# Executive Summary

## Research conducted

This research developed two soy-based bioplastic formulations for garden pots. These soy-based pots are biodegradable, self-fertilizing, and prevent root circling. The objectives accomplished were:

**Objective 1:** Two soy-based pots formulations with different compositions of soy-hulls, soy protein isolate (SPI), and polylactic acid (PLA) were molded into 3" garden pots. These new formulations are compared with existing garden pots. The four types of pots studied were:

1) Plastic (polyethylene)

2) Existing bio-based formulation from SelfEco

3) F1 - New formulation 1 (70% PLA + 30% soy hulls)

4) F2 - New formulation 2 (65% PLA + 30 soy hulls + 5% SPI)

**Objective 2**: Five plant species (Black seeded simpson lettuce, Tacitus R2 lettuce, Zinnia, French marigold, and Sheyenne tomatoes) were studied for their plant growth and root circling conditions. Degradation analysis was carried out by measuring the pot's dry weight before plantation and after harvesting.

**Objective 3:** Techno-economic analysis was performed to ensure cost competitiveness.

## Why the research is important to ND soybean farmers

It is anticipated that with the market acceptance of soy-based garden pots, container manufacturers will be able to replace as much as 50% of the product weight with protein or hauls derived from soybeans within 3-5 years. With North Dakota's soybean production of 239M bushels, the proposed product will directly impact 5% (12.5M bushels). Additional economic benefits are the profit realized from the use of domestic raw materials and the development of new domestic jobs.

## Final findings of the research

Overall, the performance of soy-based pots F1 and F2 in terms of plant health and biodegradability was better than plastic and SelfEco pots in several cases. The plant height was significantly better for Zinnia plants planted in F1 pot instead of SelfEco pot. From the visual inspections, the root circling problem was observed to be rarely present in bioplastic pots.

Both new formulations pots were deemed to have the ability to degrade faster than the SelfEco pot. Over the period of six weeks, the average degradation rate of the F1, F2, and SelfEco pots were found to be 3.121%, 5.647%, and 2.815%, respectively. By comparing the two new formulations, it can be summarized that SPI significantly increases biodegradability.

## Benefits and recommendation

The biodegradability of soy-based pots can be deemed unique compared to plastic pots. Another advantage of the proposed soy-based formulations is the root circling problem was significantly reduced.