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RESEARCH NOTE

AN OVERVIEW ON JUTE LEAF YELLOW MOSAIC DISEASE AND ITS INTEGRATED MANAGEMENT

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Jute (*Corchorus olitorius* and *C. capsularis*) is the second most important bast fibre crop next to cotton cultivated in tropical regions of the world. It is grown in South-East Asian countries like India, Bangladesh, Nepal, China Indonesia, Thailand, Myanmar and some South American countries. India is the world's largest jute producer, growing an area of 0.81 million ha, producing 1.84 million tonnes per annum (Faostat, 2009). In India jute occupies a key place in the economy of the Eastern-Indian States namely, West Bengal, Assam, Bihar, Orissa and eastern Utter Pradesh. Jute's fibre is famous for making fabrics like hessians, sacking, gunny bags, carpets, mat, rope and many other fibre-products. The young green leaves of jute contain minerals and protein, which are edible and popular as vegetables. Jute sticks are directly used as rural house building materials, fuel and for making false ceiling boards. Nearly 12-15% of the jute products are exported to about 20 countries of the world earning foreign exchange to the tune of Rs. 2000 crores per annum, and the trend is on the increase. Its production and productivity is hampered by a number of abiotic and biotic stresses. Among them jute leaf yellow mosaic has been reported to be the most important limiting factors of jute cultivation (Harender *et al.*, 1993).

Historical background/ Geographical distribution:

This disease was firstly reported by Finlow (1917). Geminiviridae is a family of plant viruses whose members cause serious damage to several crops worldwide, especially in tropical and subtropical regions (Anderson *et al*. 1995; Moriones E, 2000 and Navas-Castillo J. 2000). The leaf mosaic of jute has widespread occurrence in the major jute growing countries of the world, namely Bangladesh, Burma, India (Ghosh and Basak, 1951). In India, it is a major problem in West Bengal, Orissa, Assam, Bihar and Eastern Uttar Pradesh

Economic importance :

It is observed from different surveys that infection reduces plant height to the extent of 20% and thus adversely affects the yield of the fibre (Ghosh *et al*., 2008). Leaf mosaic infected plants have lower percentage of cellulose, lignin, and pectin, thus the fibre strength becomes weak (Biswas *et al*., 1989). Biswas *et al.* (1989) reported that the infected plants raised from infected seeds yielded 16.8 to 65.9% less fibre. The incidence of the disease has been found to be around 50% on some of the leading *C. capsularis* cultivars. The incidence of jute mosaic (syn. jute leaf mosaic, jute yellow mosaic, jute golden mosaic) was observed recently to the tune of 50% on 'JRC 7447' and 'JRC 212' (Ghosh *et al.*, 2007b).

Causal agents :

There is a lot of confusion about the exact identity of the causal agent of jute leaf mosaic or chlorosis of jute. Many workers believe that the causal agent is a virus (Ghosh and Basak, 1951, 1961, Mitra *et al*, 1984). Side by side, there are claims that the causal agent could be mycoplasma or rickettsea (Rabindran *et al*, 1988; Biswas, 1982; Biswas, *et al*; 1992). Ghosh *et al.* (2008) reported that the causal agent is a virus belonging to begomovirus genus.

Etiology of virus

Based on symptomatology and transmission, the virus was identified as a member of *Begomovirus* under family Geminiviridae. Begomoviruses have characteristic icosahedral geminate particles that encapsidate genome of circular single-stranded DNA. They infect only dicotyledonous plants and are transmitted by the whitefly *Bemisia tabaci*, Gennadius. They have monopartite or bipartite genome (Stanley *et al*. 2005). In bipartite begomoviruses, the genome is segmented into two segments (referred to as DNA A and DNA B) that are packaged into separate particles. Both segments are generally required for successful symptomatic infection in a host cell but DNA A typically has six open reading frames (ORFs): AV1/V1 (coat protein, CP) and AV2/V2 (AV2/V2 protein) on the virion- sensestrand, and AC1/C1 (replication initiation protein, Rep), AC2/C2 (transcriptional activator protein, TrAP), AC3/C3 (replication enhancer protein, REn) and AC4/C4(AC4/C4 protein) on the complementary-sense strand. DNA-B has two ORFs encodingproteins necessary for virus movement: BV1 (nuclear shuttle protein, NSP) on the virus-sense strand and BC1 (movement protein, MP) on the complementary-sense strand (Rojas *et al*. and Seal *et al*. 2006).

