Bioengineering Issues Cards

ISSUE 1

Apples start to oxidize almost immediately after they have been sliced and exposed to air. This causes apples to turn brown and a little mushy. The brown color is unappetizing and consumers often throw the apples away rather than eating them. This results in food waste.

ISSUE 2

Children in Africa can suffer from malnutrition and poor diets. They do not receive enough fruits and vegetables in their diet that provide a wide range of nutrients, and blindness can result from vitamin A deficiency. Rice is one of the staples of their diet which is an excellent source of calories.

ISSUE 3

Weeds in soybean and cotton fields compete for water, nutrients, and sunlight that the soybeans and cotton need to grow. Because they are broadleaf plants (same leaves as the weeds) farmers can't spray herbicides while the plants are growing. This results in a significant reduction in crop yield.

ISSUE 4

Papayas are susceptible to a disease called papaya ringspot virus (PRSV). This virus deforms fruit of young plants and can prevent the plant from producing fruit at all. The virus is spread by insects and cannot be contained. Papaya production in Hawaii was nearly destroyed because of this virus.

ISSUE 5

Potatoes can be bruised by impact and pressure during harvest and storage. This results in black spots on the potato. Consumers will not purchase discolored potatoes, and potatoes with these black spots are thrown away. This results in food waste.

ISSUE 6

The corn borer is a moth that lays eggs on corn plants. When the eggs hatch, the larva that looks like a small worm eats the corn plants and can cause millions of dollars of damage to the corn field.

Bioengineering Solutions Cards

SOLUTION A

Scientists discovered a gene-silencing technique to turn off the expression of polyphenol oxidase, which causes cut fruit to turn brown. By suppressing this gene, no polyphenolics are produced and no browning occurs.

SOLUTION B

Scientists use a process called transformation to copy traits from one organism and insert them into another organism's cell. By copying a protein from a virus and inserting it into the seed of a fruit, the fruit becomes resistant to that virus.

SOLUTION C

A naturally occurring soil bacterium–Bacillus thuringiensis (or Bt)–produces a protein that is toxic to caterpillars but safe for other insects, mammals, birds, and fish. Scientists insert the Bt gene into a plant's genetic code which then produces a protein that is toxic to caterpillars.

SOLUTION D

Many farmers use glyphosate (an herbicide) to control weeds. Glyphosate prevents plants from growing by stopping the production of amino acids. Using a gene gun, scientists can insert germ cells from bacterium into crop seeds so they're still able to produce amino acids. Now, when glyphosate is sprayed on crops, it kills the weeds but leaves the desired crop.

SOLUTION E

Many fruits and flowers that are orange produce beta-carotene which is necessary to produce vitamin A. Scientists added two genes (one from a grass and one from a bacterium) to turn on the carotenoids. The resulting grain was golden in color and produced beta-carotene.

SOLUTION F

Scientists discovered a gene-sequencing technique using RNA from a wild plant species to suppress natural enzymes. The gene sequence from the wild plant species is so similar that the domesticated plant easily recognizes it. This means that bruising can be reduced by up to 40%.

Bioengineering Results Cards

THE RESULTS ARE IN...

Arctic apples won't brown after they've been bitten, sliced, or bruised. Consumer research has shown that people prefer the eye-appeal of the new variety. Approximately 40% of apples are wasted because of browning. The new variety maintains a longer shelf life so food waste is decreased. There is no need to treat apples with ascorbic acid to try and prevent browning.

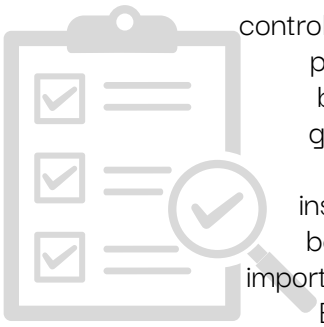
THE RESULTS ARE IN...

Golden Rice could significantly reduce vitamin A deficiency syndrome. More than 1.1 million children die every year from vitamin A deficiency. Up to 500,000 more lose their eyesight and others become susceptible to diseases. This biofortification could improve the primary food source for billions of people.

THE RESULTS ARE IN...

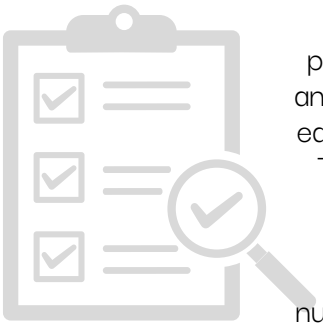
Innate potatoes reduce black spots from bruising. Previously, tons of bruised potatoes never made it to the market costing millions of dollars. The technology also resulted in reduced production of the amino acid asparagine. Asparagine is a precursor to acrylamide which is a suspected carcinogen when cooking potatoes. The new potato reduces the risk of getting cancer.

THE RESULTS ARE IN...



Bt Corn has revolutionized pest control in corn crops by providing protection from hungry corn borer larva. This means that growers will be handling and applying fewer chemical insecticides which has health benefits for the growers and important environmental benefits. Bt Corn reduces the use of insecticides, protects yields, and improves the quality of the grain.

THE RESULTS ARE IN...



The Rainbow Papaya grown in Hawaii are resistant to the papaya ringspot virus (PRSV) and have been proven safe to eat and of commercial quality. This new variety yields up to 125,000 pounds of fruit per acre–a 25x increase. The fruits are exactly the same nutrition and have been safely consumed for more than a decade.

THE RESULTS ARE IN...

RoundUp Ready soybeans and cotton were first commercially produced in the mid-1990s. These transgenic crops can be sprayed with RoundUp (glyphosate) with no damage to the corn or soybean plants. Only the weeds are killed by RoundUp which improves crop yield and quality.