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GENETICALLY MODIFIED ORGANISM

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Abstract—Advances in understanding agro biology, novel hereditary resource, genome adjustment, and omics innovations create new answers for food safety and novel biomaterials creation under changing natural conditions. New quality and germplasm up-and-comers that are foreseen to prompt improved harvest yields production and other plant attributes under pressure need to pass long advancement stages dependent on experimentation utilizing huge scope field assessment. The making of a hereditarily altered gene is a cycle in numerous stages. Hereditary designers need to isolate and incorporate the quality into the host species, including the district of a promoter and eliminator and furthermore a determination related marker. In this manner, quantitative, objective and robotized screening techniques joined with dynamic calculations are probably going to have numerous points of interest, empowering quick screening of the most encouraging harvest lines at a beginning phase followed by definite compulsory field tests. To improve natural proficiency, it is critical to substitute these synthetic pesticides for organic material for the crop and nature. For this situation, Genetically Modified Organism, GMOs have indicated a great deal of uses in agricultural biotechnology.

Keywords— Agricultural biotechnology, Gene, Modified organisms, Crop improvements, GMO.

3.1 Introduction

An organism whose genetic material has been modified using genetic manipulation techniques is a genetically modified organism (GMO) [1]. The precise description of the genetically modified organism and its components differs. Various species, from cattle to plants to micro-organisms have been genetically engineered. In the same population, genes (creating transgenic organisms) and even through reigns have been passed. It is possible to join new genes or to improve, modify or knock off endogenous genes [1].

The creation of a genetically modified organism is a process in many phases. Genetic engineers need to separate and integrate the gene into the host species, including the region of a promoter and terminator and also a selection-related marker. Numerous procedures for coordinating the separated quality into the host genome are accessible [2]. As vectors in which genetic information is inserted into other species, viruses are essential [1]. This technology is especially important for human gene therapy [3]. Virulent genes are supposed to be eliminated from viruses to produce vaccines. Plants were planned for scientific study, new colours were developed in

plants, vaccines were produced, and enhanced cultures were developed [3]. Publicly, the most divisive GMOs are genetically modified plants. Most of them are built tolerant of herbicide or resistant insects as well as to increase its nutritional value, such as for golden rice [2].

A Genetically Modified Organism in Agriculture

Manufactured plants may increase crop yields per area significantly and reduce chemical insecticides in some cases [4]. GM plants were designed for defence from a selected concoction weedkiller, rather than protection from a characteristic predator or bug [5]. Herbicide-safe yields (HRC) have been accessible since the mid-1980s; these harvests empower booming substance management of weeds, since simply the HRC plants will get by in fields treated with the scrutiny weedkiller [5]. Such harvests are significantly vital for no-till cultivating, which forestalls soil disintegration [5]. The case of a hereditarily adjusted harvest is the "brilliant" rice initially planned for Asia which was designed hereditarily to just about multiple times that of past assortments of beta-carotene [6]. Brilliant rice was made by means of the change of the rice genome to incorporate a compound known as phytoene synthase and a quality from the bacterium *Erwinia uredovora* that creates a motor known as phytoene desaturase, a daffodil *Narcissus pseudonarcissus* quality [6].

B History of Genetically Modified Organism

The principal hereditarily changed creature in 1973 were made by Herbert Boyer and Stanley Cohen [8]. He took a quality of a bacterium that delivered anti-microbial kanamycin obstruction, embedded it in a plasmid and afterward drafted other microorganisms into the plasmid [8]. Within the sight of kanamycin, microorganisms that effectively fused the plasmide endure. In 1974, this included qualities of Toad *Xenopus laevis*, which gave the first GMO to communicate a quality in a specific realm living being [8]. By injecting foreign DNA into their embryo, Rudolf Jaenish developed a transgenic mouse in 1974 which makes it the first transgenic animal in the world [9]. It took eight years, however, to create a transgenic mouse that transferred the transgenic to its offspring [9]. Mices with genes deleted (termed a mouse knockout) were developed in 1989 and cloned oncogenes, which were predisposed to the development of cancer, were generated in 1984 [9]. The main creature to combine transgenic proteins in their milk was created in 1985 and the principal creature to mice [9]. The mice were built to create human tissue plasminogen activator, a protein engaged with separating blood clusters [9].

