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Relationship of Epidemiological Factors with *Ascochyta* blight Disease on Four Gram Varieties

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Abstract
CM-72 and Paidar-91 were moderately susceptible while CM-88 and C-727 were highly susceptible. With an increase in maximum temperature (25-31 °C) or minimum temperature (16-22 °C) blight severity increased on all the gram varieties. The relationship of air temperature (max. and min.) with gram blight rate of disease development was fairly explained by linear regression models. Gram blight disease recorded on four varieties decreased with an increase of relative humidity from 65-85 per cent. The relationship of relative humidity and rain fall with gram blight disease severity was negative and it was not explained by linear regression.

Introduction
Gram blight caused by *Ascochyta rabiei* (Pass) Lab., recorded in the Punjab during 1911 (Butler, 1918) is a limiting factor in the successful cultivation of this crop in Pakistan. Several epidemics of this disease have been reported in the past (Sattar, 1933; Kausar, 1958; 1960; 1965). Due to lack of durable resistance in the available high yielding commercial varieties against diverse virulences of *A. rabiei* (Hussain and Malik, 1991; Mitsueda *et al.*, 1995), blight of gram will continue to be a major threat to this crop in future. According to Malik and Bashir (1984) gram blight disease can induce 50-70 per cent crop losses and in certain years with favorable atmospheric conditions for the disease, it may cause total failure of the crop.
Gram blight management strategies include cultivation of disease tolerant varieties and use of seed and foliar application of fungicides. Chemical control of gram blight has been reported by several research workers (Bashir and Ilyas, 1984; Bashir *et al.*, 1987; Iqbal, *et al.*, 1991). However, extensive use of fungicides may not be economical and beneficial for the environment. The frequency of fungicides can be minimized with their timely application on moderalety resistant to moderately susceptible varieties. This approach will be fruitful if fungicides application coincides with favorable environmental conditions for gram blight development. Very little is understood about the epidemiological aspects of gram blight in Pakistan (Ahmad *et al.*, 1985). Objective of the studies was to characterize environmental conditions conducive for gram blight disease development. Results of this study may be helpful to develop a disease forecasting model in future.

Materials and Methods
Experimental plots of CM-72, CM-88, Paidar-91 and C-727 were established in the Rabi season of 1996-97 at the research area of Department of Plant Pathology, University of Agriculture, Faisalabad. The plots were artificially spray inoculated with spore suspension of *Ascochyta rabiei* prepared by mass culturing technique as described by Ilyas and Khan (1986). In order to provide most favorable conditions for disease development, a spreader row of a highly susceptible variety C-727 was sown around the plot and sprayed by tap water twice a day for the availability of sufficient moisture and successful infection by the fungus. The inoculum spray was applied every day in the evening till the appearance of blight symptoms on highly susceptible cultivars. From each plot ten plants were selected randomly and disease severity was recorded at three days interval using a disease rating scale as described by Reddy and Nene (1979). Environmental data consisting of maximum and minimum air temperature, relative humidity and rain fall was recorded daily by instruments of the weather station installed in the observatory of the department. Environmental data and disease severity were subjected to regression analysis and slopes of mean disease severity were calculated. The data were plotted graphically to determine relationship between environmental variables and rate of gram blight disease development (Steel and Torrie, 1986; Anonymous, 1992).

Results and Discussion
Gram blight disease symptoms appeared and were recorded first on leaves of a highly susceptible variety C-727 during 1st week of March, 1997. The disease symptoms were delayed in case of CM-72 until 2nd week of March. Gram blight flared up in the first week of April and attained maximum severity values. No disease ratings could be taken during 3rd week of April due to the necrosis of leaves. Maximum disease severity (17.15%) was recorded on C-727 followed by CM-88 having 12.83 per cent. The disease severity on CM-88 was significantly lower than C-727. The mean disease severity recorded on CM-72 (4.46%) and Paidar-91 (4.27%) did not differ significantly from each other. Based on disease rating scale C-727 and CM-88 were highly susceptible and CM-72 and Paidar-91 were moderately susceptible. The moderately susceptible to highly susceptible response of these varieties indicates scarcity of resistance and it may be attributed to the prevalence of diverse virulences of *A. rabiei* as reported by

