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Effect of soil edaphic factors on *Rhizoctonia solani* mediated diseases in major vegetable brassica growing districts of West Bengal

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ABSTRACT

Gangetic alluvial region is the most fertile part of West Bengal where majority of farmers' livelihood is commercial vegetable production. Vegetable brassica such as cabbage, cauliflower and radish occupies 18 per cent of total vegetable cultivation in West Bengal and mainly cultivated in Nadia, Mursidabad, Purulia, North 24 praganas and South 24 praganas districts.Damping off, wire stem and root rot are the major diseases caused by *Rhizoctonia solani* in these districts. Different soil edaphic factors like soil temperature, soil pH, available carbon, available nitrogen etc. play a major role in survival and spread of *Rhizoctonia solani* and hence, this study was undertaken. The survey reveals that among different soil edaphic properties; soil pH, organic C and available N (kg/ha) are the important determinants of disease conduciveness and suppressiveness. Soil pH is the most important determining factor for disease development. The disease incidence is negatively correlated with the pH.

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INTRODUCTION

India produces 14 per cent (146.55 million tonnes) of world's vegetables on 15 per cent (8.5 million hectares) of world area under vegetables. India is second in the world (production and area wise) in vegetable brassica like cabbage, cauliflower and broccoli (IIVR, 2014). These vegetables have a great significance in food basket of Indian consumers. These are good source of vitamins and health promoting phytochemicals (Cohen *et al.*, 2000 and Chu *et al.*, 2002). It has been demonstrated that a high intake of these vegetables reduces age related chronic illness such as cardio-vascular health and reduces the risk of several type of cancer (Kristal and Lampe, 2002) .West Bengal state situated in Eastern part of India is the leading vegetable growing state in India, covering an area of about 1349.7 thousand hectares(total 10% of cultivable area) with an annual production of 21907.0 thousand tonnes (including potato) having the productivity of about 19.8 t/ha (IIVR,2014).

Gangetic alluvial region is the most fertile part of

West Bengal where majority of farmers' livelihood is commercial vegetable production. Vegetables like cabbage, cauliflower and radish occupies 18 per cent of total vegetable cultivation in West Bengal (NHB, 2013).

Soil borne diseases are the major constraints for vegetable cultivation especially for brassica vegetables under stress condition in different agro-climatic regions of West Bengal. Sclerotia forming pathogens like *Rhizoctonia* and *Sclerotium* are predominant soil invaders and under favourable condition they become major biotic stress on vegetables. Damping off, wirestem and root rot are the major diseases caused by *Rhizoctonia solani* on vegetable brassica.Wire stem is a typical symptom of cabbage and early cauliflower seedlings in the nursery bed caused by *Rhizoctonia solani* in New Alluvial Agro-climatic Zone which reduced stands and lowered yield and quality. The pathogen *R. solani* also cause root rot particularly in radish.

Rhizoctonia solani survives indefinitely in the soil, passing through unfavourable conditions primarily by forming a specialised structure known as sclerotia which is small, hardand chocolate-brown. They germinate in presence of moisture by forming delicate threads, or mycelium, that spread through the soil for several inches and penetrate roots and leaves of susceptible plants with which they come in contact and thereby cause diseases. Survival of *Rhizoctonia solani* in soil is affected by soil edaphic factors like soil temperature, Soil pH, available carbon, available nitrogen etc. (Domsch and Gams, 1970). There is an urgent need to address these aspects to reduce the economic losses and keeping these points in view, the present investigation was undertaken in five different districts of West Bengal.

MATERIAL AND METHODS

An intensive roving survey was conducted in 5 major brassica vegetable growing areas of West Bengal during 2014 (Sept.-Nov.) to access the incidence of disease caused by *Rhizoctonia solani* in brassica crops mainly radish, cauliflower and cabbage. Details of places surveyed are as follows (Table A).

