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Epidemiology of *Macrophomina* Stem and Root Rot of *Brassica juncea* (L.) Czern. & Coss. in Northern India*

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Symptoms and certain aspects of epidemiology of *Macrophomina* stem and root rot of *Brassica juncea* are described. Fortnightly observations were recorded for the incidence of disease (in five different fields) as well as various climatic factors of those fields.

This study revealed that disease incidence has a significant and positive correlation with the mean maximum temperature whereas, disease intensity showed negative and highly significant correlations with relative humidity, soil moisture and soil *p*H. However, disease intensity did not show any significant correlation with the mean minimum temperature and total rainfall.

Key Words: *Macrophomina phaseolina*, Epidemiology, *Brassica juncea*, **Climatic factors, Edaphic factors**

Introduction

The polyphagus parasite *Macrophomina phaseolina* (Tassai) Goid. ≡ *M. phaseoli* (Maubl.) Ashby ≡ *Rhizoctonia bataticola* (Taub.) Butler, is one of the most destructive plant pathogens having a very wide host range (Ghaffar 1964) and cosmopolitan occurrence (Hodges 1962). A number of crucifers have recently been added to its host list by Rai et al. (1974).

During a disease survey a large number of *Brassica juncea* (L.) Czern & Coss. (*Rai, Raya* or *Laha* in North Indian dialects) fields were found to be affected by *Macrophomina* stem and root rot disease, entailing serious losses to this economically important crop in the districts of Banda,

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Barabanki, Etawa, Hardoi, Kanpur, Lucknow and Rae barelli etc. A scrutiny of the available literature revealed that except for its record (Rai et al. 1974) so far no detailed studies have been made on this serious disease. The paper discusses certain aspects relating to the epidemiology of this disease.

Materials and Methods

General observations regarding the development of disease symptoms at various stages of growing season, spread and recurrence of disease, survival of pathogen and intensity of disease in different types of soils and under varying conditions of cultural practices were recorded from various fields during the survey and collection of disease from different localities. However, to study the effect of changing climatic factors on the incidence of disease, fortnightly observations were recorded from October 1973 to March 1974 for the incidence of disease in five different *B. juncea* fields selected near Lucknow which had serious histor of the *Macrophomina* infections. The observations for the first fortnight were made between the 1st and 3rd of each month and for the second fortnight between the 16th and 18th. Diseased plants were counted from 10 different spots, randomly selected in each field and data were statistically analysed. While recording the disease incidence a composite soil sample of 3–6″ depth was also regularly collected from each field and was analysed for soil moisture and *p*H. Weather data of this period regarding the maximum and minimum temperature, relative humidity and total rainfall were obtained from the Regional Meteorological Office, Lucknow. To find out the relationship between disease incidence and various climatic and edaphic factors, correlation analysis was done using statistical methods.