Michael W. Bevan, Richard B. Flavell and Mary-Dell Chilton developed the first genetically modified plant in 1983 [10]. The quality gene was found in 1987 and takes into account change of plants not powerless to agrobacterium disease by tissue culture [10]. The nutrient in upgraded brilliant rice was the primary harvest that was created with an improved supplement esteem [10]. In 2000, the quality firearm was created. The quality firearm was utilized to change over plants which were not powerless to the agrobacterium disease [10].

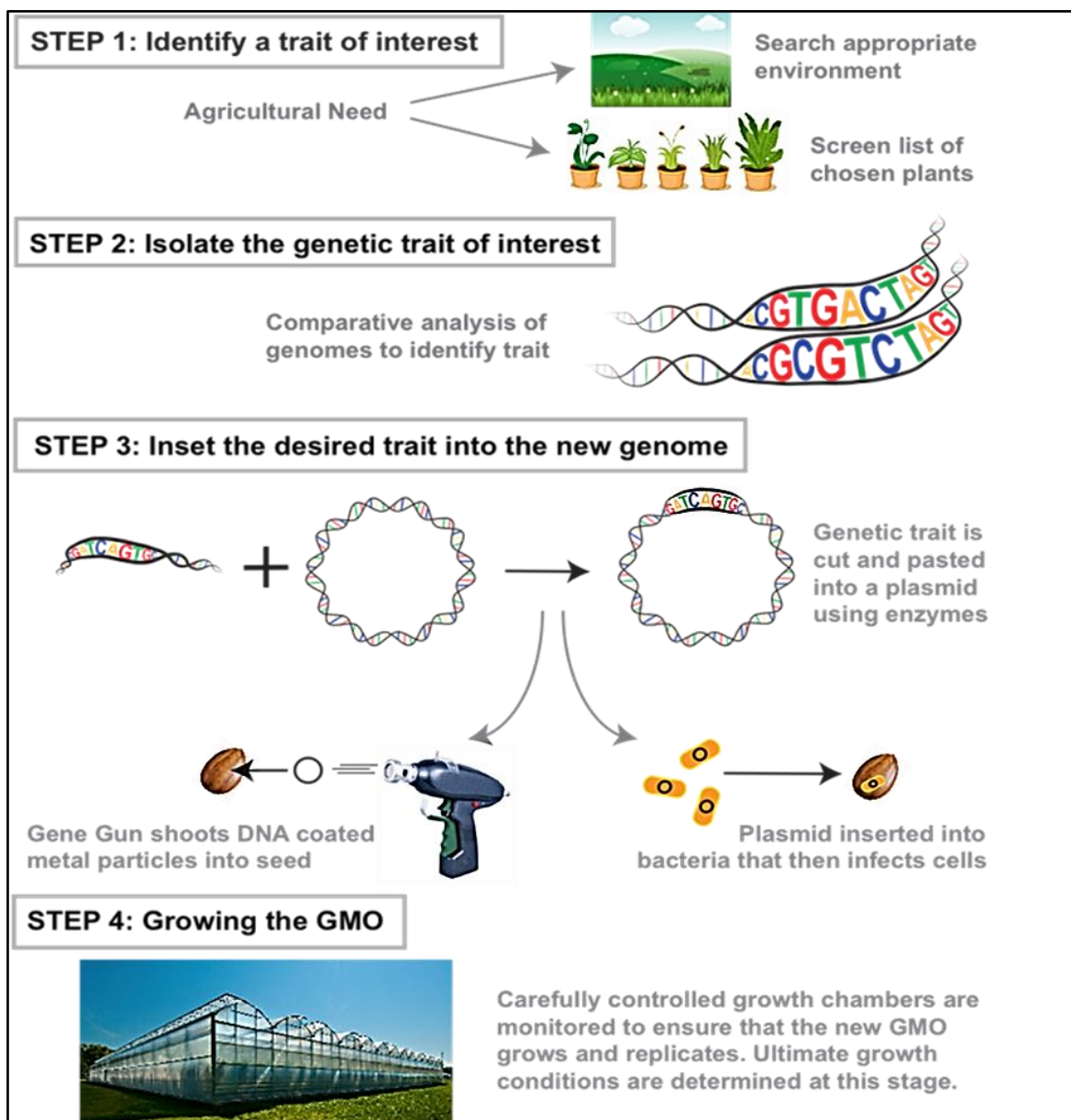


Figure 1: Few steps in genetic engineering [12].

