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APPLICATIONS OF GENETICALLY MODIFIED CROPS FOR INSECT AND HERBICIDE RESISTANCE

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Abstract

Weeds in crop fields can lead to lower agricultural production if not managed properly because they compete with crops for resources like sunlight, water, and nutrients. Glyphosate, a herbicide made by Monsanto, kills plants by inhibiting a necessary enzyme. Crops can be modified to tolerate glyphosate by introducing genes that resist the herbicide or break it down. Basta is another herbicide that contains phosphinothricin and can be resisted by crops with the PPT gene. Genetically modified Bt crops, like Bt cotton and Bt brinjal, produce insecticidal proteins from soil bacteria to protect against pests. India uses transgenic crops to improve food security and agricultural output while potentially reducing the need for pesticides. However, concerns about the safety of genetically modified foods, impact on biodiversity, socioeconomic issues, and ethical considerations have been raised. Weeds can develop resistance to herbicides over time, making it important to continue developing effective crop protection methods.

Introduction

Plants that have been altered by genetic engineering methods are known as transgenic crops.

The GEAC authorized the GM mustard hybrid DMH-11's environmental release, advancing it toward full commercial cultivation. Earlier examples include the government's 2010 indefinite prohibition on GM brinjal and the GEAC's 2017 approval of GM mustard with more testing. But at the moment, only cotton is grown commercially as a genetically modified crop in India. Transgenic technique is being tested for additional crops, such as tomatoes, brinjal, maize, and chickpeas.

Herbicide Tolerant – Glyphosate

Crop fields are always plagued with weeds. Weeds operate as a carrier of insects and illnesses in addition to competing with crops for space, sunshine, water, nutrients, and other resources. Weeds have the ability to drastically lower agricultural production if they are not managed.

The herbicide Roundup, manufactured by Monsanto in the United States, inhibits the enzyme 5-enopyruvate shikimate-3 phosphate synthase (EPSPS), hence causing plant death. It is necessary for the production of several secondary plant metabolites, vitamins, and aromatic amino acids. Crops may be altered in a number of ways to make them glyphosate-tolerant. Including a gene from a soil bacteria

that generates an EPSPS strain that is resistant to glyphosate is one tactic. Adding a separate gene from a soil bacterium that generates an enzyme that breaks down glyphosate is one additional method.

Herbicide Tolerant - Basta

The herbicide known by its trade name, "Basta," is a non-selective substance that contains phosphinothricin. From the Medicago sativa plant, the herbicide-tolerant gene PPT (L-phosphinothricin) was identified. It blocks the glutamine synthase enzyme, which is necessary for the absorption of ammonia. After the PPT gene was inserted, transgenic tobacco that was resistant to PPT was created. A related enzyme, whose bar gene encodes for phosphonothricin acetyl transferase (PAT), was also discovered from *Streptomyces hygroscopicus*. It was then inserted into agricultural plants, including sugarbeet and potatoes, and transgenic crops were created.The advantages of herbicide tolerant crops were given below: Higher crop yields are improved by weed control; herbicide spraying is reduced; crop plant-weed competition is lessened; and low-toxicity compounds that break down quickly in the soil are used (glyphosate's half-life, or how long it takes for half of its active ingredient to break down, varies depending on the water conditions).The capacity to preserve microorganisms and soil structure.

Insect resistance - Bt Crops

Bt Cotton

Bt cotton is a kind of cotton that has been genetically engineered to create an insecticide effect against bollworms. It is also known as genetically modified pest resistant plant.

Bacillus thuringiensis strains generate more than 200 distinct Bt toxins, each of which poses a threat to distinct insect species. The majority of Bt toxins are innocuous to other living things, however they are insecticidal to the larvae of moths, butterflies, beetles, and cotton bollworms. The Cry category of endotoxins contains the genes that code for poisonous crystals. The poisons in the cotton plant are dissolved in the stomachs of insects that attack and consume it. The gut's epithelial membranes obstruct some essential nutrients, causing the insects' ability to regulate potassium ions to be lost. This ultimately results in the death of the larvae by causing the epithelial cells of the intestinal membrane to die.

