Influence of weather factors and management of Septoria leaf spot of tomato in sub-tropics

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ABSTRACT: Studies conducted on the effect of weather factors on seasonal occurrence of *Septoria lycopersici* indicate that relative humidity coupled with rainy days/percentage of total rainfall elicit maximum disease build up. Only two varieties (S-12 and SH-12) out of 41 cultivars screened for disease resistance against Septoria leaf spot, showed resistance at each test locations (R.S. Pura and Paunichak). Spraying the tomato crop with Dithane Z-78 or Dithane M-45 at 0.2% each, proved highly efficacious in restricting the disease spread under field conditions and thereby stabilizing the yield returns.

Key words: *Septoria lycopersici, Lycopersicon esculentum,* screening, management

Tomato (*Lycopersicon esculentum* Mill.) is a nutrient rich vegetable grown extensively throughout the country. In Jammu sub-tropics it is ranked as a highly prized commodity in the vegetable market during both *rabi* and *kharif* seasons. Indiscriminate introduction of newly released high yielding cultivars has replaced the conventional varieties but not without giving an alarming entry to a number of diseases on tomato crop. Among the fungal diseases Septoria leaf spot is the major problem causing defoliation in tomato plants, reducing the photosynthetic area and ultimately the yield of the plant. Recently, Raina and Razdan (2006) reported sequential development of the disease. Keeping in view the importance of the disease and economic value of the crop the present studies were undertaken.

MATERIALS AND METHODS

Effect of weather parameters on seasonal occurrence of the disease

To find out the effect of weather factors viz., temperature, relative humidity and rainfall, on the seasonal occurrence of Septoria leaf spot, the per cent disease intensity was recorded periodically in tomato field at R. S. Pura on the most susceptible variety Pusa Ruby from 15th of April till crop harvest (14th July). The disease intensity was scored after McKinney's scale as applied by Horsfall and Heuberger (1942) with slight modification as follows : 0 = infection free or nearly so,1- trace to 20% of the leaf area killed, 2 = 21-40% leaf area killed, 3 = 41-60% leaf area killed and 4 = more than 60% of the leaf area killed. Twenty plants were randomly selected, marked and assessed for disease intensity by randomly taking 100 leaves from the selected plants. Simultaneously the weather data was also recorded.

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Chemical management

Eight commercially available chemical formulations viz., Dithane M-45 (mancozeb), Dithane Z-78 (zineb), Foltaf 80 WP (captafol), Captan 50WP (captan), Hexathane 75 WP (thiram), Cuman L 27 W/W (ziram) and Blue Copper 50 WP (copper oxychloride) were field evaluated for their relative efficacy to combat the disease with a check where only water was sprayed. Six week old tomato seedlings of Pusa Ruby were transplanted in a plot size of 1.8 x 2.7 m in first week of March under RBD with four replications. Six sprays were given at 15 day intervals, starting from 10th April and the last spray was given on 25th June. The sprays were conducted with knap-sac sprayer and the average volume of spray solution per treatment per spray used was 1.86 L/ plot. Disease intensity on leaves was scored 10 days after the last spray on 6th July. Per cent disease intensity and control were calculated as following formula:

Per cent disease intensity (PDI) = Σ nv/4N x 100, where, Σ is the sum of the products of 'n' leaves with rating 'v', 'N' being the total no. of leaves and 4 is the maximum rating.

Per cent disease control (PDC) = PDI in control plots – PDI in treated plots / PDI in control plots x 100

Varietal screening

Seeds of 41 tomato cultivars were collected from various sources and sown at two locations, Paunichak and R. S. Pura in the 3rd week of Feb. The plants were grown on ridges 90 cm apart with plant to plant distance as 45 cm. The test varieties were scored for their reaction to the disease 10 days before the harvest of the crop on 9th July by taking fifty leaves from 10 randomly selected plants in each variety. The per cent disease intensity on a particular variety was considered to rank the test entries as adopted by Sohi and Sokhi (1969a) with some modification (Resistant (R) = 1 to 10%; Moderately resistant (MR) = 11 to 20%; Moderately susceptible (MS) = 21 to 40%; and Susceptible (S) = 41 and above).

