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RESEARCH PAPER

Prevalence of pigeonpea sterility mosaic disease in northern parts of Karnataka*

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Abstract: Pigeonpea is an important legume crop with high protein content and nutritional qualities. Sterility mosaic disease (SMD) caused by Pigeonpea sterility mosaic virus (PPSMV) is one of the most serious diseases that affects pigeonpea and results in a significant yield loss. Infected plants could be easily identified from a far distance as they appear green, bushy with complete or partial sterility. A roving survey was carried out to assess the incidence of the Pigeonpea Sterility Mosaic Disease in northern parts of Karnataka *viz*., Bagalkot, Belagavi, Dharwad and Vijayapur districts during *Kharif* 2021. Among the surveyed districts, severe incidence of SMD was observed in the districts, Bagalkot (25.58 %) and Vijayapur (20.38 %), whereas moderate incidence was found in other districts, Belagavi (16.32 %) and Dharwad (6.27 %). The maximum disease incidence of 28.08 per cent was noted in the Jamkhandi taluk, followed by Hunugund taluk in the Bagalkot district, with 27.74 per cent incidence. Practices like ratooning, perennially grown pigeonpea plants and growing of susceptible variety/cultivars plays crucial role in the high incidence of sterility mosaic disease.

Key words: Incidence, Pigeonpea, PPSMV, Sterility mosaic disease, Survey

Introduction

Pigeonpea (*Cajanus cajan* (L.) Millsp.) known by several vernacular names such as red gram, tur, arhar, or angola pea is an important pulse crop in India, serving as a significant protein source to the human diet. It is a perennial shrub with chromosome number 2n=2x=22, which has been grown as an annual crop in Asia, Africa, Latin America, and the Caribbean region for food, feed, fodder or fuel. Pigeonpea belongs to the family Leguminosae, characterized by the ability to ameliorate soils and it is used as a hardy crop on marginal soils with drought tolerance. India is considered as the primary center of origin of pigeonpea because of numerous wild relatives present in India and vast natural genetic variability in local germplasm (Saxena *et al*., 2002).

In India, pigeonpea is mainly grown in the states *viz*., Karnataka, Maharashtra, Madhya Pradesh, Andhra Pradesh, Gujarat, Tamil Nadu and Uttar Pradesh. In Karnataka, it is grown in an area of 1.55 million hectares with an annual production of 1.09 million tones and productivity of 708 kg/ha (Anon., 2021).

Disease outbreaks are increasing and threatening food security of the world under changing climatic scenario. Global yield losses due to crop pests and diseases on crops are large. Important diseases such as pigeonpea sterility (Sayiprathap, 2020), fusarium wilt and dry root rot in chickpea (Talekar *et al*., 2017, 2021), phyllody in chickpea (Balol *et al*.,2021; Nikhil and Gurupada, 2021) and chickpea rust (Basamma *et al*., 2021), leaf spots in groundnut, phytophthora blight and wilt in pigeonpea, necrosis disease in sunflower (Sundaresha *et al*., 2012) and bud blight caused by Groundnut bud necrosis virus (Balol and Patil, 2014) *etc.* are contributing for the yield loss in leguminous crops. Outbroken pest fall armyworm in maize (Tippannavar *et al*., 2019) also threatening food security. According to Nene *et al*. (1981), there are about fifty diseases caused by fungi, bacteria, viruses, phytoplasmas and nematodes that affect pigeonpea production in mild to severe forms. Among these, the major biotic constraints to pigeonpea production in India are Sterility mosaic disease, Fusarium wilt and Phytophthora blight. This is a major area of concern, as pigeonpea demand in India is constantly increasing.

In 1931, Mitra reported Sterility mosaic disease (SMD) for the first time from Pusa, Bihar State, India (Mitra, 1931). Then, more cases of SMD incidence were reported from different parts of the country (Reddy *et al*., 1998). The symptoms of SMD include the mosaic, mottling of leaves, bushy and pale green appearance of plants, increase in the number of secondary branches, and eventually partial or complete cessation of reproductive structures. Symptoms vary depending on the plant genotype, which might be one of three types: (i) systemic severe mosaic and sterility, (ii) mild systemic mosaic and partial sterility, (iii) localized chlorotic ring spots and no sterility (Jones *et al*., 2004). An eriophyid mite, *Aceria cajani* Channabasavanna was reported as the vector of the sterility mosaic disease of pigeonpea (Seth, 1962). The mystery behind the etiology of Sterility mosaic disease for about 70 years was revealed with the discovery of Pigeonpea sterility mosaic virus (PPSMV) in 2000 and the genome sequencing of PPSMV was completed in 2014 (Elbeaino *et al*., 2014; Patil and Kumar, 2015).

