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REACTION OF GREENGRAM (*VIGNA RADIATA*) TO *CERCOSPORA CANESCENS* (ELL.) AND MART.

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ABSTRACT

Cercospora canescens **was inoculated onto different aged (20-70 days old) plants of greengram (Cv. Shalimar Mung-1). The genotype was found invariably susceptible at all its growth stages with incubation period of 6-7 days and leaf spot diameter of 7.1-7.4mm as recorded after 15 days of inoculation. Total sugar content showed an increasing trend and ranged from 124 to 129 and 133 to 135mg/g dry weight during pre- and post-flowering periods, respectively. The total phenol content also increased with plant age and was maximum (26.5 mg/g dry weigh) in 60 days old plants following which an insignificant decrease (26.5 mg/g dry weight) was recorded.Twenty five genotypes of greengram were screened for resistance against the pathogen under field conditions. The genotypes showed an indifferent response to invasion by *C. canescens* and none showed absolute resistance. However, five genotypes *viz.*, ML-935, PDM-54, Pusa Vishal, SM-710 and SM-366 were moderately susceptible and manifested lower leaf spot intensity (27.5-30.4 %) and pod infection(34-35.4 %).**

Key words: *Cercospora canescens*, Greengram, Leaf spot, Phenol, Pod infection, Sugar.

INTRODUCTION

Jammu and Kashmir is one of the important pulse growing regions with an area of 29.06 thousand hectares under different pulses producing 13.91 thousand tonnes of pulses annually including about 34 per cent from Kashmir province (Anonymous, 2008a,b). The state also happens to be important consumer of pulses and relies mainly on import from different states of India to meet the requirement. Greengram (*Vigna radiata*) is a preferred pulse for having negligible flatulence-causing factors and has considerable scope for being drought tolerant and consequently suitable for large portion of the state. The crop experiences several stresses predominated by a leaf spot caused by *Cercosporacanescens* which is a recognised destructive disease of the crop worldwide for inflicting qualitative and quantitative losses ranging from 23 to 96 per cent under natural epiphytotic conditions (Kasno, 1990; Iqbal *et al.*, 1995; Kaur, 2007). *Cercospora* spp. produce a perylenequinone toxin called cercosporin which is non-selective affecting bacteria, plants, fungi and animals unless these produce protective antioxidants such as carotenoids (Daub and Ehrenshaft, 2000). Until now very few varieties of greengram have been found resistant or moderately resistant to *C. canescens*, though several improved varieties have been developed through selection, hybridization and mutation. Although management of this disease is limited to chemicals, but due to their hazardous effects the search for resistant sources and other interventions is a continuous effort in the hands of researchers. Keeping in view the importance of greengram as well as the associated disease, present study was, therefore, intended to exploit host strength as an ecofriendly and safe strategy for management of this devastating disease.

MATERIALS AND METHODS

Effect of plant age *vis-a-vis* phenol and sugar contents on disease development: This kind of study provides basic information for determining the effective and economical disease management strategy based on the concept of seedling and/or old plant resistance. In this context an experiment was conducted under green house conditions (Temp. 28± 2 °C and RH 85± 5 %) and Shalimar Mung–1, an indeterminate cultivar of greengram, was raised in garden soil in plastic pots (200 inch^{-3}) @ 03 plants pot^{-1} with three replications in a completely randomized design. One set (3 replicate) was inoculated at 20, 30, 40, 50, 60 and 70 days after sowing with a spore suspension of *C. canescens* adjusted to 1000-2000 conidia ml^{-1} of sterile tap water (Mew *et al.*, 1975, Sindhan *et al.*, 1999) . Inoculated leaves were tagged for pathological observations with respect to incubation period and the leaf spot diameter was recorded on 15th day thereafter. Simultaneously, leaves for estimation of biochemical compounds were taken from uninoculated set of plants maintained along inoculated plants under identical conditions. The leaves were dried at 60 °C for constant weight and then analyzed for estimation of total sugar (Dubois *et al.*, 1956) and total phenol (Swain and Hills, 1959).

Screening of greengram genotype: The experiment was conducted on prominent genotypes of greengram including four varieties procured from Pulse Research Sub-station, SKUAST-K. Experiment was laid in randomized block design with three replications and each genotype was sown in 3m x 0.6m plots (2 rows) with inter-row and inter-plant spacing of 25 cm and 10cm, respectively. One local susceptible cultivar was included which was also sown around the experimental blocks to ensure presence of abundant and uniform inoculum in the field. The genotypes were categorized on the basis of an established scale as follows (Sindhan *et al.*, 1999).

