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PHYTOPLASMA AFFECTING VEGETABLE CROPS: A GLOBAL ASPECT

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Abstract

Agriculture is the most important need of world. Where growing technologies in crop production is a boon for society on other side evolving bacteria are being a pain to the crops. A cell wall lacking bacteria called phytoplasma is an emerging threat to economical production of crops this bacterium affects the yield of crops on a high level these bacteriaoccur in various distinct forms in different aspects lie in terms of size in s=terms of shape of cells and having variation in size of nuclei. The transmission mainly takes place through leafhoppers also by different material of plant propagation lie seeds. Understanding the association of phytoplasma with the vector helping in transmitting the disease is however a challenging and as well as important task for which will further help to identify other factors which are involved in developing of this disease in an effort to decrease the transmission of disease in other species and crops globally. In this paper information on most of the vegetable crops affected by the phytoplasma isreviewed here.

Keywords:phytoplasma, agriculture, vegetable, crops

1. Introduction

The parts of plant that are consumed by human and other animals as food are called vegetables. They can be eaten raw or cooked. They play an important role in providing nutrition to the human body by being high in different essential and non-essentialvitamins and minerals required by human and also rich in dietary fibres. Vegetables can be of three types depending on their cultivation they can be named as perennial, annuals and biennials. They are crops with short duration and are grown in distinct seasons of a year which in return provides economic value. They are considered to be of highest value in nutrients, vitamins, phytochemicals as well as they contribute towards decreasing the chances of some disease lie lowering the risk of heart related dysfunctionality and stroke. Several living and non-living factors affect vegetables and phytoplasmic disease in on the most contributing bacteria affecting the crops in distinct parts of the world which consequently cause high decrease in quality of crops and also yield of crops. The size variation in phytoplasma can be varied from 250 to 750 nm and also, they are known to possess a very small size genome of about 675-1550 kb. They are associated with 700 distinct plant diseases globally, mainly transmitted by insects who feed on through phloem lie leafhoppers and plant hoppers (1)for 100 of years the absence of reliable tools for identifying and characterising phytoplasmas made it impossible to determine whether the same bacteria were responsible for diseases with identical symptoms on the same or different host plants in different places.When new tools were invented then only it was possible for us to classify the phytoplasma into distinct groups and their sub groups (2). Major vegetables affected by phytoplasma belong the species of plant who belonged Cucurbitaceae, Solanaceae, Asteraceae, and Apiaceaefabacean. The difference found between them was the difference in their geographic distribution and taxonomic group numbers and subgroups of the phytoplasmas that were associated with them. Unlike the same phytoplasma affected the plant the other vegetable crops are associated with phytoplasmas that are different in genetic ways and later induced alike symptoms in the host plant. Many different reviews on different crops affected by phytoplasma lie ornamentals crops, weed crops, medicinal crops etc. (3).

Later in a single plant there was a case when two or more unlike phytoplasma caused disease that was manipulated by a stunt disease in broccoli which can be identified and associated with the presence of 16SrI, 16SrII, AND 16SrXII groups of phytoplasma (4)

Phytoplasmadetection

The prokaryotes that reside in sieve tube elements of a plant basically know as phloem of plants that infected by this bacterium. Detection of this bacteria already a challenging task but by new molecular technologies and tools it is possible to identify and characterize phytoplasma by its various properties such as its morphology, its ability to transmit, identity of sequence of its nucleic acids are presently used to characterize it.

Thesebacteria were discovered more than 60 years ago when an infected plant's sieve tubes of its root part and shoot part were taken as very thin section and observed under a microscope they were seen as bright stains with the help of fluorescence microscopy technique (5). The parts were taken from the plant of vegetables of brinjal the symptoms that were shown by brinjal plant at that time include small leaf disease. The sensitivity of detecting this disease was increased whenit was combined with serology

DNA technology

Detection of phytoplasma has become fast simple and more reliable these only by the use of nucleic acid-based assays such as polymerase chain reaction technique. A very good quality of phytoplasma is required for detecting it in pcr it also as challenging as simple. Their distribution in host plant is sometimes uneven which can cause this type of challenge. Using this technique today has increased the precision for detecting phytoplasma today (6). Due to short cycle of vegetables plant it not so applicable on vegetable plant but is an optimized technique when it come to woody plants. Some other techniques have also been discovered for the detection of phytoplasma they can be listed as digital droplet PCR (7), NGS next generation sequencing (8) and loop mediated isotheral amplification (lamp) (9). Lamp is very low cost and highly effective with increased sensitivity and very easy to handle which decrease the risk of cross contamination.

2. Diversity in genes

There is a very wide spectrum of phytoplasmas that is observed in different vegetable across the globe based on the range of host and the vector which transmit it's there are total of 16 ribosomal groups from 16SrI- 16SrVIII AND 16SrXXXI and subgroups present are more than 21 16SrI-A, -B, -C, -X; 16SrII-A, -B, -C, -D, -E; 16SrIII-B, -J, -U, -Y; 16SrVI-A, -C, -D, -J; 16SrIX-C; 16SrXII-A, -B; and 16SrXV-A).