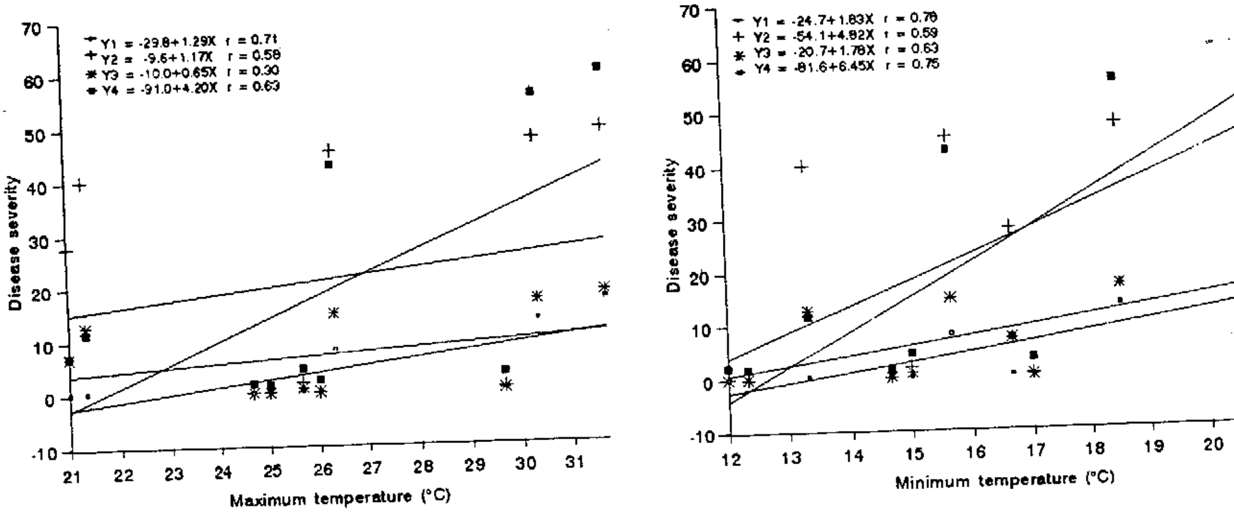

Fig. 1: Relationship of air temperature (max. and min.) with gram blight development on CM-72 (Y1), CM-88 (Y2) 91 (Y3) and C-727 (Y4) during 1997.

Hussain and Malik, (1991) and Mitsueda *et al.* (1997). The maximum temperature during disease rating period varied between 21-31 °C, while maximum disease severity was recorded at 26-31°C (Fig. 1). A linear trend of blight disease increase was found with an increase in maximum temperature from 21-31°C. This linear trend was fairly explained in C-727 and CM-72 and poorly explained in CM-88 and Paidar-91 as indicated by r values (Fig. 1). This may be attributed to differential response of these varieties to maximum temperature.

The relationship of minimum temperature with blight development on four varieties was fairly explained by linear regression models (Fig. 1). Maximum disease severity was recorded at a minimum temperature range of 16-21°C. The r values in case of air temperature (max. and min.) were below 0.80 indicating the lack of a perfect linear relationship of the environmental variables with disease development. Minimum temperature appeared to influence the disease more than maximum temperature but it was not supplemented by frequent rain showers, because during 2nd and 3rd week of March rain fall varied between 4 and 6 mm. However, during 1st week of April a total of 52 mm rain fall was recorded and disease increased rapidly as an indirect effect of availability of moisture. Rain fall occurred again in 3rd week of April but at that time crop was reaching towards maturity and very less amount of host plant tissue was left for the fungus to invade.