Five spots in each field and 100 plants at each spot were selected randomly. The total number of plants presents and number of plants showing typical symptoms due to *Rhizoctonia solani* at each spot were counted and recorded. The per cent disease incidence was calculated by using the following formula :

$$\text{Per cent disease incidence} = \frac{\text{No. of plants effected}}{\text{Total no. of plants}} \times 100$$

Soil samples were collected from these locations effected by *Rhizoctonia solani* and different soil physico-chemical properties such as soil pH, soil org. C, soil available N (kg/ha) etc. are evaluated by the standard methods (Table B) in the soil testing laboratory of

Table A : List of districts surveyed

Sr. No.	Name of the districts
1.	Nadia
2.	North 24 Paragana
3.	South 24 Paragana
4.	Mursidabad
5.	Purulia

Table B : Procedures followed to analyse different soil samples collected

Sr. No.	Parameter	Method adopted	Reference
1.	Moisture	Oven dried at 105°C for 8 hours	Jackson (1973)
2.	Soil reaction (pH)	Soil water suspension 1:2.5 ratio using pH meter (Potentiometry)	Jackson (1973)
3.	Electrical conductivity (EC)	Soil water suspension 1:2.5 ratio using EC meter. (Conductometry)	Jackson (1973)
4.	Organic carbon	Wet digestion	Walkley and Black (1934)
5.	Available nitrogen	Alkaline $KMnO_4$ oxidation method	Subbiah and Asija (1956)
6.	Available phosphorus	0.5 M $NaHCO_3$ (pH 8.5)	Olsen *et al*. (1954)
7.	Available potassium	1N NH_4OAc (pH 7.0)	Stanford and English (1949)

Berhampur and Mursidabad.

RESULTS AND DISCUSSION

Soil samples were collected from these locations affected by*Rhizoctonia solani* and soil analysis was made (Table 1) for different soil edaphic properties such as soil pH, organic carbon, electrical conductivity, available N (kg/ha). Among different soil edaphic properties soil pH, organic C and available N (kg/ha) are the important determinants of soil-borne disease conduciveness and suppressiveness (Table 1). Soil pH is the most important determining factor for disease development. The disease incidence is negatively correlated with the pH (Table 2 and Fig. 1). With the increase in pH there is a drastic reduction of disease severity of different brassica crops surveyed and vice versa. This result is at par with the findings of Ritchie *et al*. (2009) who reported that *Rhizoctonia solani* AG2-1 (Anastomosis Group2-1) and AG3 (Anastomosis Group3) isolates from potato showed mycelial growth between pH 4 and 9, with an optimum of pH 5.6. At higher pH the growth of fungus *Rhizoctonia solani* is inhibited. Another study demonstrated that at optimum pH for mycelial growth of *R. solani* AG 1-1B isolates fromlettuce ranges between pH 5 and 6 (Grosch and Kofoet, 2003). The result shows lower disease severity

Table 1 : Survey of diseases caused by *Rhizoctonia solani* in different districts of west Bengal

Sr. No.	Crop	Date of survey	Location	Disease %	pH	EC	Org C%	P_2O_5 (kg/ha)	K_2O (kg/ha)	Available N (kg/ha)
1.	Cabbage	13-08-2014	N.24. Pragana	50	6.36	0.15	0.68	110	157.304	290
2.	Radish	16-08-2014	Nadia	40	6.01	0.154	0.42	95	75.6	268
3.	Cabbage	16-08-2014	Nadia	90	6.52	0.159	0.375	65	129.472	205
4.	Cawliflower	16-08-2014	S. 24 Pragana	0	8.69	0.13	0.225	60	41.328	118
5.	Raddish	16-08-2014	S. 24 Pragana	0	8.01	0.138	0.42	78	118.776	168
6.	Radish	13-08-2014	Nadia	50	5.5	0.15	1.17	75	197.064	365
7.	Radish	13-08-2014	Nadia	60	6.18	0.197	0.18	95	88.48	184
8.	Cabbage	13-08-2014	N.24 Pragana	40	6.87	0.16	0.25	35	28.168	143
9.	Cabbage	13-08-2014	N.24 Pragana	30	6.24	0.384	0.4	48	61.04	112
10.	Radish	13-08-2014	Nadia	60	6.24	0.194	0.645	50	62.944	245
11.	Cauliflower	24-07-2014	Nadia	20	7.94	0.167	0.66	65	166.936	196
12.	Cabbage	24-07-2014	Nadia	30	6.46	0.154	0.315	60	101.92	116
13.	Cauliflower	25-08-2014	Mursidabad	0	7.27	0.165	0.885	85	97.944	332
14.	Cauliflower	25-08-2014	Mursidabad	20	7.55	0.532	0.62	22	86.18423	226
15.	Cauliflower	25-08-2014	Mursidabad	10	8.5	0.174	0.52	65	78.792	286
16.	Cauliflower	25-08-2014	Mursidabad	8	8.65	0.173	0.15	38	119.952	165
17.	Cauliflower	25-08-2014	Purulia	0	7.66	0.242	0.18	95	104.384	201
18.	Cabbage	09-09-2014	Purulia	40	6.15	0.307	0.5	40	95.928	185

