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DETECTION OF TRANSGENE IN SEED AND FOOD

Popular Article

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ABSTRACT

Concerns have been raised globally as to whether these GM products are safe for human beings, animals and to the environment. These concerns have led to demands to regulate and perhaps label seed, feed and food products to inform the consumer whether the products being imported or marketed are made of GM seed or plants. The GMOs can be detected by identifying DNA or RNA or protein. This article deals with the methods of detecting GMOs in DNA as well as in proteins.

Introduction

Advances in biotechnology have enabled the development and production of Genetically Modified Organisms (GMOs) with properties such as tolerance to herbicides, resistance to insects and the addition of nutrition values. Transformation of plants is done by inserting DNA into a single cell, which is then regrown into a complete organism, the plant. DNA is the blueprint of each cell that is transcribed into the messenger RNA (mRNA), which is then translated into a protein.

Need for Detecting GMOs

Concerns have been raised globally as to whether these GM products are safe for human beings, animals and to the environment. These concerns have led to demands to regulate and perhaps label seed, feed and food products to inform the consumer whether the products being imported or marketed are made of GM seed or plants. A processed food manufacturer needs to demonstrate that a food product does or does not contain GMOs such as starlink (Bt) protein in corn or the Roundup (RR) transgene corn or soybeans. An organic farmer needs to ensure that the seed or planting material being used is free from GMOs. A researcher needs to profile and identify a newly developed GMO. Similarly, a seed company needs to certify that it is producing and marketing pure inbred or hybrid seed, or GM seed. The quarantine stations need to test for GMOs in commodities under trade and also germplasm and research material under exchange.

Methods of GMO Detection

The GMOs can be detected by identifying DNA or RNA or protein. A majority of methods focus on detecting DNA, while only a few for detecting proteins or RNA.

DNA based methods

DNA based methods are based on detection of the specific genes, or DNA genetically engineered into the crop. The commercial testings are conducted using PCR technology. The PCR technique is based on multiplying a specific target DNA allowing the million or billion fold amplification by two synthetic oligonucleotide primers.

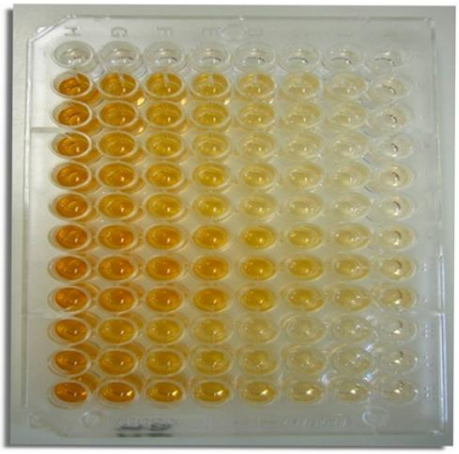
DNA based methods are highly sensitive methods, i.e., can detect trace amounts GM DNA present in the sample. These methods work with most product types, both processed and unprocessed products. DNA based methods can test for multiple GM varieties simultaneously. These methods require highly skilled personnel and laboratory analysis and are more expensive than protein based methods.

Protein based methods

Protein based methods or immunoassay are relatively cheap to perform and less time consuming. Around 5 to 20 mins for are requiredfor strips and 24 hours for ELISA. Strips do not require trained personnel. But these are limited to one or a small number of varieties per test. These methods are not appropriate for processed products and for some GM varieties such as, in certain crops the GM protein is only produced in the leaves or stems and not in the actual grain. Protein tests on the grain are therefore not informative. Protein based methods are not very sensitive i.e., ~1% of GM protein cannot be detected.

Immunoassay is based on the specific binding between an antigen and an antibody. A substance having high molecular weight (>10,000 daltons) when introduced into an animal, causes the formation of specific proteins (the immunoglobulins) in the blood, which are commonly called antibodies. The causative substance is called antigen and the blood serum containing antibodies is called antiserum. Positive reaction confirms the presence of the target protein. Now a days ELISA is the most widely used method for detection of specific proteins as they are much more sensitive than diffusion and agglutination methods, use less antibody and can be employed for simultaneous handling of a large number of samples in routine testing. Among the immunoassays most commonly used are the classical ELISA test (plate-based) and the Lateral flow Strip Method (membrane-based).

Enzyme-linked Immunosorbent Assay: The development of ELISA technique began in the field of diagnostic medicine when enzyme labeled antibodies were used for detection of antigens in tissues. Soon after, it was demonstrated that enzyme-labeling could yield quantitative assays with a sensitivity comparable to radioimmuno assays. ELISA has been the most widely used technique for the detection of viruses.



Lateral Flow Strip Method: The lateral flow test (dipstick format) uses a membrane- based detection system. The membrane contains two capture zones, one captures the bound transgenic

protein, the second captures color reagent. Paper strips or plastic paddles are used as support for the capture antibody that is immobilized onto a test strip on specific zone.

The lateral flow strip is dipped into the prepared sample in extraction solution and the sample migrates up the strip by capillary action. As the sample flows through the detection antibody strip and the capture antibody strip, the protein of interest will accumulate and thus give a high intensity band, but the volume is not as well controlled. These tests generally provide qualitative or semi-quantitative results using antibodies and colour reagents incorporated into a flow strip.

GMO analysis laboratories should participate in proficiency tests organized by independent bodies, to regularly, test and demonstrate that their analyses are reliable and accurate. For industry, control authorities and others purchasing GMO analyses, it is highly recommendable to require from the laboratories that they are accredited, that they participate in proficiency tests, and that the laboratories also make public how they perform these tests. The analyses methods should be of international standards, to avoid disputes between parties using different methods.

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