

Phytoplasma's diversity in India

Smriti MALL¹, Yamini CHATURVEDI², Govind P. RAO², Virendra K. BARNWAL²

¹Department of Botany, DDU Gorakhpur University, Gorakhpur 273 009, UP, India

²Division of Plant Pathology, IARI, New Delhi-110012. India

Abstract

Phytoplasma have been associated with 45 plant species in India. Several fruits, vegetables, ornamentals, trees and other agriculturally important crop species are affected by phytoplasma diseases. Ten groups of phytoplasma have been identified in India and most of them have been reported from north – eastern parts of the country. Only few phytoplasmas have been recorded in Eastern, Western and Central India. These phytoplasmas affects sugarcane, sesame, ornamentals, oil crops, tree species, vegetables and many weed species. Aster yellows is the most prevalent group of phytoplasmas and has been associated with more than 31 diseases in India.

Key words: phytoplasma groups, diversity, India, epidemiology.

Introduction

Sandal spike was the first phytoplasma disease reported in India (Varma *et al.*, 1969). Thereafter a large number of phytoplasma diseases were described, which included brinjal little leaf disease (Varma *et al.*, 1969), grassy shoot disease of sugarcane (Chona *et al.*, 1960), rice yellow dwarf disease (Reddy and Jeyarajan, 1990), *Sesamum* phyllody (Vasudeva and Sahambi, 1955), white leaf disease of *Cynodon dactylon* (Singh *et al.*, 1978), little leaf disease of *Acanthospermum hispidum* (Raju and Muniyappa, 1981) and yellowing disease of *Urthochoa panicoides* (Muniyappa *et al.*, 1982). These reports are mainly based on bright-field and fluorescence microscopy, electron microscopic observations, tetracycline treatment and to a lesser extent on serological assays. Following the development of molecular tools, phytoplasmas have been characterized from as many as 45 plant species in India (Chaturvedi *et al.*, 2010; Rao *et al.*, 2011). Only a few of these phytoplasmas associated with more than 25 plant taxonomic families have been characterized for their taxonomic grouping. Taxonomic studies of phytoplasmas will help in understanding their diversity and spread in India. Study on phytoplasma vectors and alternate plant hosts and other modes of secondary spread in nature are also important and being attempted.

Analysis of 16S rDNA sequences of phytoplasmas indicated that ten groups exists in India affecting sugarcane, ornamentals, oil crops, tree species, vegetables and many weed species. Aster yellows phytoplasmas are the most common group of phytoplasmas in India associated with more than 31 diseases.

Materials and methods

GenBank sequences submitted for phytoplasma associated with different plant species in India were used for their comparison and phylogenetic analysis. The 16S rDNA sequences of different phytoplasmas identified were compared with each other using BLASTn pro-

gram. Sequences were aligned using BioEdit Sequence Alignment Editor. Phylogenetic tree was constructed (MEGA 4.0 software) using 100 bootstrap datasets. A comparative analysis has been discussed in the present paper and also the distribution of different identified phytoplasma groups were depicted in figure 1.

Results and discussion

Phytoplasma groups in India showed a wide geographical distribution especially in North Eastern and Southern parts of the country (figure 1). North – eastern parts has the most diverse phytoplasma groups followed by the Southern parts of India.



Figure 1. Distribution of 16S rDNA phytoplasma groups in India.

