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| Project Number: | 2022-47 |
| Project Title: | Exploitation of weed species extracts as an effective and environmental friendly strategy to control insects and deer in soybean |
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| During this reporting period, work continued on testing encapsulation systems designed to improve the persistence and safety of anthraquinone-rich sicklepod seed extract when applied to soybean foliage. Three encapsulation methods—liposomes, poly(lactic-co-glycolic acid) (PLGA), and chitosan—were evaluated under greenhouse conditions. Treatments were followed by rainfall simulation at a rate of one inch per hour, and leaf tissues were collected for anthraquinone quantification. In the liposome study, soybean plants at the V2 stage were treated with extract encapsulated in 122 nm vesicles. The results indicated that liposome application reduced visible leaf injury compared to free extract. Although the retention of emodin and chrysophanol was not statistically different from the control, mean values suggested a trend toward higher persistence under rainfall. This system therefore appears to improve safety while still maintaining compound stability, though further optimization of dose is required.  The PLGA formulation, applied at the V4 stage, produced the highest retention of anthraquinones after rainfall, as measured by spectrophotometry. However, this treatment also resulted in noticeable phytotoxicity at the tested concentration, showing that although PLGA is effective in protecting compounds from leaching, its application rate must be adjusted to prevent injury to soybean tissues. PLGA remains promising due to its biodegradability and ability to release compounds gradually, but it will require refinement before it can be tested under field conditions. Chitosan-based encapsulation, also applied at V4, demonstrated strong adhesion to leaf surfaces and significantly higher anthraquinone retention compared with the extract alone. Like PLGA, however, phytotoxic effects were observed at the concentrations used. Despite this drawback, chitosan has considerable potential because of its low cost, natural origin, ease of preparation, and biodegradability, making it attractive for large-scale use once dosage is refined. Each of the three systems showed distinct strengths. Liposomes balanced retention with reduced injury, PLGA maximized retention but caused phytotoxicity, and chitosan provided an inexpensive and biodegradable option with high retention but again with injury at the current levels. Collectively, the results confirm that encapsulation substantially improves persistence of sicklepod extract on soybean leaves under rainfall, but careful optimization of dosage is critical to achieving both efficacy and safety.  Progress was also made on environmental stress testing. Chamber trials with heat and humidity have now been initiated to mimic field conditions. The chamber is now operational, and preliminary runs are underway to evaluate how encapsulated formulations hold under combined environmental stresses beyond rainfall. These experiments are expected to provide valuable insight into formulation stability and performance under realistic production conditions. | |