Virus-vector relationship :

The virus-vector relationship is of circulative but no evidence of multiplication of virus in the insect vector. The whitefly has a minimum acquisition feeding period (AFP) of 30 Minutes for successful transmission of JLYMV. This is the least amount of time it takes for the insect to acquire the virus from the plant tissue. After acquisition, a latent period, estimated to be at least 4 to 5 hr. is necessary before the whitefly becomes infective. The virus must be absorbed from the insect's digestive tract and travel to the accessory salivary glands and into the saliva before plant infection can occur. There is no evidence of virus replication in the vector. Once acquired, the virus may be retained several days (perhaps 20 days or more), but does not pass through the egg to the offspring. The minimum inoculation feeding period (IFP) required by the whitefly for successful transmission of the virus was 30 min. although the percentage of infection increased with the increase in the inoculation feeding period. It was found that 15 viruliferous whiteflies could transmit JLYMV to a range of hundred per cent transmissions. (Dastigeer *et al*. 2012).

Symptoms

Leaf mosaic is one of the most important diseases resulting in loss of yield and quality of jute fibre. The disease is characterized by symptoms such as small yellow flakes on the lamina during the initial infection stage which gradually increases in size to form green and chlorotic intermingled patches producing a yellow and light yellow patches and mosaic appearance. Leaves may be reduced in size and may be curled. The symptom bearing true leaves crinkled, leathery and sometimes, at the top of the plant, some-what needle like. The floral organs are more or less deformed. Internodes and branches become proliferated. These symptoms develop quickly and are more pronounced on younger leaves. Mosaic does not result in plant death, but if infection occurs early in the season, plants are stunted. Lower leaves are subjected to "mosaic burn" especially during periods of hot and dry weather. Severe infestation of whitefly may result in defoliation of jute and it causes reduction of yield through secretion of wax and honeydew which significantly reduces the photosynthetic area of the plant (Alam, 1998). The young seedlings up to the age of 20 days were found to be highly vulnerable to the virus.

Transmission :

The disease has been reported to be transmitted through grafts, seed and pollen (Ghosh and Basak, 1951). White fly (*Bemisia tabaci*) transmission of the disease has been reported by Verma *et al*. (1966); Ahmed (1978) and Ahmed *et al*. (1980). The jute leaf mosaic virus can spread very easily from one place to another through infected seeds and the vector, white fly causing epidemic and thus resulting enormous loss in crop production in the subsequent seasons. Thus sowing of infected seeds spread disease in the field and reduces the planting value of the seed. Dastigeer *et al*. (2012) was found that 15 whiteflies could transmit JLMV to a range of hundred percent transmissions.

Detection techniques :

Rapid and accurate detection of the causal virus is an important prerequisite to monitoring plant virus epidemics (Khan, J.A. 2000). Techniques based on polymerase chain reaction (PCR) and nucleic acid hybridization were used for the detection of these viruses (Sohrab *et al*. 2006). PCR allows the detection of very small amounts of plant viruses in their hosts and vectors (Henson and French, 1993; Khan *et al*. 1998). As PCR amplifies the viral nucleic acid, this approach is extremely useful in bypassing problems associated with serology.