3.2 Biotechnology in Genetically Modified Organisms, GMOs

The yields of biggest crops are currently stagnating while demand for food, including grain and animal protein, is growing. Meeting the yield enhancement task requires a relentless effort to produce a steady supply of better cultivars and lines for all major crops. Conventional breeding cannot keep up with what is needed; reaching biotechnology goals, and the production of GM crops keeps it going. Mainly in order to do genetic modification on canola, genetic engineering is used to change the

behaviour and characteristic of the canola to meet the desired needs. Commonly, genetic engineering is used for biological research. Figure 1 shows the steps involved in genetic engineering. The gene technologist uses, in basic words, a "cutting-copying-pasting" technique to transfer genes from one organism to another [11]. Of this function, bacterial enzymes are used to recognize, cut and enter DNA at different positions that serve like "scissors and tape" molecules. The chosen gene, however, is replicated multi-billion times, with the result that the volume of original genetic material in the transformed organism is incredibly small. Since

DNA does not always transfer readily from one organism to another, "vehicles" such as plasmids (small bacterial DNA rings) can be used. Alternatively, specific plant cells can be converted into target cells by "shooting" small particles coated with the new DNA using a different kind of piston, the "Gene Shot." They will then use the modified cell to create a new organism.

There are a few steps that need to be carried out in order to do genetic engineering. The first step is the need to identify a trait of interest. For example, if the plant is pest resistant etc. In order to identify a desirable new trait scientists most often look to nature [12]. The successful discovery of a unique genetic value trait is always a blend of logical thought and chance. For example, if researchers are searching for a character that would cause a crop to survive in a particular environment, they will be searching for species that would naturally survive for that specific environment. And then for the second step, which is the isolation of DNA fragments from a donor organism (Figure 2) [13], [14]. The gene of interest would usually already be accessible as an item of a "library" of short portions of the donor strain or species' complete genome. When this is the case otherwise the protocol followed is to use the PCR reaction to replicate the protein. However, if the gene is to be extracted from an uninvestigated genome, a more complicated process would need to be pursued.

The use of the Polymerase Chain Reaction (PCR) technique allows the gene to be multiplied to the amount of several million copies needed. Comparative analytics are used to decipher which portion of the genetic structure of an organism comprises the interesting trait. The genomes of plants with the character are contrasted with the non-quality genomes of similar families, with the point of characterizing qualities present just in the previous. So as to group a quality, similar to the situation while delivering Golden Rice, genomes of various living beings of a similar trademark can likewise be thought about. In the event that no hereditary data chronicle is accessible for investigation, researchers may intentionally delete or "take out" segments of the genome of premium once the ideal phenotype is missing, along these lines characterizing the qualities that add to the trademark. Monsanto has made and licensed a framework known as seed chipping to facilitate this procedure.

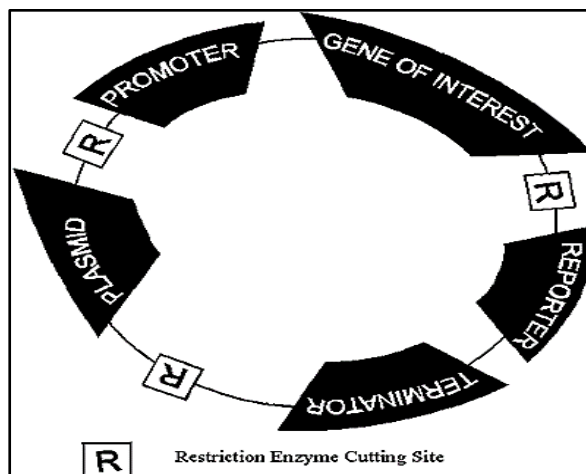


Figure 2: The diagram of DNA sequence of a basic plasmid and incorporated construct [14].

