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Frogeye Leaf Spot of Bell Pepper in Kashmir : Prevalence and Cause

Bell pepper is an important summer vegetable crop and is grown over an area of 327 hectares with an annual production of 2387 tones (Anonymous, 2005). The crop has medicinal properties and its 1g edible portion contains 1 1mg calcium, 1.2 g protein, 870 IU vitamin A, 0.06 mg vitamin B1, 0.03mg vitamin B2, 0.55mg vitamin B3 , 175 mg vitamin C and 29 calories energy (Joshi and Singh, 1975). Bell pepper is a high valued crop and so important are the stresses which counter to its production. Among many other biotic stresses, Frogeye leaf spot is a reported limiting factor in Bell pepper production (Meon, 1990). The disease appears as necrotic spots on leaves and other above ground plant parts. The manifestation was observed in alarming proportions during last few years causing lavish crop losses and thus affecting the Bell pepper growers and others in the trade. The cause of frogeye leaf spot of capsicum has been related to many species of *Cercospora* and even to other genera of Kingdom Fungi in different parts of the world. The importance of the disease as reflected by socio-economic importance of the crop necessitated exploring this aspect of this manifestation.

A brief survey for prevalence of the disease was conducted in seven Bell pepper growing locations of Kashmir viz. Bugham, Gangbugh, Kanihama, Dal-area, Noorbagh, Shalimar and Shalteng at fruit set (July 25 to Aug. 05) and fruits (Sep. 10 to Sep. 20) during 2003. Each time three fields with three selection sites per field were selected randomly to represent a location. At each selection site, 25 plants were randomly selected and from each plant a random sample of 10 leaves were drawn. The leaves were collected in paper bags and observations about incidence and intensity of frog eye leaf spot were recorded using the following formulae.

$$\text{Percent disease incidence} = \frac{\text{No. of diseased leaves}}{\text{Total No. of leaves observed}} \times 100$$

$$\text{Percent disease intensity} = \frac{(nv)}{NG} \times 100$$

Where, n = Number of leaves in each category, v = Numerical value of category, N = Total number of leaves examined and G = Maximum rating of scale.

For calculating disease intensity, the leaves were categorized according to McKinney's (1923) 0-5 rating scale after a little moderation considering 0= disease free, 1 = traces to 10% infection, 2 = 10.1 to 25% infection, 3 = 25.1 to 40% infection, 4 = 40.1 to 50% infection and 5 $\geq$ 50.1% infection.

The pathogenicity of causal fungus was established by confirming Koch's postulates on 60 days old Bell pepper plants (cv. California wonder). The morphology on host as well as in culture media, and pathology of causal fungus vis-a-vis symptomology were recorded and compared with the authentic literature for identification of the fungus.

Perusal of data (Table 1) indicates that the disease, though in varying proportions, prevailed in all Bell pepper growing areas surveyed during 2003. The overall incidence and intensity of the disease at fruit set stage ranged from 20.06 to 37.20 per cent (mean 29.30%) and 7.46 to 18.33 per cent (mean 13.49%), respectively. During fruit harvest stage, the incidence and intensity ranged from 54.63 to 68.92 and 32.46 to 44.03 per cent, respectively. Sharma (1998) recorded maximum of 49 per cent severity of frogeye leaf spot of Bell pepper in Himachal Pradesh, India. Analysis of data revealed that disease incidence was significantly higher (68.92%) at Noorbagh. At this stage, Disease intensity was also recorded maximum at Noorbagh (44.03%) which, however, was at par with Bugham (43.63%) and Shalteng (43.73%). Moderate disease was recorded at Gangbugh, Dal area and Shalimar exhibiting 38.20, 36.00 and 35.33 per cent intensity, respectively. Minimum disease incidence (54.63%) and intensity (32.40%), however, was recorded at Kanihama. Variation in the disease incidence as well as intensity at different locations confirms the possible effect of environment and cropping pattern. The higher disease incidence and intensity at Noorbagh is attributed to the closer spacing, application of higher doses of Nitrogen and monoculture like practices as such practices facilitate the build up of primary inoculum and subsequent disease development (Kovachevsky, 1938). Kapoor (1988) too stated that monoculture aggravates the fungal diseases . Contrararily , the lower disease incidence and intensity recorded at Shalimar and Kanihama locations were possibly due to proper field sanitary measures adopted by farmers but the closer spacing and monoculture practices, however, seem to have favored the disease development. The increased development of *Cercospora* with increase in planting density of celery and Urdbean was reported by Berger (1975) and Sud and Singh (1984), respectively. Bechman and Payne (1982) found relative humidity, provided by the canopy of mature corn plants, important in the development of *Cercospora zea - maydis.*

