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Prevalence, incidence and epidemiology of major diseases of garlic in Madhya Pradesh, India

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Abstract

Garlic (*Allium sativum*), is a vegetable spices that can be classified as either as food crop or medicinal. Survey gave a best idea of the diseases which was prevalent at the particular area. Survey has been made in Chhindawara, Seoni, Ujjain, Indore and Jabalpur at 24 villages covering 72 fields of particular districts of Madhya Pradesh and also in seed technology research field Jabalpur. Disease incidence for the all surveyed diseases viz. fusarial pink rot, sclerotial white rot, stemphylium tender tip blight, smut and purple blotch has been made during year 2015-2016 based upon 100 randomly selected plants. Stemphylium tender tip blight (3-31%) and Purple blotch upto 21% were widely prevalent where as other diseases fusarial pink rot and sclerotial white rot showed 4-18% and 3-19% respectively. Among the diseases of garlic the stemphylium tender tip blight showed highest disease incidence i.e. 3-31% while the smut of garlic showed no any disease incidence among all the surveyed districts. The disease incidence has been positively correlated with the amount of disease incidence. The survey which was made in seed technology research Jabalpur in two varieties i.e. G-50 and local, gave the link between disease development and weather parameters. During the 46th week the disease incidence was 3% in both the varieties (G-50, Local) with average temperature 22.5°C and relative humidity 89% which increases up to 6% (G-50) and 19% (Local) in the 49th week coinciding with average temperature 18.6°C and relative humidity 82%. During the period of 46th week the initiation of pink rot also started and the progressive development of pink rot observed maximum 51th week as G-50 showed 12% incidence and Local showed 17% incidence with average temperature 15.55°C and relative humidity 91%. The initiation of purple blotch started in 51th week but maximum incidence of disease observed at in the third week of January 2016 with corresponding average temperature 16.85°C (11.5°C minimum, 22.2 maximum) and 94% relative humidity (morning). In local variety the incidence rose up to 19% in the third week of January 2016. The incidence for the stemphylium tender tip blight started at 7th week of February 2016 and showed maximum disease incidence during 11th week the temperature (average 23.4°C) and relative humidity (85%) which favours the disease development, incidence of disease 20% (G-50) and 37% (Local variety) in the crop.

Keywords: Spices, disease incidence, survey, weather etc.

Introduction

Garlic an Asiatic origin crop as well as a potential medicinal value plant broadly cultivated as spice crop and medicinal value crop worldwide. As mentioned, garlic or more specifically the cloves is believed to have many medicinal properties ranging from positively affecting anything such as high blood pressure (BP) and lowering cholesterol to using it as a treatment for the common cold (Hammami *et al.*, 2012) [10] and fatal diseases as cancer (Dorant *et al.*, 1996) [8]. China comes under the largest producer, exporter (FAO, 2014), but India also have a significant position in garlic production with production 1617.34 million tonne (Srivastava *et al.*, 2012) [21]. In India Madhya Pradesh is the major garlic growing state with annual production of 424.50 million tonne (NHRDF, 2015-16)

Garlic as a crop cultivated worldwide and suffered from number of diseases as various stages of plant growth (Walker, 1952). From different parts of the world, downy mildew, rust, purple blotch; Stemphylium blight, basal rot, have been observed leading to substantial losses (Ahmad and Karimullah, 1998; Apaza and Matos, 2000; Schwartz and Mohan, 1995; Everts and Lacy, 1990) [2, 3, 17, 9]. Investigation on various aspects of Purple blotch (*Alternaria porri*) (Dhiman *et al.*, 1986; Quadri *et al.*, 1982) [7, 15]; Stemphylium blight (Thind *et al.*, 1985; Singh *et al.*, 1977) [22, 19], basal rot (*Fusarium oxysporum*) (Mathur and Sankhala, 1963) [25].

Rust (*Puccinia porri*) (Sandhu and Kang, 1988) [16]; garlic mosaic virus (Ahlawat, 1974) [1], downy mildew (Singh *et al.*, 1987) [20] are reported from India.