Monsanto shaves off areas of seeds by this procedure for high-throughput hereditary sequencing while at the same time leaving most of the seeds reasonable for planting. This delivers a plant hereditary database before they are even developed, where a system of standardized identifications is utilized to interface plants to their genotypes. Scientists would then be able to utilize this database to distinguish new highlights of intrigue and enhance alluring characteristics in a harvest by choosing the best plant-based genotypes. And afterward, embed the ideal hereditary attribute into another genome [12]. Due to their unbending structure, it is hard to modify the genome of plant seeds. Some biotech organizations use "quality weapons" to shoot DNA-covered metal particles into plant tissue with a 22-gauge charge. Monsanto no longer uses quality weapons however rather utilizes microscopic organisms, called *Agrobacterium tumefaciens*, which normally attack seeds and alter plants by embedding bits of their own DNA into the genome of a plant.

Genetically engineered bacterium is widely utilized in biotechnology science to supply the specified protein. It's achieved by the utilization of enzymes to cut and paste a strand useful in deoxyribonucleic acid into a plasmid that could be a skinny, circular deoxyribonucleic acid molecule. EcoRI recognizes the DNA sequence and cleaves each strand between the G and A yielding single strand ends. Such "sticky ends" can readily join on to other DNA fragments created by the same enzyme (Figure 3).

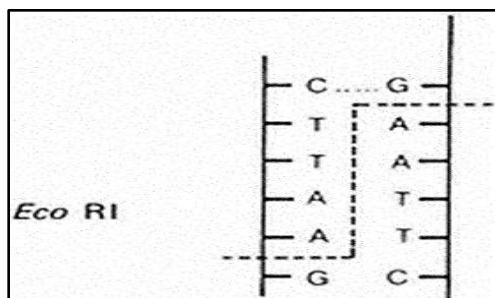


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Then, bacterium is aghast with heat or electricity in order that the cells settle for the cellular inclusion that has been built. Through amending *A. Tumefaciens* that are easier to change than plant seeds themselves, researchers might use the naturally invasive behaviour of the bacterium as a worm to inject fascinating characteristics into the genome of the crop. Then the subsequent step is to grow the GMO. Once a modification has been with success incorporated into the order of an organism, the remodelled organism with its freshly created genome can then be able to evolve and reproduce. Next, it's vital to check the genotype of the species, such researchers will unfold species within which the genome has been properly changed.

Biotech industries are spending vast amounts of money to keep these plants alive and breeding till they're developed with success. The companies use special climate-controlled growth chambers, and biologists additionally manually take a look at the plants to ensure they develop as planned. Biotech firms can use automatic machines resembling Monsanto's GenV plant to trace plants and calculate best seeding and growth conditions to form the simplest doable yields throughout this method [12]. GMO seeds usually go with spacing and nutrition directions that are the results of these studies. Each part of the step poses issues of its own. As an instance, distinguishing the correct sequence is clearly a frightening task and one of the foremost strict and sophisticated operations in biological science, "Bogorad aforementioned. The genome of the plant is growing, and unbelievably complicated. Some genes are found within the cell organ on chromosomes. Some are distributed in 2 organelles which are the chloroplasts and therefore the mitochondria.

3.3 Advantages of Genetically Modified Organism

the blooming cycle results in increased canola yields planted in the late-winter contrasted and

The world's population has exceeded 6 billion, and over the next 50 years is expected to double. Ensuring a good supply of food would be a big challenge in the years ahead for this booming population. Genetically modified organisms pledge in many ways to fulfil this need. First and foremost, the advantage of genetically modified organisms in terms of production is it can increase the yield and economic returns. Herbicide choices were limited prior to the introduction of canola cultivars. Few plant species were utilized in the dirt applied herbicides, for example, trifluralin or ethalfuralin.

The soil and environmental conditions were highly affected by productivity and were relatively poor. In addition, the rotation constraints on subsequent crops resulted in residual soil activity. Such herbicides were pushed into the soil before growth, thus reducing the use of no-till practices. In a few wide leaves weed species, the available post-emergence herbicides worked. In general, for example, weed contention caused critical loss of yield for canola and ranchers were careful just to develop canola in low-weed fields. Canola is commonly developed in weedy fields as a major aspect of a weed seed bank's decrease plan in years to come. Canola permits ranchers to control a large number of their hardest weeds [15]. Genetic modified canola yield is higher in the case of GLY or GLU than in the case of herbicides ordinarily utilized in non-HR canola, especially where the weed populaces are hard to oversee [16]. Better weed control with canola provides an opportunity for herbicides to be minimized in the following crops. Genetically modified canola allowed farmers to plant soil-incorporated herbicides earlier than a non- canola program. The improved use of the humidity of snowmelt and the decreased temperature stress during