The relationship of relative humidity, rainfall a cloudiness was poorly explained by linear regre indicated by very lower values for most of the This may be attributed to the fact that frequen showers may play an important role in disease dev rather than total amount of precipitation. Relative during disease rating period varied between 65-88 Gram blight disease has been reported to be fa high relative humidity (Kaisar, 1972; Kader and 1989). Ketelaer *et al.* (1988) concluded that a average temperature of at least 18°C and precipitation of at least 40 mm was necessa epiphytotic of gram blight disease. Kausar (1965) the epiphytotics of gram blight in 1956-57, 195 1958-59 in West Pakistan, described that th initiation and development of blight depende availability of abundant inoculum of *A. rabiei* an rains which provided conditions favorable for th and development of the disease. According to Sa occurrence of blight during 1919-20, 19 1927-28 was influenced by the amount of wi received, particularly during the flowering a periods of gram. The influence of rainfall duri and early phase of the growth of gram was co be indirect through a luxuriant vegetative gro crop, resulting in high humidity in such a crop. L pointed out that besides infected seed, blighted

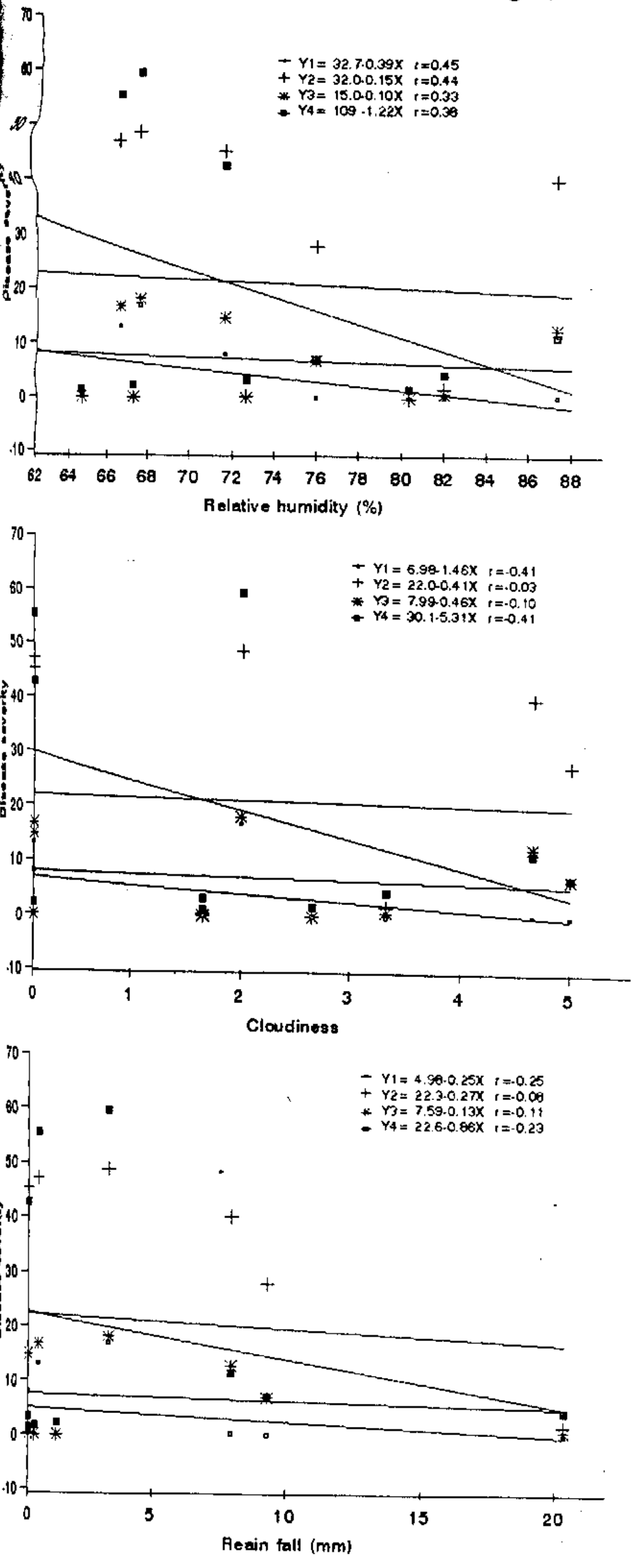

Fig. 2: Relationship of relative humidity, rain fall and cloudiness with gram blight disease development on CM-72 (Y1), CM-88 (Y2), Paidar-91 (Y3) and C-727 (Y4) during 1997.