According to Singh *et al*. (2013), the incidence of SMD varied in main and ratooned pigeonpea crops distributed in the Central Zone (Maharashtra), Southern Zone (Karnataka and Tamil Nadu) and North Eastern Plain Zone (Bihar and Uttar Pradesh). Pigeonpea production in the Indian subcontinent is seriously affected by sterility mosaic disease (SMD). It was showed that a significant variation in SMD incidence ranging from 0 to 47.50 per cent among and within the states *viz.,* Andhra

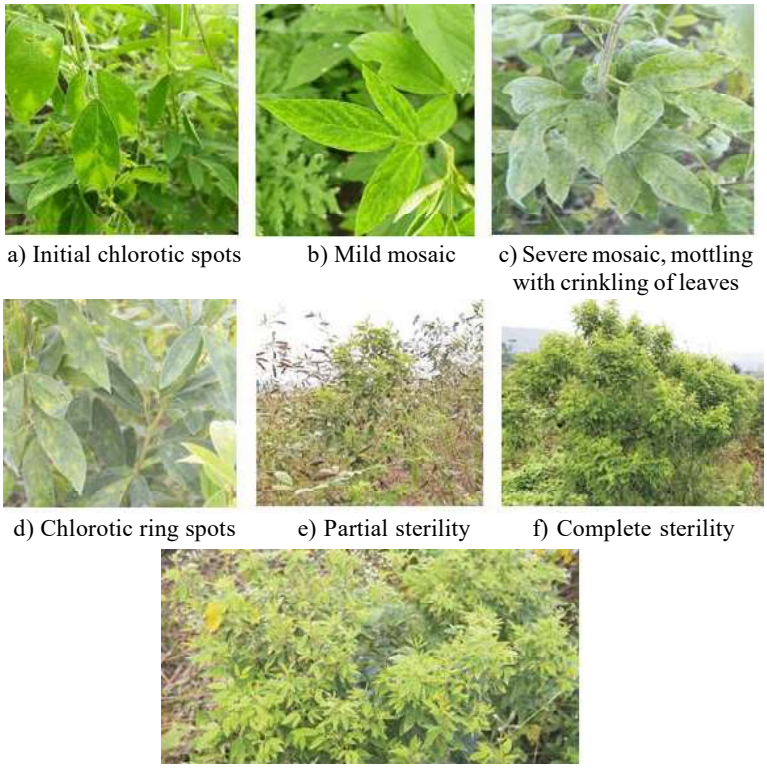
Pradesh, Karnataka, Tamil Nadu, and Telangana during the rainy season of 2017 (Sayiprathap *et al*., 2020).

Pigeonpea sterility mosaic is considered as a serious problem in major pigeonpea growing areas of northern Karnataka. Therefore, the present study was carried out to assess the prevalence of pigeonpea sterility mosaic disease in northern parts of Karnataka.

Material and methods

A roving survey was conducted during *kharif* 2021 to record the per cent disease incidence of pigeonpea sterility mosaic disease in Dharwad, Belagavi, Bagalkot and Vijayapur districts of northern Karnataka. In each district, a minimum of five fields of major pigeonpea growing areas in three taluks were surveyed for the incidence of the sterility mosaic disease. The disease incidence on pigeonpea was assessed by counting the number of plants showing characteristic mosaic, ringspot, sterility or any other characteristic disease symptoms, out of the total number of plants examined. In addition to this, other observations such as the stage of the crop, varieties grown, irrigated or rainfed, the type of insects feeding on the crop, the type of weeds in and around the plot were also recorded. Then per cent disease incidence was assessed by using the formula mentioned below, (Wheeler, 1969).

$$\text{Per cent SMD incidence} = \frac{\text{Total number of infected plants}}{\text{Total number of plants observed}} \times 100$$



a) Initial chlorotic spots b) Mild mosaic c) Severe mosaic, mottling with crinkling of leaves

d) Chlorotic ring spots e) Partial sterility f) Complete sterility

g) Bushy appearance of SMD infected pigeonpea plants with reduced internodal length and reduced leaf size

Fig.1. Different symptoms of SMD

Table 1. Incidence of pigeonpea sterility mosaic in northern parts of Karnataka during *kharif* 2021

Taluk	Incidence range	Incidence average	
Bagalkot: District			
Hunugund	9.80-38.10	27.74	
Jamakhandi	17.15-38.58	28.08	
Bilagi	8.10-32.20	21.60	
Average			25.58
Belagavi : District			
Bailhongal	5.50-28.80	19.21	
Gokak	4.20-26.40	17.69	
Saudatti	2.20-24.50	12.07	
Average			16.32
Dharwad : District			
Dharwad	2.80-14.66	9.13	
Hubballi	2.33-11.33	6.21	
Navalagund	0.60-5.30	3.47	
Average			6.27
Vijayapur : District			
Vijayapur	4.60-32.30	21.26	
Basavana Bagewadi	2.20-34.53	21.80	
Muddebihal	1.32-28.65	18.07	
Average			20.38

Results and discussion

A roving survey was conducted during *Kharif* 2021 to determine the incidence of sterility mosaic disease (SMD) of pigeonpea in the selected districts of northern Karnataka, *viz*., Bagalkot, Belagavi, Dharwad, and Vijayapur. Mild mosaic, severe mosaic, smaller leaves, excessive vegetative growth, stunted development, chlorotic ring patches, partial sterility and complete sterility were the main symptoms seen in the fields (Fig. 1).