mid-May. Planting earlier than usual often interferes with normal weed patterns that lead to

the integrated management of weed. Due to their production, hybrid cultivars are increasingly popular with farmers. Much of the canola market was made up of hybrids in 2010. Often hybrid cultivars are taller, more durable than open-pollinated, and they form a dense canopy [17]. Next, the upside of hereditarily altered life forms in terms of cost is improved administration of herbicide-safe weeds.

Genetic modified canola non-selective herbicides are used in Canada as an effective method to control herbicide resistant herbicides proactively and reactively, such as herbicide-resistant in Category A or B. It has reduced the economic effect of these herbicide-resistant weeds. However, a common use of herbicide-resistant crops for cultivation systems may be used to pick or increase selection for new herbicide-resistant biotypes, bringing about rehashed use of herbicides using a similar method of activity. The minimal effort of GLY comparable to add up to variable expense for creation of canola and its nonattendance of soil build-ups are forestalling a diminishing in the quality of herbicides. Many farmers are shortening their GM canola rotation with current gainful financial returns from developing canola and as a way to counter weed opposition. In western Canada GLU is primarily used as an alfalfa, lentil and potato seed desiccant in GLU-herbicide resistant canola. Broadening of herbicide safe qualities in developed canola and the pivot recurrence of the harvest (commonly once per three to four years in revolution) is the explanation for the absence of reports of GLY or GLU weed resistance in genetic modified canola in Canada up to now [18].

Also, the upside of hereditarily changed life forms is quality stream and biodiversity. In the field of canola, dust intervened quality streams can bring about various HR volunteers with ensured seed crops with various HR characteristics in the encompassing area. Two Canadian studies have reported a degree of GM adventitious presence in certified seed growers. Together, AP can bring about enormous, as the center of their origin in Western Canada, with not many types of farming weed and none of them uncommon or imperiled. There was no difference between GM-HR and non-HR canola of abundance of indigenous weed species relative to other species.

Different focal points of hereditarily altered life form is vermin opposition. Social misfortunes from creepy crawly irritations can be tremendous, driving in the creating scene to cataclysmic

surprising populaces of single or various HR canola and canola chips in the next years in pedigreed canola seedlots and dust interceded quality streams. All volunteers, regardless of whether non-HR, single-hr or numerous hr, are similarly very much managed by herbicides utilizing interchange methods of activity, for example, metribuzin, 2, 4-D, or MCPA. [19] found that most by far of canola volunteers happen in one year promptly following canola. Over 30 herbicide therapy treatments are registered for the management of one to four Hour voluntary canola in cereals, which is a traditional three to four-year rotational canola followed by the most frequent plant type. Herbicides are similar in canola and tillage schemes for management of volunteer canola [19]. Seventy-five percent of ranchers who developed GM-HR canola in the year 2000 said that the administration of volunteers for canola was no longer an issue with GM-HR cultivars than with non-HR cultivars. Studies exploring quality streams between GM canola and related cruciferous substances didn't show any proof of quality stream to hound mustard, wild radish or wild mustard, but the herbicide resistance has been passed on to wild birds' rape, closely related species. In addition, gene flows have been studied.

The effect of these harvests on weed decent variety is a significant issue encompassing GM crops, particularly in Europe. In Western Canada, field studies of the 1990's and 2000's measured the abundance of plant species. In the past two years, weed species diversity was used as a basis of comparison for non-HR wheat. Weed communities varied from those found in wheat when the selection of HR canola, which showed that GM-HR canola did not reduce the variety of weeds. These findings have been confirmed by [19]; while weed populations at some sites were changed over three years of glyphosate resistant wheat, no weed diversity variations have been identified. The effect of genetically modified plants on the diversity of weed is therefore not as significant

budgetary misfortunes for ranchers and starvation. Typically, ranchers utilize a great deal of huge amounts of compound pesticides every year. Buyers don't wish to eat pesticidal-dealing with nourishment because of potential well being dangers and the superfluous utilization of pesticides and manures that can bring about the debilitating of horticultural waste that sully water sources and damage the earth. Secondly, the advantage of genetically modified organisms is