Results and Discussion

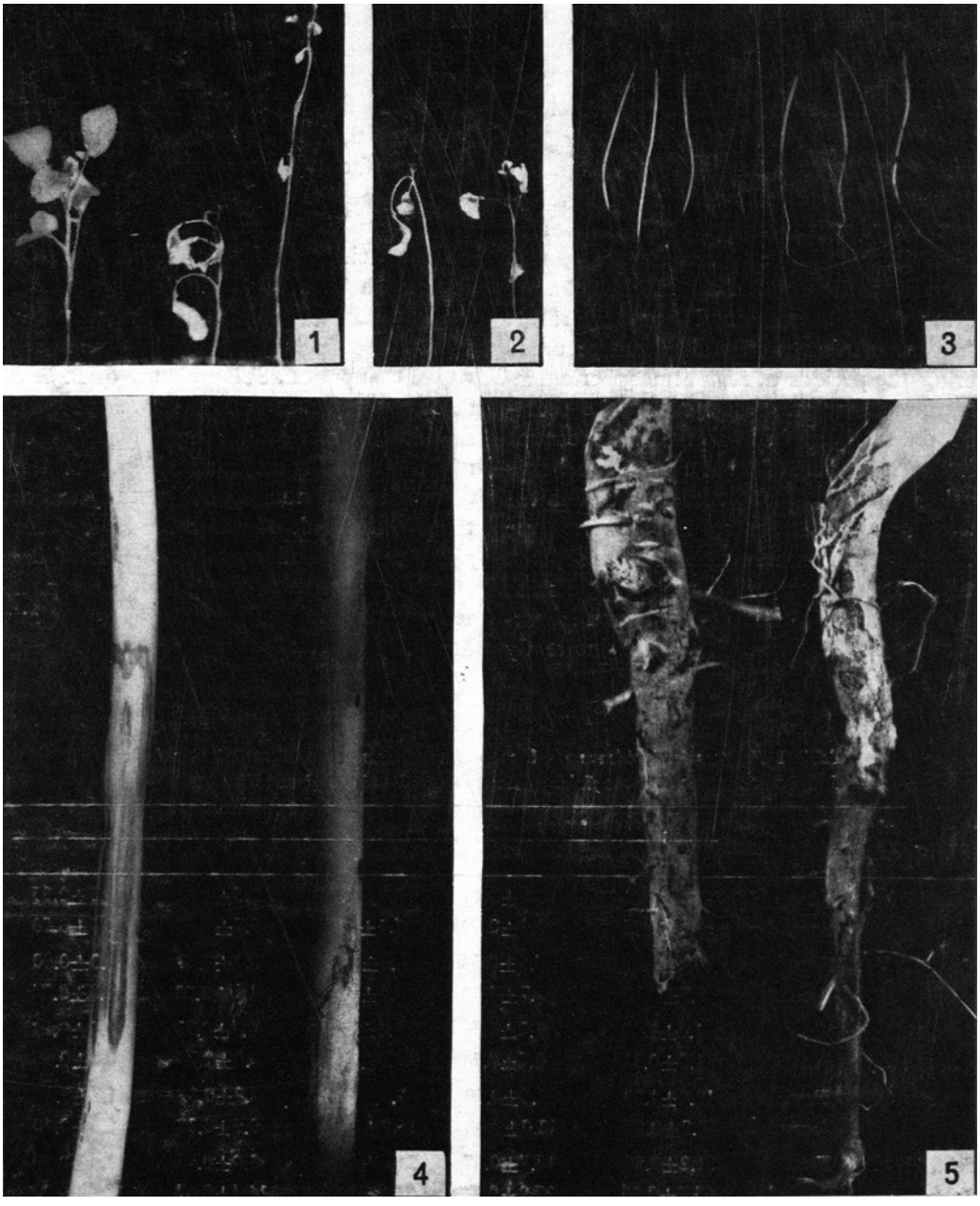
General Observations

The disease first appeared during October and early November attacking the seedlings and younger plants. However, disease incidence was too low at this stage. Seedlings showed the symptoms of damping-off, yellowing of leaves (figure 1) and brownish discolouration of hypocotyl region (figure 3). A progressive upward drying of leaves was observed in slightly older plants which led to the wilting of the plants (figure 2). During December the pathogen did not cause any visible damage, however, the disease was quite severe in late January and February at the flowering and fruiting stages of the plants. At this stage infected plants showed dark brown lesions on the roots and lower portion of stems with subsequent discolouration and rotting of these parts (figures 4 & 5).

Generally, disease was found to be relatively greater in sandy and sandy loam soils in comparison to other soils. Damage to the plants due to this infection was considerably reduced in well irrigated fields. It was observed that after the crop was harvested, the pathogen attacked several other plant species growing during that period such as *Argemone maxicana*, *Antirrhinum* sp., *Datura stramonium*, *Medicago* sp., *Melilotus alba* etc., showing its wide host range. The many sclerotia produced on host tissues during February and March appeared to be serving as an important propagule for the survival of pathogen during summers as reported in case of other diseases (Cook et al. 1973, Watanabe 1973, Meyer et al. 1974). Pycnidia produced on the exposed stem surface might be playing an important role in disease spread.

Observations of selected fields

Macrophomina phaseolina is a high-tempe-



Figures 1–5 Various symptoms of *Macrophomina* stem and root rot disease of *Brassica juncea* as observed at different stages of disease; *1*, Yellowing of leaves and damping-off at seedling stage; *2*, Wilting of slightly older plants; *3*, Brownish discolouration and rotting of hypocotyl and roots at seedling stage; *4*, Dark brown lesions and discolouration on the infected stem; *5*, Roots of infected plants showing rotting and dark coloured lesions

rature pathogen and diseases incited by it are known to be favoured by high temperature and low soil moisture (Hsi David 1962, Mathur & Sackston 1963, Edmunds 1964, Vasudeva 1960) but the last author and some other workers have reported high soil moisture as favourable for disease development (Vardarajan & Patel 1943, & Moreau 1956). Data of tables 1 and 2 indicate that generally pathogen could cause less damage during the months having lower temperature whereas, maximum mortality was recorded during the periods of high atmospheric temperature. Correlation analysis of the recorded data (given in table 3) revealed that disease incidence of all the five fields has a positive and significant correlation with the mean maximum atmospheric temperature though mean minimum temperature showed insignificant correlation with the disease severity. Relative humidity is also an important climatic factor which may be indirectly (if not directly) affecting the disease development by altering the soil moisture and temperature. Relative humidity showed a negative and highly significant correlation with the disease incidence of various fields in case of both (morning and evening) the observations. Changes in the periodical rainfall did not show significant correlation with disease incidence of that period. Although, soil *p*H showed very little changes during the growing season but has a negative and significant correlation with the disease severity of that period. Soil moisture of *B. juncea* fields under observation showed a highly significant or significant and negative correlation with the disease incidence of those fields. Thus, findings of this study indicate that in the fields of Uttar Pradesh, *Macrophomina* stem and root rot disease of *Brassica juncea* is favoured by high atmospheric temperature, low soil moisture, low relative humidity and low soil *p*H.