Bt Brinjal

Another transgenic plant, the Bt brinjal, was produced by introducing the crystal protein gene (Cry1Ac) of the soil bacteria *Bacillus thuringiensis* into the genomes of several cultivars of brinjal. Using Agrobacterium-mediated genetic transformation, the gene is inserted into the brinjal plant together with other genetic components such terminators, promoters, and an antibiotic resistance marker gene. The Bt brinjal variety has been engineered to confer resistance against Lepidopteran insects, namely the *Leucinodes orbonalis* Brinjal Fruit and Shoot Borer.

Advantages

The possibility of improving food security is one of the primary justifications for the adoption of transgenic crops in India. With India's population constantly expanding,

transgenic crops provide a viable way to boost agricultural output and satisfy the country's rising food needs. Enhanced agricultural attributes: It is possible to design transgenic crops to possess desirable properties including increased nutritional value, resistance to pests, and drought resilience. Higher yields may result from these changes, which may also make crops healthier and more robust to changing weather patterns. Farmers may profit financially from transgenic crops. For example, using crops that have been genetically modified to resist pests can lower the need for costly pesticides. One such example of this is the GEAC's recent approval of genetically modified mustard, which has the potential to raise output and, in turn, farmers' income.

Transgenic crops have the potential to mitigate environmental contamination by decreasing the demand for chemical pesticides and herbicides. Additionally, certain genetically modified crops could use less water, which would lead to more sustainable water usage. By making it easier to create new crop kinds, transgenic technology can improve agricultural biodiversity. This may provide farmers with additional options for crops to grow, which might result in agricultural systems that are more diversified.

Disadvantages

There are groups who contend eating genetically modified foods may cause health problems. Antibiotic resistance, allergenicity, and general food safety are all issues with GMO-derived foods. Impact on biodiversity: Some contend that the introduction of genetically modified crops may have an adverse effect on biodiversity. Increased usage of crops resistant to herbicides may cause harm to beneficial insects and non-target creatures. Possible socio-economic ramifications: Socioeconomic factors are also taken into account. Small farmers, for example, may have challenges if they are unable to pay for the frequently more expensive genetically modified seeds, which might exacerbate economic disparities in rural areas. Due to the patent protection of many GM seeds, farmers utilizing these seeds would be reliant on these businesses for their supply, which might result in monopolistic behavior and a loss of control over their own farming methods.

In nations like India with strong cultural and religious traditions connected to natural processes, some people find that the genetic alteration of crops raises ethical considerations about human involvement in nature. The same as all other living things, weeds adapt and change with time. With time, they may grow resistant to herbicides. Glyphosate-resistant weeds have become more prevalent. Despite not being any different from regular weeds, they are frequently referred to as "super weeds." Some herbicide-resistant crops that were formerly extremely efficient at controlling weeds when combined with glyphosate herbicide are no longer as helpful as they once were as a result of these changes.

Conclusion

Glyphosate-tolerant crops can be created by introducing genes from soil bacteria or soil bacterium that produce an enzyme that breaks down glyphosate. Basta, another herbicide, is a non-selective substance containing phosphinothricin. These crops can

improve crop yields, reduce herbicide spraying, and reduce crop plant-weed competition. Bt cotton, a genetically engineered pest-resistant plant, has been genetically engineered to produce toxins that pose a threat to insects. Bt brinjal, another transgenic plant, was created by introducing the crystal protein gene of *Bacillus thuringiensis* into brinjal cultivars. Transgenic crops can improve food security, increase agricultural attributes, lower farmers' financial costs, mitigate environmental contamination, and enhance crop diversity. However, there are concerns about health, biodiversity, socio-economic ramifications, and ethical and cultural concerns. Glyphosate-resistant weeds, often referred to as "super weeds," have become more prevalent due to genetic alteration.

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