Category	Leaf spot Intensity (%)
Resistant	0.1 to 5.0
Moderately resistant	5.1 to 15.00
Moderately susceptible	15.1 to 30.00
Susceptible	30.1 to 50.00
Highly susceptible	> 50.00

The disease was recorded at pod maturity stage for which a random sample of 10 plants was taken in each plot representing a replication. For leaf spot intensity the leaves were categorized according to 0-7 rating scale, where 0 = no infection, 1 = One spot to 20 per cent diseased area, 3 = 21–40 per cent diseased area, 5 = 41–60 per cent diseased area, and 7 = > 60 per cent diseased area. The disease was calculated by using the following formulae.

$$\text{Leaf spot intensity (\%)} = \frac{\Sigma(nv)}{NG} \times 100$$

Where, n = number of leaves in a category,
v = numerical value of category,
N = total of leaves examined and
G = maximum category value.

$$\text{Pod infection (\%)} = \frac{\text{Number of diseased pods}}{\text{Total number of pods observed}} \times 100$$

RESULTS AND DISCUSSION

Effect of plant age *vis-a-vis* phenol and sugar contents on disease development: The data (Table-1) revealed that age of plants had non-significant effect on the development of initial symptoms. Although incubation period was shorter in older plants, the difference was statistically non-significant and ranged from 6 to 7 days. There was also non-significant difference in the diameter of leaf spots which ranged from 7.1 to 7.4 mm when recorded after 15 days of inoculation. Leaf spot diameter, however, was slightly lesser in younger plants. The total sugar showed increasing trend with plant age and was maximum (135 mg/g dry weight) in 70 days old plants. It was lowest (124 mg/g dry weight) in 20 days old plants whereas 30 days old plants contained 127 mg sugar which was statistically at par with that recorded in younger plants. There was also non-significant difference in 50, 60 and 70 days old plants wherein sugar content of 133-135 mg/g dry weight was recorded. Likewise, the total phenol content showed an increase with increase in plant age and was maximum (26.5 mg/g dry weight) in 60 days old plants. The 70 days old plants, however, showed an insignificant decrease in phenol content (26 mg/g dry weight) and it was at par with that of 30, 40 and 50 days old plants which contained 23-26 mg. The phenol content of 20 days old plants (21 mg/g dry weight) was at par with that of 30 days old plants, but significantly lower than that recorded with 40 days and older plants. Results of the investigation were in agreement to those of Sindhan *et al.*, (1999) and Garain *et al.* (2004) as they observed high phenol and low carbohydrate contents in less susceptible greengram. Garain *et al.* (2004) recorded increase in phenol content upto 45 days after sowing of both resistant as well as susceptible greengram. Moreover, they observed that resistant cultivars

TABLE 1: *Cercospora* leaf spot *vis-a-vis* pre-existing sugar and phenol of greengram (cv. Shalimar Mung-1)

Age of plant when inoculated (days)*	Disease manifestation		Biochemical substances(mg/g dry weight)	
	Av. incubation period (days)	Av. leaf spot diameter (mm)	Total sugar	Total phenol
20	6.83	7.13	124.03	20.73
30	6.78	7.16	126.70	23.13
40	6.72	7.25	129.03	24.67
50	6.72	7.27	132.84	26.11
60	6.66	7.30	134.01	26.53
70	6.61	7.36	134.89	26.03
CV (%)	3.14	4.34	2.00	7.26
CD (P= 0.05)	NS	NS	4.53	3.02

*Also represents the age of crop when sampled for estimation of biochemical substances.

contained significantly higher phenol during 30-60 days after sowing. In a recent study, Kulkarni *et al.* (2009) also noted that healthy leaves of greengram cultivars, resistant or moderately resistant to anthracnose, contained comparatively higher amount of phenolics and lower amount of sugars. The investigation further revealed that the cultivar under study was invariably susceptible to *C. canescens* at all its growth stages. The inference is in accordance with prior report (Lapis *et al.*, 1996) that prolonged incubation period, delayed latent period, reduced lesion size and lesion density were the expressions of resistance against *C. canescens.*