Table 1 *Progressive incidence of* Macrophomina *stem and root rot disease in 5 different* Brassica juncea *fields of Lucknow at fortnightly intervals*

Month and year of record	Fortnight	*Percentage disease incidence				
		Field No. 1	Field No. 2	Field No. 3	Field No. 4	Field No. 5
Oct., 1973	First	22.2±0.68**	10.8±0.41	9.9±0.38	8.5±0.41	5.5±0.35
	Second	16.1±0.48	9.0±0.40	7.1±0.38	5.7±0.48	4.0±0.50
Nov., 1973	First	10.4±0.48	7.5±0.35	6.4±0.40	2.8±0.41	2.3±0.40
	Second	8.7±0.80	5.7±0.42	4.3±0.47	1.4±0.23	1.2±0.24
Dec., 1973	First	1.6±0.40	1.3±0.30	1.4±0.23	0.7±0.23	0.0±0.00
	Second	1.8±0.33	0.7±0.21	0.8±0.24	0.0±0.00	0.0±0.00
Jan., 1974	First	18.8±1.26	6.6±0.40	7.3±0.42	2.2±0.39	1.7±0.36
	Second	40.0±0.58	12.0±0.42	16.9±0.44	9.9±0.38	6.6±0.40
Feb., 1974	First	51.2±0.56	17.7±0.47	21.4±0.48	13.0±0.47	11.6±0.40
	Second	63.7±0.36	27.9±0.64	31.6±0.56	24.7±0.47	17.6±0.40
Mar., 1974	First	70.8±0.50	38.1±0.44	43.1±0.38	31.9±0.53	23.1±0.52
	Second	73.6±0.60	46.5±0.45	50.8±0.56	42.4±0.57	30.9±0.79

*Mean of plant mortality recorded from 10 different spots randomly selected in each field
**Standard Error

Table 2 *The changes in mean atmospheric temperature (maximum and minimum), relative humidity and total rainfall from October, 1973 to March, 1974 at fortnightly intervals alongwith the soil pH and moisture of* B. juncea *fields under observation*

Month and year of record	Fortnight of the month	Atmospheric temperature (in °C) Maximum Range	Maximum Average	Minimum Range	Minimum Average	Relative humidity (in %) 8.30 hr	17.30 hr	Total rainfall (in mm)	*Soil moisture	*Soil *p*H
Oct., 1973	First	25.2–33.8	30.53	20.2–24.4	22.2	85.4	76.0	61.5	17.5	7.5
	Second	29.7–33.5	31.30	14.0–21.0	18.2	77.5	60.0	8.5	17.0	7.3
Nov., 1973	First	27.6–31.1	29.5	9.6–16.8	13.3	76.0	58.0	0.0	15.2	7.0
	Second	26.2–29.4	27.5	7.4–11.7	8.8	74.0	56.0	0.0	14.6	7.0
Dec., 1973	First	21.5–26.5	24.8	7.1–11.6	8.5	81.0	57.0	0.8	13.3	7.0
	Second	15.0–26.1	21.5	0.5– 9.6	4.8	91.0	61.0	0.0	12.8	6.8
Jan., 1974	First	22.0–26.1	23.7	1.2– 9.4	5.7	82.0	51.0	0.0	11.2	6.6
	Second	17.8–27.9	22.9	1.6–10.3	6.4	79.0	53.0	0.0	10.8	6.6
Feb., 1974	First	18.5–28.6	22.6	2.2–10.6	6.0	72.0	38.0	4.4	10.1	6.5
	Second	26.2–32.9	29.2	7.3–14.0	10.3	66.0	37.0	0.0	9.5	6.5
Mar., 1974	First	27.8–36.7	32.3	9.4–16.0	12.8	57.5	29.1	0.0	8.9	6.5
	Second	30.8–35.2	33.4	11.3–19.6	16.2	50.4	27.5	4.6	8.6	6.3

*Soil *p*H and Soil moisture given in the Table is mean of all the 5 fields under observation

Table 3 *The values of correlation* (r) *between disease incidence of five different fields and various environmental factors*

Disease incidence recorded in five different fields	Mean Maximum Temperature	Mean Minimum Temperature	Relative Humidity at 8 30 hr.	Relative Humidity at 17.30 hr	Total Rainfall	Soil Moisture	Soil *p*H
Field No. 1	0.4342**	0.1034 NS	−0.8493***	−0.8459***	−0.1247NS	−0.7604**	−0.6860*
Field No.	20.6303*	0.2887 NS	−0.9328***	−0.8332***	−0.1026NS	−0.6776*	−0.6159*
Field No. 3	0.5537*	−0.0169 NS	−0.9183**	−0.8586***	−0.1366NS	−0.7386*	−0.6711*
Field No. 4	0.6121*	0.3003 NS	−0.9109***	−0.8142**	−0.0783NS	−0.6804*	−0.6108*
Field No. 5	0.5893*	0.2709 NS	−0.9187***	−0.8367***	−0.0954NS	−0.6962*	−0.6325*

*Significant at 5%
**Significant at 1%
***Significant at 0.1%
NS Not Significant

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