debris lying in the field on the surface of the soil was a very important source of perpetuating the disease from year to year, and that blighted gram plant debris exposed to rains was rendered less harmful than the debris lying in dry conditions (Luthra *et al.*, 1935) Trapero and Kaiser (1987) while studying the factors influencing development of the teleomorph of *A. rabiei* under control conditions found that moisture was essential for the initiation of and development of pseudothecia and for the discharge of ascospores. No pseudothecia formed in naturally infested chickpea debris incubated in dry conditions. Pseudothecia were initiated at 5-25°C and reached maturity fastest (5 days) at 5°C. At 15-25°C 70 per cent of the ascospores were discharged from the mature perithecia within 2 h after wetting the tissue. At 5-10°C there was a delay in ascospore discharge and a reduction in the number of spores released. Light did not affect pseudothecial development of ascospore release. Reddy and Singh (1990) studied the relationship between temperature, relative humidity and *Ascochyta* blight development in winter-sown chickpea. Their studies revealed that in three seasons (1983-86), *Ascochyta* blight was severe, reaching a score of 8 on a 1-9 scale in field trials at Tel Hadya, Syria. In that climate temperature influenced epidemic development more than RH. In the early part of crop growth (Jan.-March), although RH was high (>60%), cool temperature (minimum <5°C) and maximum (>15°C) limited the epidemics. Epidemics developed when weekly mean temperatures were between 10 and 20°C. Weekly maximum temperature less than 25°C slowed disease progress. Weekly mean RH > 60 per cent promoted blight development.

According to Trapero and Kaisar (1992) optimum temperature for infection of *A. rabiei* in 2 week old seedlings of chickpea was 20°C. At this temperature 7.6 and 17 h of wetness were required for pathogen to cause light and severe infection, respectively. Increasing wetness period to more than 6 h resulted in increased disease severity, regardless of temperature. Some infection (9.6%) occurred even when plants did not receive a wetting period after inoculation. Dry periods (6-48 h) immediately after inoculation increased disease severity compared with plants receiving the same wetness period without drying, while the opposite effect occurred when dry periods >12 h were initiated after and initial wetting period of 6 h. Although disease development and symptom expression were most affected by temperature during infection, post infection temperature was also influential. The lower and upper limits for infection and disease development were <5 and about 30°C, respectively. Disease development was suppressed at 30°C in plants incubated at 20°C during the infection period. At a constant temperature of 20°C the minimum incubation and latent periods were 4.5 and 5.5 days, respectively. Lower or higher temperature increased the duration of these periods.

In the current studies very broad ranges of air temperature i.e, 21-31, 12-21°C, relative humidity 64-88 per cent, rain fall 1-20 mm and cloudiness 1-5 indicated that most ideal condition for disease development were not prevalent. The disease initiated due to one or two favorable environmental variables then checked due to a span of unfavorable weather, and after one week or so it progressed again due to conducive environment. Thus low to moderate epidemic of gram blight resulted due to heavy inoculation and some favorable minimum temperature and rain fall. In environmental conditions favorable to the development of sexual stage, the ascospore production from infected chick pea straw, could play an important role as the primary inoculum for the disease (Trapero and Kaiser, 1992b). The relative humidity > 80 per cent, frequent showers of rain fall minimum temperature 18-20°C appear to be favorable for gram blight disease development in epiphytotic form. The relationship of these environmental conditions needs to be studied in detail on daily basis for accurate disease prediction.

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