Pesticide Ingredients, Triadimefon and Glyphosate, Affect the Growth of Escherichia coli

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ABSTRACT

Ingredients found in commonly used agricultural pesticides have been indicated to have negative effects on bacteria, particularly the beneficial kind that inhabit the human gastrointestinal tract. In this experiment, ingredients, ‘Triadimefon and Glyphosate’, present in two of the leading pesticides (Bayer and ProTurf products and Round-Up) were used to test the effect they had on the growth of the bacteria, Escherichia coli, found abundantly in our digestive system tracts. E. coli were plated on agar plates treated with various dilutions of the active ingredients, Triadimefon and Glyphosate, and growth observed over time. Results indicated that only Triadimefon caused a decrease in growth and colony forming ability of E. coli over time. The most effective dose appeared to be a 50% dilution of Triadimefon, a dose which was far less potent compared to the actual strength found in commercial products. Glyphosate known to be more toxic than Triadimefon had no adverse effect on the growth of E. coli in our experiments. While these results are preliminary and not conclusive, future studies could further analyze the specific effects these ingredients have on the bacteria, such as on their morphology, metabolism, various colony forming ability, and the rate of growth over time.

Introduction

There are over 900 million acres of land dedicated to agriculture in the United States and with the growing populations, pesticides are used to aid in resisting the loss of crops. Herbicides that get rid of unwanted vegetation in large farms and fungicides which destroy fungus that threaten the growth of necessary agriculture are routinely used to help crops grow without pests and other destructive organisms. Pesticide use in general, can have positive, negative or no effect on pathogenic organisms and associated crop diseases through direct effects on inoculum levels or indirect effects on host susceptibility (Wisler & Norris 2005). Interestingly enough, although both Glyphosate and Triadimefon are used in many pesticide products and used on agricultural plants we eat and ingest, they are also necessary to protect the crops and to ward off unwanted bacteria and fungi that could be detrimental to the plants.

Glyphosate is an herbicide which is used in gardens, forestry and lawns to kill weeds as well as to regulate bacteria and fungus that could potentially harm food/crops grown in farms. This herbicide inhibits certain plant proteins from being made by interfering with its enzymatic pathways. Glyphosate’s half-life has been shown to last an average of 32 days in agricultural and forest soil although can vary depending on the concentration of the herbicide as well as the environmental conditions. Compared to Glyphosate, Triadimefon is of higher toxicity and yet is still used in most pesticides on large farms and in small gardens. When tested in small oral dosages in humans, the contents were broken down and excreted through the urine or feces within a few days and the initial amount was out of the with ingredients like Glyphosate and Triadimefon can cause mild to severe health complications and affect the life of the organism. Different concentrations of the pesticides have been shown to interact in a negative manner with intestinal organisms (D’Brant 2014). Such negative effect on microorganisms have led to the prediction that pesticides reduce the growth rate and the overall growth of bacterial colonies.

Several different strains of the bacteria E. coli exist in the human body that are both beneficial as well as non-beneficial. The beneficial strain of the bacteria demonstrates a mutualistic relationship where both the bacteria and human benefit from the bacteria’s presence in the intestinal flora. In this relationship, the human benefits by the bacteria giving the human its necessary nutrients for good digestive health as well as help in sustaining a strong immune system, and the bacteria receives nutrients from food the human host ingests and provides precise environmental conditions for the bacteria to grow and thrive.

In our experiment, we studied the effects of two principal ingredients, Glyphosate and Triadimefon found in two leading pesticides (Bayer and ProTurf and Round-Up) on the growth of E. coli.

Methods

E. coli was initially grown on agar broth containing two different concentrations of the active ingredients, Glyphosate and Triadimefon (25% and 50% of the original concentrations used in the commercial pesticides). Every two hours over an eight-hour period, each concentration was serially diluted, plated, placed in an incubator, and colonies counted.

Results

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<tr>
<th>Effect of Triadimefon on E. Coli Growth</th>
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<tbody>
<tr>
<td>Triadimefon (50%) Most Detrimental at Four and Eight</td>
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<tr>
<td>Triadimefon (25%) Most Detrimental After Four Hours</td>
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<tr>
<td>Dose Response Effect of Triadimefon: 50% Most Detrimental</td>
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<tr>
<th>Effect of Glyphosate on E. Coli Growth</th>
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<tr>
<td>Spike In Cell Proliferation with Glyphosate (50%) at Hour Six</td>
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<tr>
<td>Glyphosate (5%) Shows No detrimental Effect on Cell Proliferation</td>
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<tr>
<td>Triadimefon 50% Found to be More Effective than Glyphosate 50% in Inhibiting Cell Growth</td>
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Conclusions

• Drastic decrease in cell numbers of E. coli in all concentrations except the 25% Triadimefon at four hours.
• Increase in cell numbers of E. coli in all concentrations except the 25% Triadimefon at six hours.
• Triadimefon (50%) was most detrimental at 4 and 8 hours on cell growth.
• When compared to the control all concentrations of Glyphosate and Triadimefon had a decrease in overall growth of E. coli, with Triadimefon having the most inhibitory effect.
• Of the four concentrations of Glyphosate and Triadimefon, three of the four concentrations had a decrease in cell numbers at the four-hour period. The only concentration that didn’t cause a decrease at the four-hour mark was the 25% Triadimefon. In contrast, it showed an increase in cell numbers. After the six hour period three of the four concentrations had an increase in cell number. Again, the 25% Triadimefon showed the opposite effect where a decrease in numbers was observed. The drastic increase in colonies at the six hour could be an indication that the E. coli was eventually able to repress the pesticides.
• When compared to the control, there is clear variation of colony growth in E. coli over the eight hours. What became clear is that the active ingredients were most effective in decreasing the number of cells at the four-hour mark for these concentrations across the board. However, the E. coli were able to recover as colonies increased thereafter.

Further tests can be done, looking at optical density with the liquid LB agar, which would be able to generate a more accurate growth rate curve at various concentrations.

References


Acknowledgements

We would like to thank Dr. Carlos Peralta for his guidance and vast knowledge of the subject matter helped consolidate the vital aspects of this project. A great deal of thanks to Oksana Franklin for being a part of the initial research and experiment; we thank her for participating in this project. The greatest of thanks to Dr. Syeda Mumina for her unbelievable amount of dedication to this project, great knowledge and insight of the subject matter, and for also being a tremendous mentor to her students throughout this endeavor.