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Effect of *Macrophomina phaseolina* on rhizosperic soil factors of resistant and susceptible variety of Mungbean

Paritosh Kumar and VK Gaur

Abstract
Macrophomina phaseolina (Tassi) Goid. incitant of dry root rot disease in mungbean is the most devastating disease in all the mungbean growing districts of Rajasthan. Different soil factors *viz*. soil temperature, soil moisture, pH, electrical conductivity and organic carbon were also observed at initial infested soil and rhizosphere soil of resistant MSJ-118 and susceptible RMG-62 varieties of mungbean. Soil temperature, pH and electrical conductivity decreased from initial infested soil, seedling and flowering stages of both varieties. Organic carbon increased from initial infested soil and rhizosphere soil of resistant MSJ-118 and susceptible RMG-62 varieties whereas moisture content was remains almost same at initial infested soil, seedling and flowering stages of both varieties.

Keywords: *Macrophomina phaseolina*, dry root rot, soil factors, MSJ-118, RMG-62

Introduction
Mungbean [*Vigna radiata* (L.) Wilczek] also known as green gram belongs to family Leguminosae. Mungbean believed to be originated from India, is a source of protein (25%) with high quality of lysine (4600 mg/g N) and tryptophan (60 mg/g N). Mungbean is grown in almost all parts of the country in summer and *kharif* season in Northern and Southern India. Mungbean is being infected by several fungal, bacterial and viral diseases but, dry root rot caused by *Macrophomina phaseolina* (Tassi) Goid. is considered as the most devastating disease in all the mungbean growing areas of country. The disease is quite wide spread across the Rajasthan state due to congenial weather conditions and causes considerable yield losses (Philip *et al*., 1969, Grevel, 1988) [5]. The pathogen may infect almost all parts of plants i.e. root, stem, branches, petioles, leaves and pods. Seed infection due to *Macrophomina phaseolina* ranges from 2.2 to 15.7 per cent which may cause losses in grain yield to the extent of 10.8 per cent and protein content of 12.3 per cent (Kaushik *et al*., 1987) [4]. The infected seeds act as an important source of primary inoculum for new areas. Plant stand is affected due to pre and post-emergence infection of the crop. In pre-emergence stage, the fungus causes seed rot and mortality of germinating seedlings while in post emergence stage seedlings get blightened due to soil and seed-borne infection. In later stages of crop growth decay of secondary roots and shredding of the cortex region of the tap roots are commonly observed. The fungus produces dark brown lesions on the epicotyls and hypocotyls of seedlings and seedling death follows because of obstruction of xylem vessels and wilting. In adult plants, the pathogen causes red to brown lesions on roots and stems, and produces dark mycelia and black microsclerotia. The stem shows longitudinal dark lesions and the plant becomes defoliated and wilted. The asexual structures formed by the fungus are pycnidia and microsclerotia. The black, 0.1–1 mm sized microsclerotia are formed in soil, which infect seeds or host tissues and constitute the primary inoculum source of the pathogen (Abawi and Pastor-Corrales, 1990) [1]. Microsclerotia can survive up to 15 years depending on environmental conditions, and associated with host residues (Short *et al*., 1980) [9]. Secondary dispersal by Pycnidiospores produced on infected stem and leaf tissues. *M. phaseolina* is a heat tolerant pathogen since sclerotia could withstand a temperature range of 60-65 ºC. The seed-borne nature of the disease has also been demonstrated (Sheikh and Ghaffer, 1978) [8]. Since rhizosphere is characterized by greater microbial activities, the studies will be done in rhizospheric soil factors of resistant MSJ-118 and susceptible RMG-62 varieties of mungbean at different stages of plant growth.

Materials and Methods

Soil factors which varied under the influence of growing root system of plants and inturn bring about changes in the soil microflora were analysed in initial infested soil and in rhizosphere soil of resistant MSJ-118 and susceptible RMG-62 variety of mungbean. pH and electrical conductivity were measured as described by Jackson (1973) [3] and Richards (1954) [7], respectively. Ten gram of soil was added to 25 ml of distilled water in a 50 ml beaker and stirred intermittently with glass rod for one hour. pH of soil suspension was determined by direct reading with pH metre using glass electrode, with calomel electrode as the reference. The pH meter was earliar standardized with buffer solution of given pH 7.0. The above soil suspension was utilized to determine the E.C. in dS/m, using "Direct reading conductivity meter".

To determine soil moisture the technique outlined by Piper (1950) [6] was followed. 10 gm of soil was weighed in moisture box of known weight which were left in a hot air oven at 105 ± 1 ^{0}C overnight or till a constant weight was reached. The moisture boxes were cooled in Desicator prior to each weighing. The soil moisture in per cent was calculated as:

$$\text{Soil moisture (\%)} = \frac{W_2 - W_1}{10} \times 100$$

Where,

W_1 = Weight of moisture box

W_2 = Weight of moisture box + oven dried soil

10 = Weight of soil taken in gram

Soil temperature was recorded with the help of 'Round dial soil temperature thermometer'. The metallic tube was inserted inside the soil upto the redmark and the temperature were noted in ^{0}C when the movement of the needle became stationary.