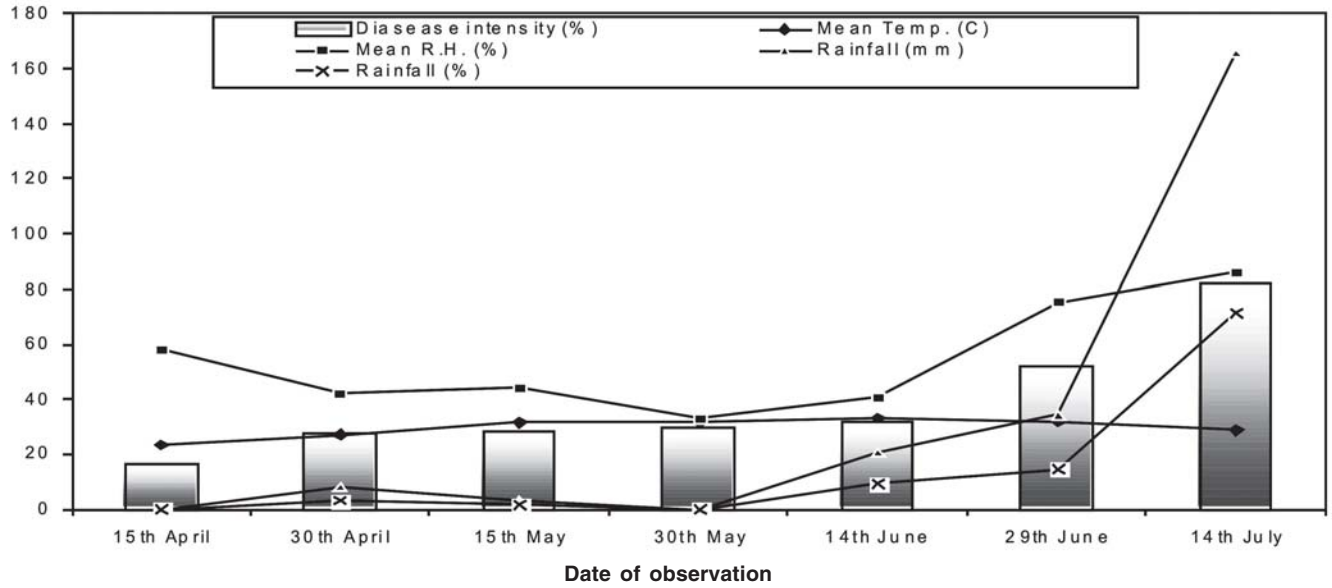

Fig. 1. Effect of temperature, relative humidity and rainfall on the intensity of Septoria leaf spot (*Septoria lycopersici*) on tomato. Regression coefficient: Disease intensity (%) x Mean temperature (^{0}C) = 0.2423, Disease intensity (%) x Mean relative humidity (%) = 0.8016, Disease intensity (%) x Rainfall (mm) = 0.9445, Disease intensity (%) x Percentage of total rainfall = 0.9445

RESULTS AND DISCUSSION

The disease severity on tomato leaves in relation to temperature, relative humidity and rain fall recorded on fortnightly basis (Fig. 1) reveal that rainfall and relative humidity were significantly and positively correlated with the disease development, whereas, temperature had insignificant effect on the disease.

The dry phase marked by lowest rainfall (4.82%), moderate to high mean temperature (23.43-31.75 °C) and moderate relative humidity (44.25%) during first half of early planting (April-May) restricted the disease intensity to the maximum of 30%. During the following fortnight (14th June) all weather components remained almost unchanged, except rainfall which was restricted for a few days for later half of the fortnight. The disease intensity increased marginally (31.40%).

During the penultimate fortnight (29th June) relative humidity (75%) and rainfall (14.79%) increased significantly and the rainy/cloudy days were well spaced but the temperature showed a stationary trend around 32.11°C. The foregoing account support the fact that well spaced rainy days, high relative humidity apart from aged leaf tissue lead to high disease build up.

The maturity phase of the crop in July received the highest rain fall (71.35%) in well spaced rainy days and uniformly spread over time, relative humidity was all time high (86%) and mean temperature declined to 29°C. The disease build up was highest (82%) synchronizing with the increased leaf density and larger proportion of aged leaf tissues. From the fore ground account it is inferred that mean temperature not exceeding 29°C, relative humidity around 86% and a couple of good and well spaced rainy days spreading over time during the maturity phase of crop in July elicit maximum disease build up. These observations derive support from Chupp and Sherf (1960), who reported that 2-3 muggy days or rainy days in succession made the requirement for fungal penetration admirably and were even better than dashing rains which wash of the spores. The relative humidity and temperature requirement for disease development in the preset case are similar to those reported by Rizinski (1965) who reported that high relative humidity and temperature optima of 20-27°C coincide for disease development. Recently Kumar and Sugha (2003) also reported temperature optima of 28-30°C with high relative humidity for spore germination of *Septoria lycopersici.* Gautam (1976) also supported the above observations while working on Septoria leaf spot of hops (*Humulus lupulus*). However, Coulombe (1979) reported high relative humidity (70-84%) but lower temperature range (19-20°C) in late June – July conducive for disease development in Canada, which are in contrary to the finding of Sohi and Sokhi (1969 a) who did not find any correlation of diseased development to rainfall and humidity but only to the temperature optima of 25°C favourable for disease development under Himachal Pardesh conditions.