Table 2 : Correlation of different soil edaphic factors and *Rhizoctonia solani* disease incidence percentage

	DI
DI	1.0000
Soil pH	-.728**
Soil EC	-.060
Soil Org.C	0.123
Soil P_2O_5 content	0.055
Soil K_2O content	0.158
Soil available N content	0.137

** indicate significance of value at P=0.01

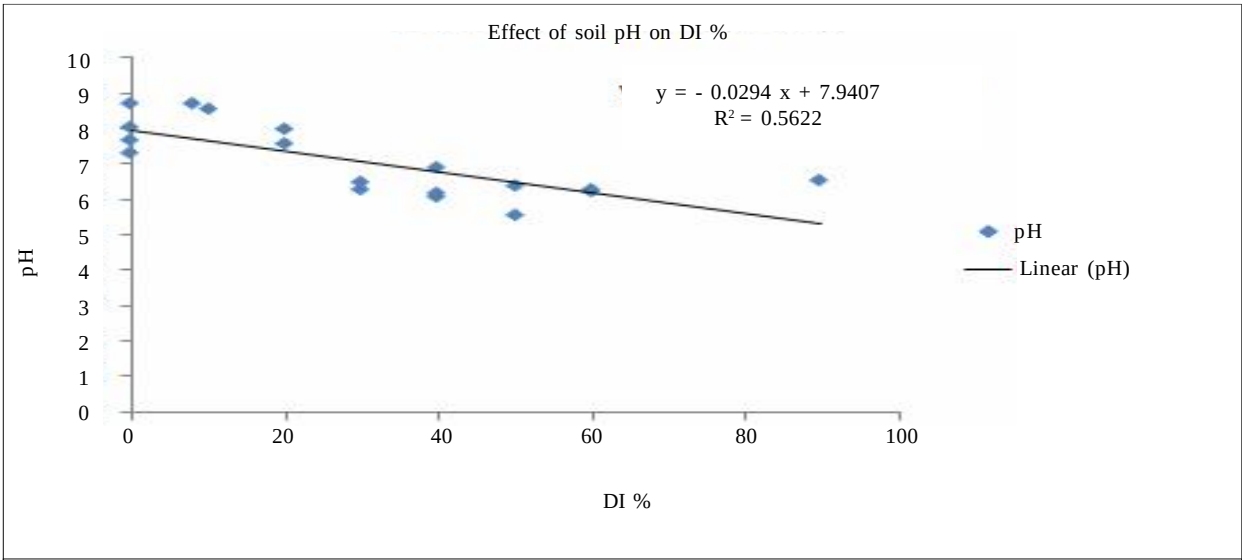

Fig. 1 : Effect of soil pH on DI per cent of *Rhizoctonia solani*

in higher soil pH. The reason may be bacterial antagonists indigenous to these soil samples may be involved in the disease suppression, since soil bacteria in general are less tolerant to low soil pH than soil fungi (Davet, 2004). Kuhn (1858) found that the occurrence of *Rhizoctonia* crown and root rot in sugar beet was significantly related to the soil C: N ratio, indicating the influence of soil organic matter on the disease occurrence.A range of soil properties (e.g., soil compaction, high clay content, inadequate soil nutrient status, and high soil organic-matter [SOM] content) have been mentioned to favour the outbreak and spread of the *Rhizoctonia* crown and root rot in sugar beet (Herr and Roberts, 1980; Kiewnick *et al*., 2001 and Führer Ithurrart *et al*., 2004).

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