herbicide tolerance. For certain crops, the physical removal of weeds, such as tilling, is not cost-effective, so farmers also spray huge amounts of different herbicides to kill weeds, a tedious and expensive method that takes care not to damage the crops or the ecosystem. Genetically engineering crop plants which are resistant to a very powerful herbicide may minimize the number of herbicides required to avoid environmental harm. Monsanto, for example, developed a strain of soya that has been genetically engineered so that its herbicide Roundup is not affected. A rancher develops soya that at that point requires just one weed-executioner application rather than various applications, diminishes creation expenses and restricts the dangers related with the surging of homestead squander. Thirdly, the advantage of genetically modified organisms is nutrition. In underdeveloped nations where the poor

3.4 Effects of Genetically Modified Organism on Today Society

A Economic Benefits

As we can see, GMOs actually have some big impacts on society. This is because when the crop is modified, it is noticeable that some of the bad traits or characteristics of a crop have been removed in order to benefit the producer and also consumer. First, the impact of GMO on society is GMOs provide economic benefits to millions of consumers [22]. According to a 2010 study by Graham Brookes et al, if there are no GM crops that are used to grow, it is estimated that corn-based products would be significantly 6% more expensive as it will be then and soybean-based products will also be 10% more expensive compared to today's prices. Globally for over the

B Conservation Tillage

As we know, tillage actually increases the cost and time for the farmer's production, and these actually put significant stress to the soil which later makes the soils become dry and infertile. By using herbicide tolerant GM canola oil, this will help them to effectively control weeds at a significantly lower cost rather than using conventional method tilling which is more time consuming. Also, by spraying herbicides onto the field, they can get rid of weeds and at the same

depending on a solitary grain, for example, rice, as the chief staple of their eating routine, malnutrition is normal. Rice does not provide enough nutrients to avoid malnutrition, however. Genetically modified rice can reduce nutrient defects by supplying additional vitamins and minerals. In Third World countries, for instance, blindness caused by deficit in vitamin A is a common problem. In conclusion, the upside of hereditarily adjusted life forms is dry season resistance/saltiness resilience. At the point when the total populace increments and more land is utilized rather than nourishment creation for lodging purposes, ranchers need to plant crops which are historically unfit for crop production. The development of plants that withstand long droughts or high levels of salt will help people grow crops in previously unfriendly areas.

past 20 years, GM technology has actually succeeded in reducing the use of chemical pesticides by 37%, 22% increase in crop yields which lead to the increased number of products produced and also increasing the number of profits that farmers make by a big amount of 68%.

A report found that farmers received an average of \$3.59 for every dollar that is invested for GM crops in the year 2014. Now this may seem big, but the number is even bigger in other developing countries, as for example farmers in Africa, South and Latin America and Asia got an average of \$4.42 for every dollar that they invest for GM crops. Although GM canola seed is significantly higher in prices, the farmers actually save more by using less pesticides/herbicides, labor and input cost due to the fact that GM canola oil now has tolerance to herbicides thus reducing the time spent for spraying herbicides.

time protect the crops and also the soil thus keeping the soil stay moist and fertile. By applying the method above, these actually can make the soil become more fertile and better. This is because with herbicide tolerant GM crops, weeds can be sprayed and left in the field to protect the soil [22]. These will make the next crop that is to be planted into the organic leftover without actually making the soil turn over or become bad. The number of tillage operations per year that is applied also significantly decreased since herbicide-tolerant (HT) crops were introduced. On average, 2.63 tillage operations per year were done by the farmers in 1999. This number has a significant drop on 2006 where the average of 0.48 tillage operation per year is done since by

that time, 66% of the farmers already adopted the reduced-tillage system in which they already used herbicide-tolerant canola. The number has increased significantly where 86% of the farmers have already planted herbicide-tolerant canola in order to reduce soil erosion [23].

