15-inch row spacing, soil samples were collected only from the middle of crop rows since there is minimum spatial variation. Each composite sample was air-dried and sent to the LSU AgCenter Soil Testing and Plant Analysis Laboratory, Baton Rouge, LA for Mehlich-3 routine soil analysis (pH, Mehlich-3 extractable P, K, Ca, Mg, Na, S, Fe, Mn, Zn, Cu, B).Besides soil sampling, summer crop residue from each no-tillage plot of each replication was also collected at harvest and will be continued at 3-4 weeks intervals until next year's soybean planting. The harvested crop residue was dried and analyzed for nutrient concentrations (P, K, Ca, Mg, Na, S, Fe, Mn, Zn, Cu, B) at LSU AgCenter Soil Testing and Plant Analysis Laboratory, Baton Rouge, LA to determine the amount of nutrient release from crop residue following summer crop harvest. Rainfall and temperature data along with soil sampling will be collected and will be used as a covariate for the regression model.Results from our last two year's trial showed that Mechlich-3 soil K concentration was 27-36 and 29-32 ppm greater in mid-March compared to right after harvesting corn and rice, respectively in mid-September (Figure 1; Table 1). This soil K concentration difference from mid-October after soybean harvest to mid-March was 8-18 ppm and from mid-November after cotton harvest to mid-March was 12-23 ppm (Figure 1; Table 1). Soil P differences for these same periods after harvesting corn, rice, cotton, and soybean were 6-10, 5-9, 11-12, and 3-15 ppm, respectively (Figure 2; Table 2).**Corn – Soybean Rotation: Soil-Test Potassium (K) Concentration**  **Rice – Soybean Rotation: Soil-Test Potassium (K) Concentration**  Figure 1. Mehlich-3 soil K concentration (left) and amount & concentration of K leaching from straw (right) across time after corn harvest in 2022-2023 (top) and in 2023-2024 (2nd from the top) and after the rice harvest in 2022-2023 (3rd from the top) and in 2023-2024 (bottom) for research trial conducted at LSU AgCenter – Macon Ridge & Northeast Research Station for corn–soybean and rice–soybean rotations.**Corn – Soybean Rotation: Soil-Test Phosphorus (P) Concentration**  Figure 1. Mehlich-3 soil P concentration (left) and amount & concentration of P leaching from straw (right) across time after corn harvest in 2022-2023 (top) and in 2023-2024 (bottom) for research trial conducted at LSU AgCenter – Northeast Research Station for corn–soybean rotation.

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| **Table 1. Changes in Soil-K Concentration from Fall to Spring** | **Table 2. Changes in Soil-P Concentration from Fall to Spring** |
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| **Crop** | **Site Year** | **Bed-K** | **Furrow-K** | **Tillage-K** |
|   |  | Change from Mid-Sep to Mid-March (ppm) |
| **Corn**  | 4 | **27.2** | **36.4** | **31.7** |
|  |  |  |
|  |  | Change from Mid-Sep to Mid-March (ppm) |
| **Rice** | 3 | **29.3** | - | **32.5** |
|  |  |  |
|  |  | Change from Mid-Nov to Mid-March (ppm) |
| **Cotton** | 2 | **14.8** | **12.4** | **23.3** |
|  |  |  |
|  |  | Change from Mid-Oct to Mid-March (ppm) |
| **Soybean** | 4 | **7.5** | **18.2** | **9.0** |

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| **Crop** | **Site Year** | **Bed-P** | **Furrow-P** | **Tillage-P** |
|   |  | Change from Mid-Sep to Mid-March (ppm) |
| **Corn**  | 4 | **7.9** | **9.7** | **6.1** |
|  |  |  |
|  |  | Change from Mid-Sep to Mid-March (ppm) |
| **Rice** | 3 | **5.0** | - | **9.2** |
|  |  |  |
|  |  | Change from Mid-Nov to Mid-March (ppm) |
| **Cotton** | 2 | **10.7** | **11.7** | **10.6** |
|  |  |  |
|  |  | Change from Mid-Oct to Mid-March (ppm) |
| **Soybean** | 4 | **2.5** | **14.6** | **6.4** |

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