

# Effects of Bisphenol A On Germination of Soybean Seeds

Anna Benton, Dr. Alfred Conklin, Jr.

Wilmington College Agriculture Department. Wilmington, OH USA. 2013

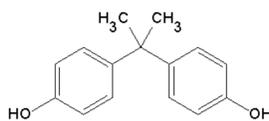
## Abstract

Endocrine disrupters such as bisphenol A (BPA) have been shown to have an effect on humans and animals. Therefore this research is exploring the effect of BPA on soybean seed germination. Different concentrations of BPA in deionized water were used to wet soybean seeds in multiple germination trials. The germination rates were analyzed to determine significant difference. The data showed near 100% germination without BPA exposure, and an average of 13% decrease in germination when exposed to 100 parts per million (ppm) BPA. Further research is needed to determine the actual average levels of BPA to which soybean seeds are exposed. This may influence the outcome of other research involving soybean germination if the seed has been exposed to significant levels of BPA.

## Introduction

The manufacture of plastics uses bisphenol A (BPA) as a hardening agent. It is also used in the resin lining of metal cans. Since BPA is water soluble and plastics are used in a variety of applications in soybean culture, the possibility of BPA exposure exists. Previous research at Wilmington College on how BPA affects the growth of soybean plants was inconclusive so this research focuses on the possible effects of BPA on germinating soybean seeds. It is important to know what level of concern BPA contamination poses in order for production practices to be adjusted, and manufacturing and legislative measures to be taken.

### Bisphenol A



### Possible Germination Failure



### Statistical T-test

$$t = \frac{\bar{x} - \mu_0}{\frac{s}{\sqrt{n}}}$$

where there is a significant difference if  $t > 2.920$  or  $t < -2.920$

## Materials

- Soybean seeds from Asgrow, variety Ag 2933 were used in all trials.
- Seeds were placed on standard industrial paper towels.
- Solutions of deionized water (DI) and Aldrich 99+% BPA were sprayed on the seeds using 32 oz. Garden Treasures spray bottle.
- Germination trials were incubated in a Precision Scientific, Gravity Convection Incubator.



### Germination Trial

## Procedure

- Three sets of germination trials were done comparing the effects of 100ppm and 50ppm solutions of BPA with pure DI water.
- In each trial, one hundred soy bean seeds were spread randomly over paper towels.
- The seeds were wetted with water or one of the BPA solutions. Another set of paper towels was placed over the seeds, wetted, rolled up, and placed in a sealed plastic bag.
- The plastic bags were placed in an incubator at 31°C for seven days.
- The number of seeds that had started to germinate were counted.
- All materials except BPA solutions were tested using Ultraviolet/visible spectrophotometry and showed no BPA.
- A statistical T-test was used on the resulting data to determine if there was significant difference in germination rates.

## Results

- The control trials had nearly one hundred percent germination.
- The trials using 100 ppm BPA had the lowest and most variable germination rates.
- The trials using 50ppm BPA experienced slightly less variation in germination.

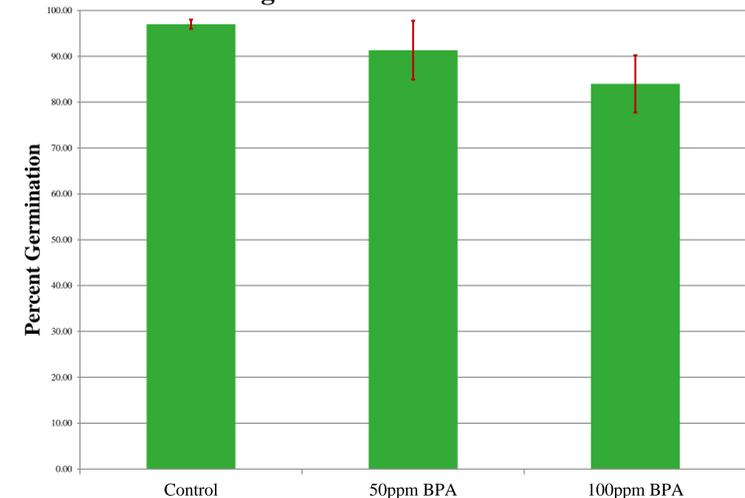
### Germination Rates

Trial Number	Solution Used (ppmBPA)	Amount of water (g)	Germination (%)
1	0	49.99	98
1	50	51.06	94
1	100	58.52	77
2	0	50.06	97
2	50	45.72	84
2	100	48.12	86
3	0	50.03	96
3	50	49.90	96
3	100	51.55	89

- The average germination of the 100ppm BPA group was 13% less than the average control group germination, and the lowest 100ppm trial had a germination rate 21% lower than the average control group.
- Statistical analysis showed that the difference between the 100ppm group and the control was significant, but the difference between the 50ppm group and the control was not.

*Special Thanks to the Wilmington College Agriculture and Chemistry Departments for supporting this research.*

### Average Percent Germination



- Though there were attempts to apply precisely the same amount of solution to each trial, the actual amount of solution used to wet each trial was not exactly the same, causing the absolute amount of BPA applied to the seeds to vary between trials. This is a source of error.
- There could be almost 20 bushels out of every 100 bushels of soybean seeds that do not germinate and the germination rate would be much less predictable.

## Conclusion

Germination rates showed a statistically significant decrease between the control trials and the trials with 100ppm BPA. The variability between trials was also much greater for the trials with 100ppm BPA. This shows a need for further research to determine the actual BPA contamination levels due to exposure in transport, storage and handling. Also, this may impact the interpretation of other research involving soybean germination if the seed has been exposed to significant levels of BPA.

## References

- Richter, Catherine A., Birnbaum, Linda S., Farabollini, Francesca, Newbold, Retha R., Rubin, Beverly S., Talsness, Chris E., Vandenberg, John G., Walser-Kuntz, Debby R., vom Saal, Frederick S. **Effects of bisphenol A in laboratory rodent studies.** Reproductive Toxicology 24:199-224, 2007.
- Vandenberg, Laura N., Hauser, Russ, Marcus, Michele, Olea, Nicolas, Welshons, Wade V. **Human exposure to bisphenol A (BPA).** Reproductive Toxicology, 24:139-177, 2007.
- Amanda Middleton **Effects of Bisphenol A on Soybean Growth and Chlorophyll,** Wilmington College, 2013