The typical disease symptoms were observed on leaves, stem and peduncles. On leaves the spots appeared as necrotic, circular to sub-circular with grayish white centre, surrounded by brown to grayish brown area and marginated by a definite darker zone. The spots enlarged up to a mean diameter of 9.8 mm, coalesced frequently and lead to defoliation with or without yellowing. The spots become raised and resembled frog eye. The lesions on stem, peduncle and petioles, however, were longer rather than round. Present obervations on symptomology are almost similar to those reported by Walker (1952) and Meon (1990). Heald and Wolf (1911), Chup (1953) and Vasudeva (1963) have given similar account of symptoms but there is no mention of stem, petiole and peduncle infection. Although, Basak (1994) described *Cercospora* among fruit rotting fungi, no such symptoms were recorded. The symptoms as recorded on peduncle are in addition to the symptoms reported earlier by various workers elsewhere.

Table 1. Prevalence of frogeye leaf spot of bell pepper (*Capsicum annum* var. grossum) in various locations of Kashmir (Karif, 2003)

Location	Disease Incidence (%)		Disease intensity (%)	
	Fruit set	Pre harvest	Fruit set	Pre harvest
Bugham	32.83 (34.93)	64.03 (53.13)	14.93 (22.69)	43.63 (41.31)
Gangbugh	35.66 (36.64)	60.20 (50.86)	16.87 (24.21)	38.20 (38.15)
Kanihama	23.72 (29.130	54.63 (47.63)	10.96 (19.31)	32.46 (34.70)
Dal-area	25.60 (30.37)	59.50 (50.26)	12.40 (20.60)	36.00 (36.85)
Noorbagh	37.20 (37.56)	68.92 (56.10)	18.33 (25.29)	44.03 (41.55)
Shalimar	20.06 (26.59)	56.91 (48.95)	7.46 (15.75)	35.23 (36.39)
Shalteng	30.06 (33.23)	62.63 (52.29)	13.50 (21.51)	41.73 (40.22)
S.Em±	0.94	0.55	1.45	1.13
C. D at 5%	2.05	1.20	3.17	2.47

Figures in parenthesis represent arc sine transformed values.

The mycelium was irregularly branched, septate, light brown, 3.9 to 4.8 µm in diameter. Conidiophores were light brown, un-branched, continuous, 1 to 5 septate, straight to sub-straight and borne on stromata in facscicles of 7 to 13 . Conidia were acicular, continuous, 1 to 13 septate, hyaline and borne solitary on conidiophores. Conspicuous scar on conidiophore apex as well as thickened hilum of conidia were also observed. These gross morphological characters slightly differed from the descriptions presented by Heald and Wolf (1911) for *Cercospora capsici* . Saccardo (1931) has also reported more or less similar types of morphological characters of the fungus but the additional characteristics like presence of brown stromata of 15 to 30 µm diameter and hyaline conidia reported by Chup (1954) and Vasudeva (1963), however, collectively corroborate our identification of hte present isolate as *Cercospora capsici* Heald and Wolf. The recorded conidiophore and conidial measurements of present isolate vary from those reported by other workers elsewhere. The conidia and conidiophore of our collection measured 3.5 - 5.2 x 25-86 µm and 3.5 - 5.5 x 30-75 µm respectively. The review of literature, however, showed respective dimensions of condidia and conidiophore as 4-5 x 70 -25µm 4.5 x 30-60µm (Heald and Wolf, 1911), 2.5-4x30-200µm and 3.5 - 5 x 20- 150 µm (Chup, 1954) and 3.3-4.4 x 35.2-51.7 µm and 4-5 x 30-65 µm (Vasudeva, 1963).

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