Isolation of Synthetic Chemicals from Plant Leaves

Developers:

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Discipline:

Biology, Environmental Science, Ecology

Grade Levels:

Grades 7 - 12

Goal:

To isolate and identify a dye, which represents a synthetic pesticide, from plants.

Materials:

Whatman #1 filter paper
Bean plants (with at least two leaves)
Colored markers, food coloring
Spray bottle
Ethanol
Distilled water
Glass bottles
Long wave UV light
Scissors
Ruler
Sand
Mortar and pestle
Pasteur pipets
Toothpicks
Atomizer or plant mister
Goggles

Teacher Preparation:

1. Extract dyes from markers. This is done by removing the tip and top of the marker with pliers. The ink cartridge can be easily extracted.
2. Put 10 ml of ethanol into a small beaker. Cut the cartridge up and place in the ethanol. This will extract the dye from the cartridge. If needed, add water (about 2 ml) to completely dissolve the pigments. Pour the dyes into small bottles, cap and label. These are your stock solutions.
3. Each bean plant is then sprayed with one of the stock solutions. A household atomizer or plant mister can be used. Be sure to wash out atomizer between dyes. Each plant should be sprayed with a different dye.
4. Allow the leaves to dry and spray 3 to 5 times.
5. Each group of students is given a plant to analyze. A non-treated plant should be used as a control.

Student Experiment:

A. Chromatography Materials

1. For each extract to be analyzed, cut a piece of chromatography or filter paper to fit in your jar.
2. On each paper draw a faint pencil line 2 cm from the bottom. This is your origin.

B. Standards

1. Dip a toothpick into the dye extract and trace over the pencil line on the chromatogram.
2. Place paper in the jar and add your solvent (water); make sure that the water does not touch your extract.
3. Remove the chromatogram when the solvent is 1-2 cm from the top of the paper and mark with a pencil how far the solvent has moved. This is called the solvent front.
4. After the chromatogram has dried, look at the results in classroom light and under UV light. Measure how far the center of the dye and the solvent front are from the origin. Calculate the relative movement of the dye (called Rf) by dividing the distance moved by the dye by the distance moved by the solvent.

$$\mathbf{Rf} = \frac{\textbf{dye distance}}{\textbf{solvent distance}}$$

Extensions:

C. Plant Assay:

1. Tear off one leaf from each plant.
2. Put leaf in mortar and pestle with a little bit of sand. Grind leaf and then add a little water.
3. Transfer a portion of your leaf extract to the paper by dipping the tip of the pipet into the liquid. Next hold your finger over the top of the pipet and draw the pipet tip across the pencil line while slowly releasing the liquid.
4. Place paper in jar and add your solvent (water). Make sure that the water does not touch your extract.
5. Follow steps 3 and 4 as listed under B.
6. Compare the chromatogram of your unknown extract to those of the known dye standards and identify your dye.

1. Change plant type
2. Use different solvents to develop the chromatograms.
3. Extract dyes from leaves by placing the leaf directly on the paper chromatogram and crushing a line from the plant using a nickel along the origin.