The study revealed that the district wise disease incidence was in the range of 6.27 - 25.58 per cent. Higher incidence of SMD was observed in the districts like Bagalkot (25.58%) and Vijayapur (20.38%), whereas moderate incidence was found in other districts, Belagavi (16.32 %) and Dharwad (6.27%). Among the different taluks surveyed in these districts, the maximum disease incidence of 28.08 per cent was noted in the Jamkhandi taluk, followed by Hunugund taluk in the Bagalkot district, with 27.74 per cent incidence. In contrast, the least incidence of 3.47 per cent, was noted in the Navalagund taluk in the Dharwad district. The taluk and district wise disease incidence is presented in Table 1.

The maximum disease incidence of 38.58 per cent and 35.10 per cent was noticed in Kumbarhalla and Hunugund villages of Bagalkot district, respectively and minimum incidence of 0.6 per cent was noticed in Naganur and Belavatagi villages of Dharwad and Belagavi districts, respectively.

Among the different taluks of Belagavi district, maximum incidence of 19.21 per cent was registered in Bailhongal taluk followed by 17.69 per cent incidence in Gokak taluk and the least incidence of 12.07 per cent

was registered in Saundatti taluk. Among all villages surveyed in the Belagavi district, maximum disease incidence was recorded in the Tigadi (28.80 %) and Saundatti (24.50 %) villages. In Vijayapur district, maximum incidence of 21.80 per cent was recorded in Basavana Begewadi taluk followed by 21.26 per cent incidence in Vijayapur taluk and the least incidence of 18.07 per cent was observed in Muddebihal taluk. Among all villages surveyed in Vijayapur district, maximum incidence of 34.53 per cent in Bagewadi and 32.3 per cent in Vijayapur villages was recorded. Among the surveyed taluks of Bagalkot district, maximum incidence of 28.08 per cent was recorded in Jamkhandi taluk followed by 27.74 per cent in Hunugund taluk and the least incidence of 21.60 per cent was recorded in Bilagi taluk. In Bagalkot district, Kumbarhalla village of Jamkhandi taluk recorded maximum incidence followed Hunugund village. In Dharwad district, maximum incidence of 9.13 per cent was observed in Dharwad taluk followed by 6.21 per cent incidence in Hubballi taluk and the least incidence of 3.47 per cent was registered in Navalgund taluk.

In contrast to the findings of the survey in *Kharif* 2021, SMD incidence in the Vijayapur district was 12.33 per cent during *Kharif* 2017 as reported by Sayiprathap *et al*., 2020. This shows that there is an increasing trend of SMD incidence in Vijayapur district from 2017 to 2020. This may be attributed by increase in area of pigeonpea cultivation and growing susceptible varieties like Gulyal local in larger area. It was observed that the cropping pattern, variety/cultivars cultivated and the maintenance of pigeonpea fields are the crucial parameters which influence on the maximum incidence of sterility mosaic disease.

The main reason for high incidence of SMD could be due to extensive and continuous cultivation of susceptible varieties like TTB 7 and BRG 2 in southern Karnataka and Gulyal local, Benur local and ICP 8863 (Maruti) in northern Karnataka (Manjunatha, 2012). In the current study, it was observed that susceptible pigeonpea varieties such as ICP 8863, TS 3R, BRG 2 and local cultivars like Gulyal local are cultivated in the northern parts of Karnataka which plays a crucial role in the increase in the SMD incidence. It is in agreement with the observations made by Dharmaraj *et al*. (2004) reported that growing of susceptible variety ICP 8863 in the northern parts of Karnataka and the practice of leaving stubbles after harvesting of the crop, especially the plants under sugarcane shade irrigation channels found to be the reasons for increasing incidence of SMD. Thus, it provides primary source of inoculums and also helps in survival of mite vector.

One of the probable reasons contributing for SMD incidence in Bagalkot and Vijayapur districts may be attributed to the off-season survival of sterility mosaic virus in ratooned and perennial crop grown along the borders and bunds of different crop fields and also pigeonpea flushes of the previous season crop which was commonly observed in SMD infected fields. The present research findings are concordant with the observations made by Narayana *et al*. (2000) and Sayiprathap (2020).

Conclusion

The results of present study revealed that pigeonpea sterility mosaic disease remains as a major biotic constraint in the northern parts of Karnataka with a high disease incidence. Cultivation of SMD susceptible pigeonpea varieties such as ICP 8863, TS 3R, BRG 2 and local cultivars like Gulyal local was observed over the major pigeonpea growing areas under survey which enhances the chance of disease incidence and support the multiplication as well as dispersal of viruliferous mite vectors over different places. It signifies the requirement of use of SMD resistant cultivars/ varieties, proper management of pigeonpea fields and recommended cultivation practices to reduce the disease incidence and restrict the chance of spread of SMD.

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