Screening of greengram genotype: Greengram genotype showed an indifferent response to leaf spot incitent, *C. canescens,* over years (Table-2). The pooled data of two years study showed that lowest leaf spot intensity (27.48 %) and pod infection (34.04 %) were recorded on ML-935, and highest on local cultivar which manifested 37 and 45per cent leaf spot intensity and pod infection, respectively. Shalimar Mung-1 consistently showed results comparable with many other less promising cultivars with average pod infection and leaf spot intensity of 34.26 and 42.46 per cent, respectively. The genotypes were categorized on the basis of leaf spot intensity and out of the total screened material none was found resistant or moderately resistant to *C. canescens* under natural epiphytotic conditions. While most of the genotypes including Shalimar Mung-1 were found susceptible to the disease incitent, four genotypes *viz.*, ML-935, PDM-54, SKUA-M-710 and SKUA-M-366 were moderately susceptible with less than 30 per cent leaf area diseased. However, the disease manifested by Pusa Vishal was at par with that of moderately susceptible cultivar, PDM-54. The disease on pods as such was not recorded earlier and is, therefore, first evidence of variable *Cercospora*-greengram pods interaction. Genotypes otherwise escaping pod infection by *C. canescens* would have been desirable for the later being seed borne in nature. The possible influence of growth habit was nullified due to uniform closer plant spacing. This character, otherwise, is worth for having bearing in greengram-*Cercospora* interaction as the pathogen secretes a photosensitive toxin i.e., cercosporin (Singh and Thind, 1984; Daub and Ehrenshaft, 2000). These reports revealed the role of exposure of host surface area to pathogen as well as light radiation in disease manifestation. However, the shaded lower leaves were also found severely infected during present investigation. The present finding did not deny above records but rather removed misconception about influence of light intensity. Therefore, the variable reaction of greengram genotypes to *C. canescens* was due primarily to the difference in their physico-chemical characteristics. These results are in conformity with several other such and allied reports. Garain *et al.* (2003) noted significant influence of stomatal frequency in greengram susceptible to *Cercospora* leaf spot. In a subsequent study, Garain *et al.* (2004) found the disease to be inversely related to phenolic, soluble protein, phosphorus and potassium contents of the host. Moreover, Dutta *et al.* (2008) attributed the degree of defense in greengram to higher trichome frequency besides lower frequency of stomata. PDM-54, a resistant cultivar as documented earlier (Chauhan and

TABLE 2: Response of greengram genotype to *Cercospora canescens* under field conditions

Genotype	Pod infection (%)	Leaf spot intensity (%)	Reaction
Shalimar Mung-1	42.46 (40.65)	34.26 (35.81)	Susceptible
Pusa Vishal	35.42 (36.52)	30.43 (33.46)	Moderately Susceptible
PDM-54	34.51 (35.96)	29.71 (33.01)	Moderately susceptible
ML-935	34.04 (35.67)	27.48 (31.60)	Moderately susceptible
SKUA-M-110	43.27 (41.12)	34.74 (36.10)	Susceptible
SKUA-M-300	43.90 (41.48)	33.80 (35.53)	Susceptible
SKUA-M-301	43.17 (41.05)	35.05 (36.28)	Susceptible
SKUA-M-351	41.60 (40.15)	34.53 (35.97)	Susceptible
SKUA-M-353	44.34 (41.73)	35.73 (36.69)	Susceptible
SKUA-M-363	41.10 (39.86)	33.59 (35.40)	Susceptible
SKUA-M-365	39.72 (39.05)	33.30 (35.23)	Susceptible
SKUA-M-366	36.40 (37.09)	28.66 (32.35)	Moderately susceptible
SKUA-M-367	38.01 (38.05)	31.73 (34.27)	Susceptible
SKUA-M-368	42.84 (40.86)	34.67 (36.06)	Susceptible
SKUA-M-701	40.85 (39.71)	31.56 (34.16)	Susceptible
SKUA-M-703	42.45 (40.63)	35.48 (36.54)	Susceptible
SKUA-M-704	43.55 (41.28)	35.31 (36.44)	Susceptible
SKUA-M-705	41.17 (39.89)	32.82 (34.94)	Susceptible
SKUA-M-706	42.98 (40.94)	34.27 (35.81)	Susceptible
SKUA-M-707	42.36 (40.59)	32.16 (34.53)	Susceptible
SKUA-M-708	43.64 (41.33)	35.98 (36.84)	Susceptible
SKUA-M-709	40.08 (39.26)	32.05 (34.47)	Susceptible
SKUA-M-710	35.44 (36.51)	27.83 (31.82)	Moderately susceptible
Local cultivar	44.93 (42.07)	36.74 (37.29)	Susceptible
CV	2.25	1.67	
CD (5%)	1.47	0.96	

Figures in parenthesis are transformed (arcsine) values.

Singh, 2004), was categorized moderately susceptible in the present investigation. This varied response was attributable to the nature of fungal isolate characterized by its pathogenic variability (dela-Cueva *et al.*, 1992; Chand *et al.*, 2000; Joshi *et al.*, 2006). However, the material lacks in desirable character, the resistance and needs further improvement comparable to present disease scenario particularly the devastating *Cercospora* leaf spot.

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