Chemical management

The data on relative efficacy of 8 chemical formulations to manage Septoria leaf spot reveal that all the chemicals reduced the disease apart from increasing the yield of tomato significantly (Table 1). Dithane Z-78, Dithane M-45, Foltaf, Captan, Blitox and Hexathir were significantly superior to Blue copper and Cuman L. Dithane Z-78, Dithane M-45 and Foltaf were at par with each other limiting disease intensity, respectively, to 20.0, 20.5 and 25.0% and yield 296, 294 and 267 q/ha in the same order. Better control of disease with Dihane Z-78 (Sharma *et al.* 1966; Sohi and Sokhi, 1970; Ragimov, 1974; Christenzio, 1957) and with mancozeb (Bates, 1961; Alexandri and Iosifescu, 1973; Rajgopalan and Vidhyasekaran, 1983) is supportive to the

Table 1. Effect of different fungicides on the intensity of Septoria leaf spot (*Septoria lycopersici*) on tomato, cultivar Pusa Ruby

Fungicide	Concn. (%)	Disease intensity (%)	Disease control (%)	Average yield (kg/plot)	Calculatedyield (q/ha)	Additional yield over control (q/ha)
Dithane M-45	0.2	20.50	74.84	14.30	294	181
Dithane Z-78	0.2	20.00	75.46	14.39	296	183
Foltaf	0.2	25.00	69.32	13.00	267	154
Captan	0.2	28.75	64.72	13.50	278	165
Blitox	0.3	33.75	58.58	11.60	239	126
Hexathir	0.2	38.75	52.45	11.00	226	113
Cuman L	0.2	57.50	29.44	9.00	185	72
Blue copper	0.3	52.50	35.58	8.10	167	54
Check	(Water spray)	81.50	0.00	5.50	113	0
CD (0.5 %)		6.12		1.35		

Result based on two year pooled data.
Sprays were conducted at 15 days interval starting from 10 week old plants.

Table 2. Reaction of different tomato germplasm to Septoria leaf spot under natural conditions

Germplasm	Reaction	
	R. S. Pura	Paunichak
DM-30	MS	S
Drusuba	MS	MS
EC-1	S	S
EC-10	MS	MS
EC-6747	S	S
EC-13042	S	S
EC-39409	MS	MS
EC-94481	MR	MR
EC-102193	MR	MR
EC-114496	MR	MR
EC-122966	MS	MS
EC-122969	S	S
EC-122974	S	S
EC-127211	MS	MS
EC-128767	S	S
EC-128965	MS	MS
EC-129571	S	S
EC-130038	S	S
EC-130054	MS	MS
EC-130163	MR	MR
EC168693	MS	MS
EC-168702	S	S
H-165	MR	MR
H-245	MR	MR
H-451	S	MS
Hissar Lalit	MS	MS
HS-101	MS	MS
HS-102	MS	MS
HS-1010	MR	MR
KS-1	MS	MS
KT-1	MR	MR
New Yorker	MR	MR
Ogosta	S	S
OX-heart	MS	MS
Pusa early Dwarf	MS	S
Pusa Sheetal	MR	MR
S-1	S	S
S-12	R	R
Selection-7 (Arun)	MS	S
SH-12	R	R
VL-11-1	MS	MS

present findings. Closely followed were Captan, Blitox and Hexathir, restricting disease intensity to 28.75, 33.75 and 38.75%, respectively, compared to least effective Blue copper and Cuman L which exhibited disease intensity of 52.5 and 57.5% and also the lowest yield of 167 and 185 q/ha, respectively, as against 113 q/ha in control.

Varietal screening

Reaction of different tomato cultivars/lines to Septoria leaf spot (Table 2), under natural conditions reveal that 11 varieties were susceptible, 14 were moderately susceptible and 10 moderately resistant at both the test location of Paunichak and R.S. Pura. Only two varieties, SH-12 and S-2 were found to be resistant at both the places. The disease pressure as monitored on susceptible check, Pusa Ruby was sufficiently high at both the locations reducing the possibility of disease escape during the screening period. The performance of S-12 with resistance of promise has also been reported by Chauhan (1987). Pandey and Pandey (2002) reported tomato germplasm line LE-415 resistant against *Septoria, Alternaria* and bacterial disease complex at seedling stage. Contrarily 4 lines viz. H-451, Selaction-7 (Arun), Pusa early dwarf and DM-3 depicted differential reaction at two locations showing reaction of less promise ranging between moderately susceptible to susceptible. Remaining 25 lines showed reaction oscillating between the same rankings at the two locations. Susceptibility of different tomato germplasm to *Septoria lycopersici* under field conditions has also been reported (Rizinski, 1965; Dunenko and Belikova, 1977; Marcinkowaska, 1977), whereas, Sohi and Sokhi (1969 b) and Farber (1981) reported good number of tomato cultivator resistant to Septoria leaf spot.

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