Materials and Methods

The investigation on the status related aspects was conducted at different districts of Madhya Pradesh viz. Chhindwara, Seoni, Ujjain, Indore, Jabalpur. Status of garlic diseases was recorded in 7 districts (Seoni, Chhindwara, Indore, Ujjain, and Jabalpur) covering, 24 villages, and 72 fields with major fungal, and clove associated garlic pathogens. Random plot survey and fixed plot survey were made in the farmer's field and Seed Technology Research experiment field respectively. In random plot survey Incidence of fungal diseases was determined using random plot survey method using zigzag movement technique in a unit field Seoni, Chhindwara, Indore and Ujjain. Random plot survey was made in 6 villages of a particular district covering 24 fields from each district. The incidence for fungal disease was recorded on the basis of typical visual symptoms. The observations on incidence of diseases were made in two phase of plant growth during (i) 15 October to 15 December 2015 and (ii) 30 December 2015 to 15 January 2016 for targeted diseases. One hundred randomly selected plants were taken as sample size for recording of incidence of diseases under field conditions. Also status of diseases was made in farmer's field after the harvesting of crop cloves were observed for associated fungal diseases. Based upon randomly selected 100 clove diseases were observed under natural field conditions during the harvest period of February to March 2016. Diseases were identified based upon typical symptoms observed in garlic clove.

During fixed plot survey incidence of fungal diseases was determined using random plot survey method using zigzag movement technique in a unit field Seoni, Chhindwara, Indore and Ujjain. Random plot survey was made in 6 villages of a particular district covering 24 fields from each district. The incidence for fungal disease was recorded on the basis of typical visual symptoms. The observations on incidence of diseases were made in two phase of plant growth during (i) 15 October to 15 December 2015 and (ii) 30 December 2015 to 15 January 2016 for targeted diseases. One hundred randomly selected plants were taken as sample size for recording of incidence of diseases under field conditions. Also status of diseases was made in farmer's field after the harvesting of crop cloves were observed for associated fungal diseases. Based upon randomly selected 100 clove diseases were observed under natural field conditions during the harvest period of February to March 2016. Diseases were identified based upon typical symptoms observed in garlic

clove.

Measurement of disease

The percent disease incidence (PDI) was calculated by formula advocated by Singh and Singh (2000).

$$PDI = \frac{\text{Number of diseased plants}}{\text{Total number of plants observed}} \times 100$$

Development of diseases under field conditions

The progressive development of basal rot, white rot, purple blotch and Stemphylium tender tip blight were determined under natural field conditions at Seed Technology Research experiment field, JNKVV Jabalpur during Rabi 2015-2016 in varieties were G 50, and Local. The development of disease was correlated with weather parameters such as temperature, relative humidity and rainfall during crop growth period with standard weeks.

Incubation chamber

The incubation chamber was used to provide optimum conditions for the isolated microorganism. Two set of Philips 40 Watt daylight tubes were provided in the chamber, horizontally at the height of 40 cm. Alternate cycles of 12 hour light and 12 hour dark periods were maintained.

Result

Survey has been made on the diseases of garlic to know the incidence at the farmer's field and STR (seed technology research) Jabalpur. In the villages of Chhindwara the disease incidence of fusarial pink rot observed was 2-14%, in Seoni villages 3-17%, Indore villages 2-14%, Ujjain villages 3-14% and in Jabalpur STR incidence was 4-18% which was highest among the all surveyed district villages. The disease incidence of sclerotial wet rot lowest at Indore villages 2-9% and highest at STR Jabalpur 3-19% and other districts Chhindwara villages' incidence was 2-14%, Seoni villages 3-15% and at Ujjain village's incidence was 2-11% were observed. The disease incidence of stemphylium tender tip blight was maximum at STR Jabalpur 3-31% and minimum at 3-18% at Ujjain, the other districts observed 4-19%, 7-20%, 3-20% Chhindwara, Seoni and Indore respectively. None of the surveyed district villages showed the disease incidence for smut of garlic as this disease was not prevalent in these district villages. The disease incidence for the purple blotch was higher at STR Jabalpur 3-21% and lowest at Indore 2-15%. The other three districts Chhindwara, Seoni and Ujjain observed 3-20%, 3-16%, 3-19% respectively (Table 1).