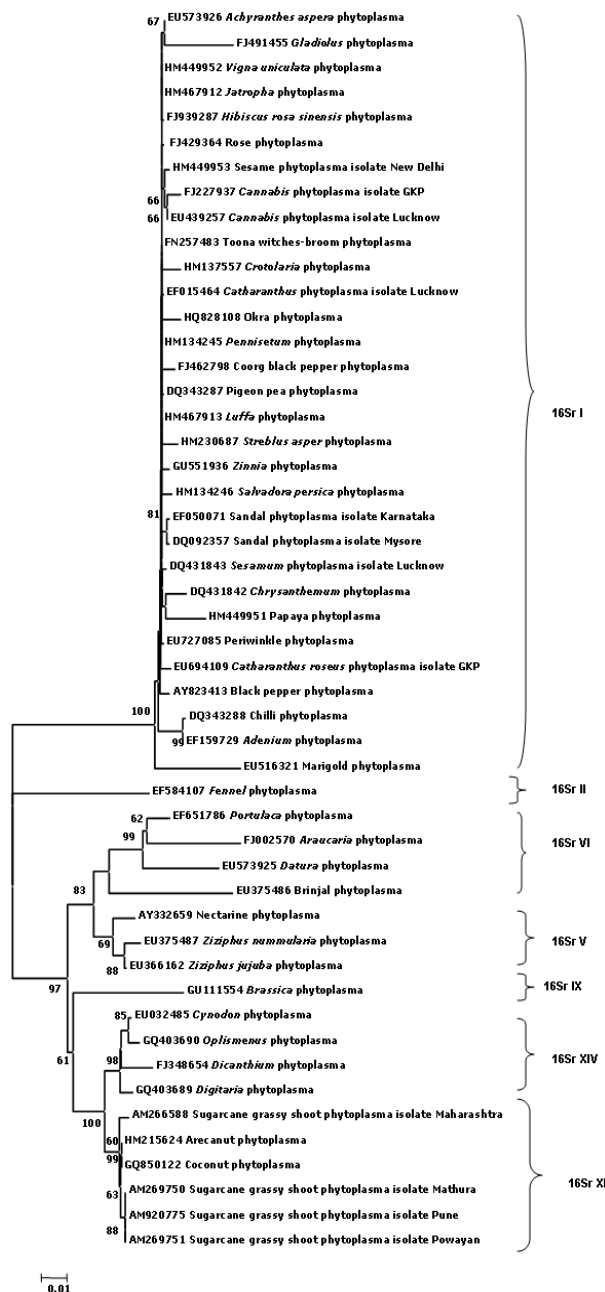


Figure 2. Phylogenetic tree constructed by using Clustal W algorithm and MEGA 4.0 version with 16S rDNA sequences retrieved from GenBank from different phytoplasmas identified in ornamental and other types of plants in India.

Sugarcane grassy shoot associated with 16SrXI phytoplasmas, sesame phyllody associated 16SrIV and coconut wilt disease associated 16SrIV and 16SrXI are the most important diseases causing serious economic losses in India (Rao *et al.*, 2005; Khan *et al.*, 2007; Manimekalai *et al.*, 2010) and need further investigation for their management.

Nucleotide sequence studies of 16S rDNA have shown that the '*Candidatus* Phytoplasma asteris', '*Ca. P. aurantifolia*', '*Ca. P. ulmi*', '*Ca. P. trifolii*', '*Ca. P.*

phoenicium', '*Ca. P. oryzae*', '*Ca. P. cynodontis*', respectively representing 16SrI, 16SrII, 16SrV, 16SrVI, 16SrIX, 16SrXI and 16SrXIV groups are the major groups associated with different plant species in India (figure 2). However, the aster yellows phytoplasma group (16SrI) is the most important which affects ornamentals, tree species, vegetables, sugarcane, fruit crops and pulses in India (figure 2).

Even though phytoplasma diseases are of common occurrence in India, only few of them have been fully characterized, particularly in North-Eastern and Southern parts of the country. Further studies of these phytoplasma diseases are prompted including their characterization, incidence, transmission and vector identification.

References

- CHATURVEDI Y., RAO G. P., TEWARI A. K., DUDUK B., BERTACCINI A., 2010.- Phytoplasma in ornamentals: detection, diversity and management.- *Acta Phytopathologica et Entomologica Hungarica*, 45: 31-69.
- CHONA B. L., CAPOOR S. P., VARMA P. M., SETH M. L., 1960.- Grassy shoot disease of sugarcane.- *Indian Phytopathology*, 13: 37-47.
- KHAN M. S., RAJ S. K., SNEHI S. K., 2007.- First report of molecular identification of '*Candidatus* Phytoplasma asteris' affecting Sesame (*Sesamum indicum*) cultivation in India.- *Journal of Plant Pathology*, 89: 291-295.
- MANIMEKALAI R., SOUMYA V. P., SATHISH K. R., SELVARAJAN R., REDDY K., THOMAS G. V., SASIKALA M., RAJEEV G., BARANWAL V. K., 2010.- Molecular detection of 16SrXI group phytoplasma associated with root (wilt) disease of coconut (*Cocos nucifera*) in India.- *Plant Disease*, 94 : 636.
- MUNIYAPPA V., RAO M. S., GOVINDU H. C., 1982.- Yellowing disease of *Urochloa panicoides*.- *Current Science*, 51: 427-428.
- RAJU B. C., MUNIYAPPA V., 1981.- Association of MLO with little leaf disease of *Acanthospermum hispidum*.- *Phytopathologische Zeitschrift*, 102: 232-237.
- RAO G. P., SINGH A., SINGH S. B., SHARMA S.R., 2005.- Phytoplasma diseases of sugarcane: characterization, diagnosis and management.- *Indian Journal of Plant Pathology*, 23: 1-21.
- RAO G. P., MALL S., RAJ S. K., SNEHI S. K., 2011.- Phytoplasma disease affecting various plant species in India.- *Acta Phytopathologica et Entomologica Hungarica*, 46: 59-99.
- REDDY A. V., JEYARAJAN R., 1990.- Chemodiagnosis of rice yellow dwarf (RYD) infected plants.- *Indian Journal of Mycology and Plant Pathology*, 20: 26-29.
- SINGH U. P., SAKAI A., SINGH A. K., 1978.- White leaf disease of *Cynodon dactylon* Pers., a mycoplasmal disease in India.- *Cellular and Molecular Life Sciences*, 34: 1447-1448.
- VARMA A., CHENULU V. V., RAYCHAUDHURI S. P., PRAKASH N., RAO P. S., 1969.- Mycoplasma-like bodies in tissues infected with sandal spike and brinjal little leaf.- *Indian Phytopathology*, 22: 289-291.
- VASUDEVA S., SAHAMI H. S., 1955.- Phyllody in sesame (*S. orientale* L.).- *Indian Phytopathology*, 8: 124-129.

Corresponding author: Govind P. RAO (e-mail: gprao_gor@rediffmail.com), Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi-110012, India.