Organic carbon is determined by Walklay and Black's wet digestion method (1934). 2 gm soil was taken in 500 ml conical flask and adds 10 ml of 1N potassium dichromate solution. Flask was kept on an asbesdus sheet and 20 ml conc. Hydrogen sulphate added. Flask was kept on room temperature for 30min. After 30 min 200 ml distilled water and 10ml phosphoric acid or 0.5 gm sodium fluoride added and content was shaken. 10 drops of diphenyl amine indicator added to content and titerated with N/2 ferrous ammonium sulphate solution till colour changes from violet to blue or bright green. Organic carbon in per cent was calculated as:

$$\text{Organic carbon (\%)} = \frac{x - y}{2} \times 0.003 \times \frac{100}{s}$$

Where,

X= Blank reading in ml

Y= Sample reading in ml

S= weight of soil sample in gram

Results and Discussion

The various soil factors were analysed in initial infested soil as well as in rhizosphere soil of resistant MSJ-118 and susceptible RMG-62 varieties of mungbean at seedling and flowering stages (Table 1).

The electrical conductivity (dS/m) of soil varied considerably from initial infested soil, seedling and flowering stages of both varieties, i.e. 2.23, 2.12, 1.95 in resistant MSJ-118 and 2.23, 2.00, 1.83 in susceptible RMG-62 variety, respectively.

The pH of soil varied considerably from initial infested soil, seedling and flowering stages of both varieties, i.e. 8.2, 7.8, 7.3 in resistant MSJ-118 and 8.2, 7.4, 6.9 in susceptible RMG-62 variety, respectively.

The soil moisture depends upon supplemental irrigation given for proper plant growth and at prevailing temperatures. The moisture content (%) of soil in initial infested soil, seedling and flowering stages of both varieties remained almost same i.e 6.49, 6.32, 6.49 in resistant MSJ-118 and 6.49, 6.21, 6.23 in susceptible RMG-62 variety, respectively.

The variation in soil temperature (ºC) was observed from initial infested soil, seedling and flowering stages i.e. 40.7, 36.6, 32.8 in resistant MSJ-118 and 40.7, 38.3, 34.3 in susceptible RMG-62 variety, respectively.

Considerable variation in organic carbon (%) was also observed from initial infested soil, seedling and flowering stages i.e. 0.07, 0.38, 0.53 in resistant MSJ-118 and 0.07, 0.29, 0.48 in susceptible RMG-62 variety, respectively.

Soil factors *viz.* soil temperature, soil moisture, pH, electrical conductivity and organic carbon were also observed at initial infested soil and rhizosphere soil of resistant MSJ-118 and susceptible RMG-62 varieties of mungbean. Soil temperature had decreasing trend from initial infested soil, seedling and flowering stages of both varieties. Soil moisture content was almost constant in initial infested soil, seedling and flowering stages of both varieties due to supplemental irrigation given for proper plant growth. pH was continuously decreasing from initial infested soil, seedling and flowering stages of both varieties due to some organic acids secreated by root exudates and development of acidic condition by the reaction of water and carbon dioxide (released by decomposition of organic matter). Electrical conductivity was also decreasing from initial infested soil, seedling and flowering stages of both varieties showing that availability of total nutrient decreased in later stage of plant growth. Organic carbon increasing from initial infested soil, seedling and flowering stages of both varieties due to decomposition of dead roots and organic matter in rhizosphere soil in later stage of plant growth.

Table 1: Soil factors of initial infested soil and rhizosphere soil of resistant MSJ-118 and susceptible RMG-62 varieties of mungbean

Soil factor	Initial infested soil	Rhizosphere of resistant (MSJ-118)		Rhizosphere of susceptible (RMG-62)	
		Seedling	Flowering	Seedling	Flowering
Temperature (^{0}C)	40.7	36.6	32.8	38.3	34.3
Moisture (%)	6.49	6.32	6.39	6.21	6.23
pH	8.2	7.8	7.3	7.4	6.9
Electrical conductivity (dS/m)	2.23	2.12	1.95	2.0	1.83
Organic carbon (%)	0.07	0.38	0.53	0.29	0.48

Conclusion

Soil temperature, pH and electrical conductivity decreased from initial infested soil, seedling and flowering stages of both varieties. Organic carbon increased from initial infested soil and rhizosphere soil of resistant MSJ-118 and susceptible RMG-62 varieties whereas moisture content was remains almost same at initial infested soil, seedling and flowering stages of both varieties.

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