Table 1: Incidence of major fungal diseases of garlic at farmers' fields (Random survey) and seed technology research Jabalpur (Fixed plot survey)

Farmers field at Districts	Disease incidence%				
	Fusarial pink rot	Sclerotial white rot	Stemphylium tender tip blight	Smut	Purple blotch
Chhindwara	2-14%	2-14%	4-19%	0-0.0%	3-20%
Seoni	3-17%	3-15%	7-20%	0-0.0%	3-16%
Indore	2-14%	2-9%	3-20%	0-0.0%	2-15%
Ujjain	3-14%	2-11%	3-18%	0-0.0%	3-19%
Jabalpur	4-18%	3-19%	3-31%	0-0.0%	3-21%

The initiation of white rot disease started at November 2015 (46th standard week) when temperature ranged from 14.1°C to 30.9°C, relative humidity was 89% (Morning) and no rainfall was observed during disease development phase. In variety G-50 and Local incidence was same i.e. 3.0% during the

period of disease initiation. The maximum white rot disease incidence was observed up to 49th standard week of the month of December 2015, temperature range was 9.1°C to 28.1°C and relative humidity was 82% (Morning) with the 6%

disease incidence for the G-50 variety where as Local variety shows 19% disease incidence (Table 2).

The progressive development of pink rot disease under same set of environment for the same variety i.e. G-50 and Local with the preselected 100 plants at Seed technology research field at Jabalpur. The disease incidence in Local variety initiated at November 2015 (46th standard week) when temperature ranged from 14.1°C to 30.9°C, relative humidity was 89% (Morning) while in variety G-50, pink rot disease incidence initiated in 48th week of November with temperature ranges from 14.5°C to 30.8°C, relative humidity 92% (Morning). The maximum incidence of pink rot was 12% (G-50) and 17% (Local variety) observed when the

temperature ranges 7.0°C to 24.1°C, relative humidity 91% (morning) during the 51th week of December 2015 (Table 2).

Appearance of disease of purple blotch and spots started during the month of December 2015, 51 standard week with 3% disease incidence and 2% disease incidence for G-50 and Local variety respectively. During the 52th standard week of December temperature 7.0°C to 21.1°C with 91% (morning) relative humidity. The incidence in G-50 3% in 52th week of December rose up to 6% in the third week of January 2016 with corresponding average temperature 16.85°C (11.5°C minimum, 22.2 maximum) and 94% relative humidity (morning). In local variety the incidence rose up to 19% in the third week of January 2016 (Table 2).

Table 2: Progressive development of major diseases of garlic during Rabi 2015-16 at Jabalpur as observed under fixed plot technique
Observations recorded based on 100 pre tagged plant

Month	Standard week	Percent Incidence of White rot		Percent Incidence of pink rot		Percent Incidence of purple blotch and spots		Percent Incidence of Stemphylium tender tip blight		Temp.(°C)		R. H. (%)		Rainfall
		G50	Local	G50	Local	G50	Local	G50	Local	Maxx	Mini.	I	II	
October 2015	40	00.0	00.0	G50	Local	00.0	00.0	-	-	33.1	19.5	88	35	0.00
	41	00.0	00.0	00.0	00.0	00.0	00.0	-	-	35.1	17.9	88	31	0.00
	42	00.0	00.0	00.0	00.0	00.0	00.0	-	-	34.0	19.0	86	36	0.00
	43	00.0	00.0	00.0	00.0	00.0	00.0	-	-	33.3	18.4	87	47	40.00
	44	00.0	00.0	00.0	00.0	00.0	00.0	-	-	28.0	17.0	92	58	0.00
November 2015	45	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	31.4	17.9	88	40	0.00
	46	03.0	03.0	00.0	03.0	00.0	00.0	00.0	00.0	30.9	14.1	89	35	0.00
	47	03.0	07.0	00.0	09.0	00.0	00.0	00.0	00.0	29.0	12.7	88	36	0.00
	48	04.0	19.0	04.0	12.0	00.0	00.0	00.0	00.0	30.8	14.5	92	34	0.00
December 2015	49	06.0	19.0	05.0	13.0	00.0	02.0	00.0	00.0	28.1	9.2	82	30	0.00
	50	06.0	-	11.0	17.0	00.0	02.0	00.0	00.0	26.6	9.2	86	32	0.00
	51	-	-	12.0	17.0	03.0	02.0	00.0	00.0	24.1	7.0	91	37	0.00
	52	-	-	12.0	-	03.0	03.0	00.0	00.0	24.2	5.4	88	25	0.00
	01	-	-	-	-	03.0	07.0	00.0	00.0	27.5	7.9	81	27	0.00
January 2016	02	-	-	-	-	05.0	07.0	00.0	00.0	26.7	8.0	92	32	12.20
	03	-	-	-	-	06.0	19.0	00.0	00.0	22.2	11.5	94	65	0.00
	04	-	-	-	-	06.0	-	00.0	00.0	23.3	4.2	92	29	0.00
	05	-	-	-	-	-	-	00.0	00.0	27.7	9.1	84	35	0.00
February 2016	06	-	-	-	-	-	-	00.0	03.0	26.4	8.4	88	34	0.00
	07	-	-	-	-	-	-	03.0	09.0	28.5	11.3	92	40	0.00
	08	-	-	-	-	-	-	13.0	10.0	30.2	11.8	90	32	0.00
	09	-	-	-	-	-	-	20.0	25.0	30.5	13.4	85	34	0.00
March 2016	10	-	-	-	-	-	-	20.0	29.0	31.9	17.0	88	47	0.00
	11	-	-	-	-	-	-	20.0	37.0	30.9	15.9	85	37	0.00

