Effects of Harvest Aids on Seed Composition and Seed Damage in Soybean Grown in Mississippi Project No: 32-2019

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Background and Objectives

The transition to the use of the Early Soybean Production System in the Midsouth resulted in higher seed yields. However, with the shift towards the use of early-maturing soybean cultivars in the mid-South, the incidence of green stems, green pods, green leaf retention, and late-season weed infestation increased, thereby complicating harvest, reducing seed quality, and penalizing producers for increased seed moisture, foreign material and damaged seed at the elevator. Therefore, the use of harvest aids to defoliate green tissues in order to achieve uniformly dry plants at harvest, improve harvest efficiency, increase yield, reduce elevator discounts and increase net returns is critical. Although several studies have been conducted on the effects of harvest aid application on yield, there is very limited information available on the effects of harvest aid on seed composition, mineral nutrition, and seed damage in soybean.

Paraquat is a common harvest aid used in the Midsouth that can also be effective in defoliating grass and broadleaf weeds when applied late season. However, its application can cause significant crop damage if applied too early such as at the R5 or early R6 growth stages. Application of paraquat after physiological maturity (R7) decreased the number of green stems, green pods, and retained green leaves, allowing harvest 1 to 2 weeks earlier than non-treated soybean. Therefore, considering application timing of harvest aids on soybean is critical to maintain yield and seed quality. In the current research, paraquat (Gramoxone SL 2.0), as harvest-aid, was applied at the label rate of 15 gallons/acre or 1 qt/acre) at R6, R6.5, R7 growth stages. A 1% of Fire Zone Methylated Seed Oil (MSO) was used for paraquat application of paraquat at R6, R6.5, R7, and control). Two recent maturity IV commercial soybean cultivars were used (P46A57BX and P48A60X).

Objective One:

To evaluate the impact of timing of paraquat application on seed composition (protein, oil, fatty acids, sugars, and minerals) and seed quality (seed germination and FGIS seed damage) in soybean.

Report of Progress/Activity

The research was conducted at the USDA ARS Jamie Whitten Delta States Research Center at Stoneville, Stoneville, MS. The field trial was conducted using two recent commercial soybean cultivars of IV (P46A57BX and P48A60X) under irrigated conditions. Paraquat was applied at the concentration recommended by the label for the use paraquat as harvest-aid (15 gallons/acre or 1 qt/acre) at growth stages R6, R6.5, and R7. No paraquat applied soybean was used as control. Soybeans were planted on May 1, 2019 using a 4 row-planter. The experiment was a randomized complete block design with ten replications. Each block contains all treatments (cultivars and paraquat timing application treatments). To avoid weathering effects, a 5-ft subsample of each of the center two rows of each plot was hand-harvested timely at full maturity (R8) for seed composition and seed damage analysis. The remaining of the two center rows of each plot with their weights separately. Seed composition constituents were analyzed by near infra-red (NIR) instrument, and seed minerals were conducted by inductively coupled plasma (ICP) spectrometry and C/N/S Elemental Analyzer. Seed quality, including hardseededness were estimated by the State Seed Testing Laboratory, Mississippi State, MS following the protocol of the

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Association of Official Seed Analysts (2001). Mature seed damage was estimated by seed graders certified by the Federal Grain Inspection Service (FGIS). Preliminary results showed that application of paraquat at R6 resulted in significant reduction in yield for both cultivars compared with soybean applied at R6.5, R7, or non-treated soybean (Figure 1A, Figure 2 A). Similar observation was noticed for germination rate where seed from soybean cultivar P46A57BX applied at R6 was 28.3% compared with those of R6.5 [(47.9%), R7 (55.6%), or control (47.9%)]. Similar observation was noticed for cultivar P48A60X [(germination rate at R6 was 29.6% compared with those of R6.5 (69.8%), R7 (70%), or control (64.5%)]. No seed damage (FGIS) effect was recorded in both cultivars in all treatments [(for example for cultivar P46A57BX, seed damage at R6 application was 1.2% compared with those of R6.5 (1.0%), R7 (0.4%), or control (0.5%)]. Also, preliminary results showed that application of paraquat may result in alteration of seed protein and oil as protein decreased and oil increased in both cultivars (Figure 1B; Figure 2B). These results are preliminary and need a second year trail, current year, to make reasonable conclusion and possible recommendations. Seed mineral nutrients statistical analyses are still underway, and results will be reported in the first quarter report of the current year.

Impacts and Benefits to Mississippi Soybean Producers

The use of early soybean cultivars in the Early Soybean Production System in the Midsouth (Arkansas, Louisiana, Mississippi, Missouri bootheel, and west Tennessee) has increased the incidence at harvest of green stems, green pods, green-leaf retention, and late-season weed infestation, complicating harvest and reducing seed quality. Green stems and leaves, when mixed with seed during harvest, increase moisture, foreign material, and seed damage thereby, decreasing net returns at the elevator. To achieve uniform harvesting safely reduce moisture, and improve harvest efficiency, harvest aids are applied to the soybean crop to defoliate foliage and desiccate stems and remaining petioles. Therefore, the objective of this research was to evaluate the application of the harvest aid paraquat, as a commonly used harvest aid in the Midsouth, on soybean seed composition (protein, oil, fatty acids, sugars, and minerals) and seed damage (FGIS seed damage).

We have completed the first-year of experimentation and intend to conduct the second-year of experimentation using two recent commercial soybean cultivars of IV (P46A57BX and P48A60X) under irrigated conditions. Since application of harvest aids too early (R6) can decrease yield and impact seed composition and seed damage, application timing of a harvest aid is critical. Therefore, paraquat was applied at R6, R6.5, and R7 and include a no-paraquat treatment as a control. The preliminary results showed that application of paraquat at R6 significantly reduced yield, and germination compared to application at R6.5, R7, and no-paraquat treatment. Application of paraquat may alter seed protein and oil as may decrease seed protein and increase oil. This research will provide producers with useful information on the effects of harvest-aid application management (time of application) and its impact on seed composition, seed damage, and potential dockage at the elevator. This information is critical to decisions made by producers in order to maintain yield, seed composition and seed damage, and avoid losses in profit margins.

End Products–Completed or Forthcoming

As the current results are preliminary and represent the first year activity of this project, no publication or other activities were made. The second year of this project will be focused on results completion and analyses and preparing peer-review manuscripts, conference presentations, and results dissemination.

Graphics/Tables







Figure 1: Application of paraquat (Gramoxone SL 2.0) at different growth stages of soybean; rate of 15 gallons/acre

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Figure 2: Application of paraquat (Gramoxone SL 2.0) at different growth stages of soybean; rate of 15 gallons/acre

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Figure 3: Application of paraquat at R6 was 8/7/2019; Response of soybean after one day (8/8/2019) of paraquat application. Paraquat was applied to the two center rows.



Figure 4: Application of paraquat at R6 was 8/7/2019; Response of soybean after six days (8/13/2019) of paraquat application. Paraquat was applied to the two center rows.