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C *Regulation Enforced to GMO*

It is the consumer's right for them to know what is in their food as for example where the food originated, what is the ingredient and what are the nutritional values. Malaysia is one of 64 countries all around the world that enforce GM food and need to have labelling on them. This is actually important for the consumer and also the producer so that they will be transparent as in what the food is. There are a few of regulation laws that are enforced in Malaysia, which is:

- Biosafety Act 2007 (Ministry of Natural Resources and Environment, NRE) - to control the release, importation, exportation and contained use of LMOs (Living Modified Organisms), and the release of products of such organisms [25].
- Food Regulations 1985, amended in 2010 (Ministry of Health, MOH) - to ensure that there are labelling on every GMO [25].

The criteria for labelling generally apply only to the three primary ingredients in the product list. If there are animal-derived genes from the GMO and ingredients that can cause allergies, the source of the gene should be mentioned in the labelling for the consumer to know, e.g.: "gene derived from (origin)" (Figure 4).

If the GMO product has a content with no more than 3% of a food/certain ingredient, it cannot be put on the label provided that existence is unavoidable. However, if the derived gene can cause

hypersensitivity or if the nutritional value of the product is significantly changed or if it can cause allergy, it also cannot be exempted from the labelling. This regulation has been enforced in Malaysia since July 2014 [25].

D Environmental Effect

There is a significant amount of tillage operation per year reduced since GM Canola is introduced to the farmers. This has actually led to reduced greenhouse gas emission by the crops every year.

Since farmers have now adapted to the no-till systems, there is a big reduction in tractor usage because back then the tractor was used to do tillage. Tilling actually requires farmers for them to operate the tractor more often and thus contributing to a large number of fuels burned for agriculture. By now since the no-till system is widely used, the amount of fuel usage has automatically dropped thus contributing to fewer CO₂ emissions. In 2014 in Canada, they managed to reduce the greenhouse gas emissions by 1 billion kg in that particular year, this is equivalent to removing 500,000 cars on Canadian roads.

CONCLUSION

In conclusion, agricultural biotechnology has to establish a system that gives crops in particular a sustainable advantage, thus improving agricultural crop production to meet the world food, fibre and fuel demand. To maintain a balanced diet and an adequate supply of crops for humans and animals, it is important to cultivate a variety of plants that can survive climate change, pathogens and insects. Chemical pesticides are used extensively over half a century early in the year of crop protection against pests and insect pesticides. The amount of these chemicals used has many adverse effects on emissions and toxicity for the environment. To improve environmental efficiency, it is very important to substitute these chemical pesticides for a biological material for the crop and the environment.

In this case study, GMO has shown a lot of application in agricultural biotechnology. In this finding, we successfully discussed the background of genetically modified organisms. Next, we also explained about the biological process and technology used to make the canola oil that applied the concept of genetic modified organisms. The genetic modified organism also

has a lot of advantages in the agriculture sector and we also discussed it in this study. Last but not least, we also justified the effect of the genetically modified organism in agriculture on society.

PQR®
CORN
(Genetically Modified)

Storage instruction: Store in dry place.

BEST BEFORE: 01/01/2013

Packed by:
PQR Sdn. Bhd.
No.1, Jalan 123, Taman Perindustrian PQR,
58000 Kuala Lumpur

Net weight: 1kg

STU®
SOYA BEAN
(Genetically Modified)
(Gene Derived from Cow)

Storage instruction: Store in dry place.

BEST BEFORE: 01/01/2013

Packed by:
MN Sdn. Bhd.
No.1, Jalan 123, Taman Perindustrian XY,
58000 Kuala Lumpur

Net weight: 1kg

FGH®
CORN BREAD
Contains Genetically Modified Ingredient

Nutrition Information
Serving size: 60g
Serving per package: 12

	Per 100g	Per serving 2 slices (60g)
Energy	252kcal	151kcal
Carbohydrate	48.5g	29.1g
Protein	8.3g	5.0g
Fat	2.4g	1.4g
Calcium	250mg	150mg

Ingredient: Wheat flour, corn flour (genetically modified corn), corn (genetically modified), yeast, non fat milk, corn oil, salt, butter.

Contains permitted preservative.
Net weight: 360g
Storage instruction: Store in dry place.

BEST BEFORE: 01/01/2013

Manufactured by:
FGH Sdn. Bhd.
No. 1, Jalan 123, Taman Perindustrian FGH,
58000 Kuala Lumpur

Figure 4: The example of GMO labelling in Malaysia [25].

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