Observations recorded based on 100 pre tagged plant

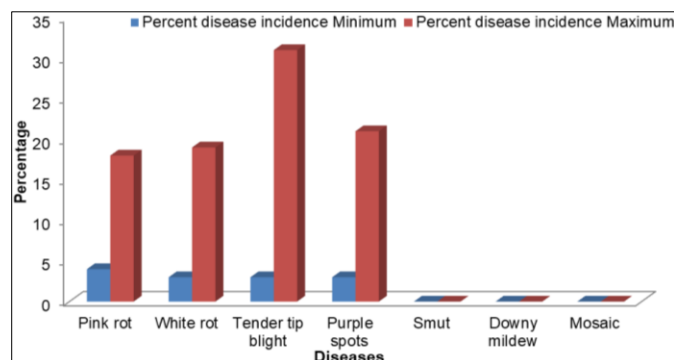


Fig 1: The percent disease incidence minimum

The development of the disease stemphylium tender tip blight initially was slow as disease incidence 3% (G-50) and 9% (Local variety) in seventh week of February 2016 with 19.9°C average temperature and 92% relative humidity (morning) and reached maximum on 11th week March 2016. In 11th week the temperature (average 23.4°C) and relative humidity

(85%) favours the disease development show maximum incidence of disease 20% (G-50) and 37% (Local variety) in the crop (Table 2).

Discussion

The crop has shown susceptibility due to a number of diseases at field and storage conditions during survey. Status and prevalence of targeted five diseases was made in five districts at 24 villages covering 72 fields during 2015-16. Based upon 100 randomly selected plants in a unit field, four major diseases were recorded in variable proportion. These included pink rot caused by *Fusarium oxysporum*; white rot by *Sclerotium cepivorum*; tender tip blight by *Stemphylium vesicarium* and purple blotch by *Alternaria porri*. Garlic smut was not recorded during random field survey taken in December 2015 to January 2016 period at Chhindawara, Seoni, Ujjain, Indore and Jabalpur. Purple blotch upto 20% and tender tip blight 19% diseases were widely prevalent.

The role of environmental conditions cannot be denied in case of creation of epiphytotic situations in plant diseases.

Each parameter of environmental factor plays its role in reducing or enhancing of pathogenic activity. Different environment variables (max. temperature, min. temperature and avg. temperature) significantly influenced the disease incident. Under fixed plot technique incremental development of pink rot, white rot, purple blotch and *Stemphylium* tender tip blight was studied at weekly interval. Factors such as weather air temperature 18.5°C, relative humidity 82% and precipitation 1670mm favoured the disease development of white rot were discussed (Sharma, 1985; Crowe and Hall, 1980) [18, 6]. A brief account on disease development of pink rot was conducted by Tsutsui (1991) [23]; Walker and Tims, 1924; Kehr *et al.*, 1962; Kodama, 1983) [24, 11, 12]. Drier season heavy dew favours the purple blotch (*Alternaria porri*) (Miller, 1995; Bisht and Agrawal, 1993) [13, 4]. The stemphylium blight incidence observed with temperature (average 23.4°C) and relative humidity (85%) favours the disease development show maximum incidence of disease 20% (G-50) and 37% (Local variety) in the crop. Such condition for disease development also observed by Bock (1964) [5]. Under conditions of Jabalpur, garlic disease succession studies indicate that pink rot was noticed first, later white rot disease followed by purple blotch and later *Stemphylium* tender tip blight. During the jump period of the disease, meteorological data were also studied.

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