3. Disease found in vegetable crops

Potato

In 1935 in Crimea Russia phytoplasma disease was first observed in stolbur called potato and then during 1951 – 1961 it was first reported. In potatoes so far, 5 distinct groups of phytoplasmas have been observed including groups Of 16Srna (I,II,III,VI, AND XII) were identified in Russia (10) while one group clover proliferation was discovered in Korea these phytoplasmic outbreaks in different countries contributes to a loss of around 40% to 70% (11) some potatoes were found infected but they showed no symptoms of the prokaryote the two groups that were associated with the asymptomatic potato plant were 16Sr2 and 16Sr10 and other 16Sr13 and 16Sr18 groups were found in potato purple top disease in north America (12).

Figure 1: stolbur and phytoplasma

Tomato

Some disease of phytoplasma named as big bud disease changing its name from one country to another is other disease of these parasitic pathogens are reported in many parts of Indian states like Uttar Pradesh (13), in northern Australia in countries of Europe some groups of this disease including 16SrI, 16SrIII, 16Srv, and 16SrXII were found (14)

Figure 2: Big bud disease in tomato

Brinjal

Little leaf disease in z elegans was first time reported by Thomas and KrishnaswamiUN 1939 in India when there was 100% yield loss in epidemics. Also, for this disease, five ribosomal groups were reported: 16SrI (Japan, Bangladesh, and India), 16SrII (Oman and India), 16SrVI (Turkey and India), 16SrIX (Iran) and 16SrXII (Russia and Turkey).

Chilli

In India,America and Egypt's the witch's broom and brote grande were reported in chilli plant they were found to be associated with 16SrVI phytoplasmic ggroup and 16SrII in Egypt (15).

4. Cruciferous Crops

Phytoplasmas in cruciferous crops can cause many symptoms like development of green pigmentation of normally green parts of plant takes place abnormally known as floral virescence, abnormal development of floral parts of plant into leafy structure, witches' broom and yellowing. The major groups detected in cabbage were 16SrVI and 16SrII in Iran and China respectively (16). The major constraints in brassica oleracea,cabbage, broccoli, cucurbita, Lagenaria siceraria, sponge gourd, bitter gourd, Cucumis melo, are also correlated with pathogen in Brazil where cauliflower and broccoli stunt werecorrelated with phytoplasmas of 16SrIII group. These diseases were identified by red leaf, stunted growth, constriction of phloem and malformed inflorescences.

Management

There are number of approaches which were suggested to manage phytoplasmic parasitic disease and vectors transmitting it. But not a single a single control measure has been identified up to date that is effective and strong. There isa possible way to control vectors transmitting it by the use ofpesticides which will limit the spread of phytoplasma in vegetables crops. However, to eliminate them completely is not practicaldespite using doses of chemicals in high amount. The small leaf disease in brinjal was controlled by using excessive force on symptomatic plants, and spray of insecticides (17).

Another method is the treating the infected plants by tetracycline to manage the phytoplasmic disease. But it is not a permanent solution to the problem because when those treated plants are exposed to the vectors again, they are prone to re infect moreover applying antibiotics can cost a lot of money and also it is banned by many countries as it can lead to secondary toxicity In humans.

Several biological agents are also utilised to manage the disease tomato plants that were infected with stolbur phytoplasma were treated with arbuscular mycorrhizal (AM) fungi resulted in reduction of symptoms and also degenerated some phytoplasmic cells however gibberellic acid also was proven to start recovery of damage sone by symptoms on brinjal plant and also increased the recovery rate when followed by ledermycin. Its management on a single chemical is very different from that carried out on fungi and bacteria because of its dependency on host for its survival.

Geographical distribution

The topographical conveyance and effect of phytoplasma illnesses principally relies upon the host range just as the taking care of inclination of bug vectors. One plant animal group can be tainted by a solitary or various phytoplasmas and an individual phytoplasma strain might

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contaminate various plant species demonstrating the incessant absence of host-explicitness of phytoplasmas. Moreover, discontinuous recognition of phytoplasmas in new yields or new districts shows nonstop spread of the vector which addresses a danger to new harvests and new skylines. Notwithstanding phytoplasma diagnostics, future exploration needs ought to be centeredon vector-phytoplasma communications; vector science; job of climate boundaries in sickness pestilences; improvement of safe assortments; and harvest and locale explicit incorporated infection the executives' modules. Needs for future examination ought to be founded on instruments of spread of the vector(s), confirmation of seed transmission and improvement of safe assortments to control phytoplasma-related infections.

Figure 3: Distribution of phytoplasma globally

5. Conclusion

The various symptoms have been explored that help to identify this disease in vegetable plants are listed lie small or little leaves, abnormal development of floral parts of plant into leafy structure, and also development of green pigmentation of normally green parts of plant takes place abnormally known as floral virescence, increased size of buds and witches broom disease. It is divided into at lease sixteen distinct groups of ribosomes this infection in vegetable crops have been identifies globally various times. It not only affects vegetable crops but also other crops like ornamental and medicinal crops. Controlling this phytoplasmas disease most feasibly is the result of scientist hard work of inventing and finding new ways of development and execution of combined disease management programs.

The invention of tools capable of identifying the strains of phytoplasma at molecular level help to facilitate this kind of approach.

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