Integrated Disease Management (IDM) :

As the mosaic disease deteriorates the yield and quality of jute fibre and stick, it is necessary to adopt appropriate measure to manage the disease. It is unquestionable that proper disease control measure can substantially improve the quality of jute and significantly increase yield. There is no specific resistant variety available so far against mosaic disease. Moreover, chemical control of vectors creates environmental pollution. Cultural practices such as field sanitation with rouging, hanging of polythene strips over the plot and proper dose of fertilizer application can be adopted for reducing the incidence and severity of leaf mosaic disease of jute. Now days, control of plant diseases by employing integrated disease management (IDM) program has been drawn special attention to the researcher all over the world. IDM is the use of a combined set of strategies and practices aimed to keep pests below the level of economic damage threshold. The term IDM, coined by entomologists in the mid-1960s, was developed in order to reduce the risks associated with excessive use of pesticides and to preserve the ecological balance.

Cultural Methods :

Cultural control of insect pests is affected by the manipulation of the environment in such a way as to render it unfavourable for the pest. Many of the methods interfere with the pests' ability to colonize a crop, promoting dispersal, reducing reproduction or survival.

Sanitation is one of the common control methods for JLYMV, which includes removing the infected plants and weeds from field. Rouging of young infected plants appears to reduce the amount of secondary spread within a field when incidences are low in the beginning of the season. Clean seedlings should be always used against this damaging pest. Crop rotation should also be employed to avoid infected soil/ seed beds for at least two years. Young plants are generally more susceptible to damage and so early infestations need to be avoided. Hand-removal of leaves heavily infested with the nonmobile nymphal and pupal stages may reduce populations to levels that natural enemies can contain. Water sprays (syringing) may also be useful in dislodging adults. Mishra (1986) reported that cultural control such as water management, soil pH, fertilizer use, weeding, thinning, rouging and removal of infected stubble reduced the mosaic disease incidence. The low population of white fly was observed 1.75, 1.75 and 2.00 per plant in field sanitation with rouging, nitrogen and hanging of shining polythene strips respectively (Hoque *et al*., 2003).

Biological Methods :

Biological methods have also been proposed to control whitefly infestation. Whiteflies have many natural enemies such green lacewings (*Paecilomyces fumosoroseus*), ladybirds *Clitostethus arcuatus*), bigeyed bugs, and minute pirate bugs that are much effective in controlling whitefly infestations. Releasing parasitic wasps to attack whitefly can serves as a valuable management tool.

Botanical Methods :

Application of mineral and vegetable oils has been found to inhibit virus transmission and possibly can help to avoid difficulties with insecticide resistance in whiteflies. Application of neem cake @ 250 kg/ha before sowing was found effective in controlling whitefly. Neem oil (1%), fish oil resin soap (2.5%) and neem seed kernel extract (NSKE) 5 % also gave effective control of whitefly (Veenila *et al.* 2007).

Physical Methods:

Yellow sticky traps can be used to detect and monitor whitefly activity. Around 3–5 traps should be placed in a block of 2–3 ha., level with the tops of the plants. Baskey (1983) observed that transparent and light blue plastics mulches decreased the number of mosaic infected plants by 70 and 77% respectively. Horowitz (1986) found significant drop of white fly population level at heavy rain condition. Salinas and Sumalde (1994) observed that high temperature and rainfall appeared to have a disruptive effect on the population of the white flies.

Chemical Methods :

Need based, judicious and safe application of pesticides are the most vital tripartite segments of chemical control measures under the ambit of IDM. The most effective and widely used class of insecticides to reduce whitefly populations is the neonicotinoids of which imidacloprid either as seed treatment or as foliar application early in the season have been found to significantly reduce the population of JLCV infected jute plants. Seed treatment with imidacloprid 70% WS @ 1g/kg of jute seeds and use of neem cake @ 250 kg/ha before sowing of the crop was much effective against whiteflies. Foliar application of imidacloprid @ 0.25 ml/l for one ha at early vegetative growth. Borah (1996) who reported that foliar application with cypermethrin, deltamethrin and dimethoate 30 EC at 50 DAS proved quite effective in reducing the incidence of *B. tabaci* and thus also the virus infection. Triazophos 40 EC @ 600 g a.i./ha, Ethion 50 EC@ 1000 g a.i./ ha and acetamaprid 20 SP @ 30-40 g/ha ware effective against whiteflies (Veenila *et al.,* 2007).

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