India is the world’s second-largest producer of tropical fruit and vegetables, but a huge amount of the harvest — up to 40 per cent — is lost to spoilage on the farm, in the warehouse and in transit before it ever reaches the consumer. Mangoes, for example, can be a lucrative crop, but the entire harvest tends to ripen within a very short time. This causes a sudden glut on the market, driving down prices and leaving excess fruit to rot. “The fruit is ready on the tree, but there is no way to get it to market,” says Jayasankar Subramanian, an agricultural biotechnologist at the University of Guelph.

To reduce the waste, researchers at India’s Tamil Nadu Agricultural University and the University of Guelph in Canada are finding ways to use a natural substance called hexanal to slow ripening, get more fruit to market and improve the lives of farmers. “If we can give farmers a bigger window, it gives more stability to the pricing and more flexibility for packers and shippers,” says Subramanian. The work is jointly funded by IDRC and Global Affairs Canada through the Canadian International Food Security Research Fund.

In 2012, Subramanian and K.S. Subramanian (no relation), a biochemist at Tamil Nadu Agricultural University, started testing hexanal on tropical fruits such as mangoes and bananas in India. Some varieties of mango sprayed with hexanal stayed on the trees for an extra three weeks before needing to be picked, and after harvest they lasted three weeks longer in storage than unsprayed fruit. That delay brought big advantages for the farmers. Instead of harvesting at the same time as everyone else when prices are low, they could wait for prices to rise again as the glut cleared. “The longer you can retain the fruit on the trees, the higher the price,” says K.S. Subramanian. Each day that the farmers could hold off on harvesting earned them an extra 1,000 rupees per acre.

The sprayed fruit was also more firmly attached to the trees, reducing losses to strong wind and rain, and had fewer pests and diseases, reducing the amount of rejected fruit from 50 per cent to less than 10 per cent. Because they retained fruit better, each sprayed tree produced between five kilograms and six kilograms more fruit than the control trees. Bananas proved to be trickier because their thick skins and waxy coatings made field spraying ineffective. But dipping them in hexanal after harvest helped them to stay fresh for several weeks longer than usual.

The research involved 4,000 farms across the state of Tamil Nadu, 70 per cent of which were small or marginal farms of less than two hectares. The technology was popular with farmers, with 70 per cent of those involved saying they would like to keep using it in the future, says K.S. Subramanian.

The researchers are now working on embedding hexanal into tiny pores in nanoparticles that can be placed in a pouch in a packing box (much like the small desiccant packages found in shoeboxes) or made into a sticker that’s placed on the fruit after harvest and continues to release hexanal during shipping, keeping the fruit fresher for longer. “It can close down the ripening process significantly,” says Jayasankar Subramanian.

The spray and dip technology is already starting to be accepted by agricultural regulators in India and Sri Lanka, says K.S. Subramanian, where it will soon be available commercially, with work continuing on the nanoparticles. Jayasankar Subramanian expects it to be approved in North America within 18 months, and in Costa Rica and Guatemala in 2019. The researchers also hope to expand the use of hexanal to Africa.

The work could have an impact on health as well. Because so much of the harvest is lost, people in India and Africa are not big consumers of the fruits and vegetables that they produce. Hexanal could help not only improve the economic outlook for farmers but also the diet of local people.

“If we can save up to 50 per cent of the losses, depending on the crop,” says Jayasankar Subramanian, “that will translate into
STOPPING THE ROT
How a natural compound called hexanal is helping prevent India’s lucrative fruit crops from spoiling

READING AS THINKING

1. Underline five main ideas in the article and list three keywords associated with each idea.

   ____________________________________________________________
   •                                                            •
   •                                                            •
   ____________________________
   •                                                            •
   •                                                            •

2. Pictures play a key role in communicating ideas. Take 30 seconds to observe the picture in the article and then answer the questions below.

<table>
<thead>
<tr>
<th>What do you see in the picture?</th>
</tr>
</thead>
<tbody>
<tr>
<td>What does it remind you of? What personal connections can you make to the picture?</td>
</tr>
<tr>
<td>What is the link between the picture and the article? What might be some reasons as to why this picture was chosen for the article?</td>
</tr>
</tbody>
</table>

3. Explain the various problems that hexanal addresses.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
ACTIVITY 31
STOPPING THE ROT
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4. Who is affected by the use of hexanal, both directly and indirectly? How are they affected?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

5. What are some concerns that you may have as a consumer who is not familiar with hexanal?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

6. What are the next steps in using hexanal?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

7. K.S. Subramanian is quoted as saying, “The longer you can retain the fruit on the trees, the higher the price.” Explain this reasoning.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
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Think-Pair-Share

8. **Think**
   Imagine that you are a mango or banana farmer in a country of your choosing who has been approached to use hexanal on your crops. What would be some questions or concerns that you might have? Think of issues specific to that context. Predict how the question or concern could be addressed.

<table>
<thead>
<tr>
<th>QUESTIONS/ CONCERNS</th>
<th>POTENTIAL ANSWERS</th>
</tr>
</thead>
<tbody>
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</table>

9. **Pair**
   Compare your questions, concerns and answers with a partner who chose a different country.

<table>
<thead>
<tr>
<th>HOW ARE THEY DIFFERENT? WHAT IS DIFFERENT?</th>
<th>HOW ARE THEY THE SAME? WHAT IS THE SAME?</th>
</tr>
</thead>
<tbody>
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</table>

10. **Share**
    As a class, share the questions/concerns specific to the different countries. Answer as a class why these particular countries would have this type of question or concern.
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ONLINE

1. Using Google Maps, locate the Tamil Nadu state in India and explore the state by using Street View and the satellite and map modes. Using the quick facts section and other research tools find the following:
   a. the population
   b. the neighbouring states
   c. the major bodies of water
   d. the major cities

2. Using Google Maps Street View or a general picture search, compare the landscapes of one major city in Tamil Nadu and another major city in a northern state.

3. Learn more about using hexanal to preserve fruit longer.

4. Read about how packaging keeps consumers safe.

5. Watch this video to learn more about the benefits of nanotechnology in preserving fruit.
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CROSSWORD:

Across
3. India's currency
7. Those who oversee the rules
9. A selection of food consumed habitually
10. Forty per cent of fruits and vegetables in India are lost to this
11. A natural substance that slows fruit ripening
12. A type of particle
13. The researchers working with hexanal hope to expand its use to this continent
14. Troublesome animal

Down
1. Gathering crops
2. Something that dehydrates
4. India produces this type of fruit
5. One could describe the coating of bananas as this
6. Jayasankar Subramanian's profession
8. Oversupply