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EFFECT OF AGE OF HOST ON DEVELOPMENT OF POWDERY MILDEW, *ALTERNARIA* BLIGHT AND BACTERIAL LEAF BLIGHT OF CLUSTER BEAN

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ABSTRACT

Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub], an important legume crop in India. It suffers from several diseases that cause quantitative and qualitative losses, among them; Powdery mildew (*Leveillula taurica*), Alternaria blight (*Alternaria cyamopsidis*) and Bacterial leaf blight (*Xanthomonas axonopodis* pv. *cyamopsidis*) are major diseases of economic importance. Investigations were undertaken on effect of host age on development of powdery mildew, Alternaria blight and bacterial leaf blight on susceptible local land race of pot grown cluster bean plants under artificial epiphytotic conditions. Effect of host age on development of powdery mildew and Alternaria blight pathogen showed an increase in per cent disease index with increased plant age. Maximum per cent disease index was observed in plants aging 41 DAS with PDI 50.3 and 56.6 respectively for both the diseases. However, maximum per cent disease index of 62.4 at 27 DAS on old plants, susceptibility of bacterial leaf blight decreased with increasing age of the plants, younger plants exhibited more susceptibility than older plants. The present finding showed that the younger plants were more susceptible than old ones in case of bacterial leaf blight while, in case of powdery mildew and Alternaria blight older plants were more prone to disease than younger plants.

INTRODUCTION

Cluster bean [*Cymopsis tetragonoloba* (L.) Taub.] has become popular not only for consumption as vegetables but also seeds of cluster bean are good source of useful industrial 'Guar gum' (Reddy *et al.*, 2014). Rajasthan is leading in both production and area under cultivation which contributes more than 70 per cent total produce of India. The major threat to crop is powdery mildew caused by *Leveillula taurica* and it was observed for the first time in Arizona on guar (*Cyamopsis tetragonoloba*) and on the native hosts *Nicotiana trigonophylla* and *Caesalpinia gilliesii* (Mihail and Alcorn., 1984) *Alternaria* spp. is an economically important pathogen widely distributed throughout the world and cause devastating disease on field crops (Ambesh *et al.*, 2014). *Alternaria* blight of cluster bean is also severe which was reported from Pusa (Bihar) and Madras. Bacterial leaf blight of cluster bean caused by *Xanthomonas axonopodis* pv. *cyamopsidis* (Patel *et al.*, 1953) Dye has assumed an important place among bacterial diseases which causes up to 58-68 per cent loss in grain yield (Gupta, 1978). Early infection may reduce the yield to a great extent (Gandhi and Chand., 1985). Earlier studies on epidemiology have only dealt with the environmental conditions favourable for bacterial leaf blight development (Srivastava and Rao., 1963). In several other host pathogen systems, host susceptibility varied during plant growth (Luttrell *et al.*, 1974; Shukla *et al.*, 1975; Burr and Hurwitz., 1981; Getz *et al.*, 1983). Other factors such as host susceptibility, plant age also play an important role in disease development. The plants are most susceptible at 8-10 week's age, *Alternaria* spp. was under severe condition may lead to complete defoliation, can occur in areas with high rainfall, high humidity and high temperature (24-29°C) as well as in semi arid climates where frequent and prolonged night dews occur (Sahu, *et al.*, 2014).

Powdery mildew under favorable condition causes yield losses up to 50-60 per cent (Richard *et al.*, 1999). Alternaria blight cause yield losses 43-87% when leaves are infected at seedling stage than at older stages (Sharma, 1983). Bacterial leaf blight is reported to cause as high as 58-68 per cent losses in grain yield. Age of host plays a vital role in disease development and epidemiology of any disease. No specific information is available on relationship between age of the host and disease development due to powdery mildew, Alternaria blight and bacterial leaf blight of cluster bean. The present investigations were aimed to know the age at which the cluster bean plants are most susceptible for infection and disease development and also to devise suitable management strategies for combating the losses caused by them. There is a need to identify at what age of plant does infection starts so as to find possible control measures.

MATERIALS AND METHODS

The present study was carried out at Department of plant pathology, MPUAT, Udaipur under artificial epiphytotic conditions in 2014-15. Inoculations for Alternaria blight and bacterial leaf blight were done by standard spray inoculation technique. Pot experiments were laid out in completely randomized design (CRD) with five replications separately for each of the three diseases *i.e.*, powdery mildew,

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Alternaria blight and bacterial leaf blight.

Production of inoculum

Alternaria cyamopsidis cultures were grown on potato dextrose agar (PDA) medium and *Xanthomonas axonopodis* pv. *cyamopsidis* were grown on yeast glucose chalk agar medium for 72h at $28 \pm 1^\circ$ C. Inoculum was prepared by washing cells from agar surface with sterile distilled water (SDW). Final inoculum concentration was adjusted by dilution with SDW to approximately 1×10^3 conidia ml^{-1} and 2.5×10^6 colony-forming units per ml.

Raising of host and inoculation

Cluster bean plants were raised in 25 cm earthen pots having Soil: FYM (3:1) mixture from organic field where, organic farming is practiced for past six years in MPUAT campus farm. The long term management of field is being done by only organic means and no synthetic products like fertilizers, pesticides are being used. The field has become one of the model agriculture unit. Each pot contained five plants. The susceptible local cluster bean land race was sown by staggered sowing at 7 days interval. The sowing dates were adjusted so as to obtain 20, 27, 34 and 41 days-old plants for simultaneous inoculation at one time for each of the two diseases. Four different stages were spray inoculated simultaneously at one time with *A. cyamopsidis*, using inoculum density of 1×10^3 conidia ml^{-1} and *X. axonopodis* pv. *cyamopsidis* using inoculum density of 2.5×10^6 cfu ml^{-1} . Inoculated plants were kept in humid chamber for 24 hrs and then transferred to cage house and maintained throughout the disease development period by regular irrigation. In case of powdery mildew, four different stages were studied under un-inoculated natural condition.

Observations for disease severity of powdery mildew, Alternaria blight and bacterial leaf blight were recorded when plants reach at the physiological maturity using 1-5 disease rating scale given by McKinney's formula (1923).

The per cent disease index (McKinney 1923, Chester, 1959 and Wheeler, 1969) was calculated as

$$\text{Per cent disease index (PDI)} = \frac{\text{Sum of all individual disease rating}}{\text{Total No. of plants assessed} \times \text{maximum rating}} \times 100$$

RESULTS AND DISCUSSION

It has been found plant age and its relation with disease intensity to be different with disease and it was quite interesting to note that these revelations of immense utility in economy of the crop. Maximum powdery mildew was observed in the plant ageing 41 DAS with PDI 50.3 followed by plants ageing 34 DAS with PDI 18.6, 27 DAS with PDI 13.4 and plants with age of 20 DAS did not exhibit any disease. Similarly, there was gradual increase in Alternaria blight with the increase in age of plants. Maximum PDI 56.6 was seen in plants ageing 41 DAS followed by PDI 37.2, 25.8 and 17.4 in plants with age of 34, 27 and 20 DAS, respectively. This shows that defense response is triggered at the seedling stage and most of the biochemical defense secretions are active and workable till 20 days old plant. Later on the concentration of defense bio-molecules lowers down and hence plant becomes susceptible. The case was opposite with bacterial leaf blight, younger plants exhibited more susceptibility than older plants. However, it was also observed that plant at 27 DAS exhibited maximum PDI 62.4 of bacterial leaf blight as compared to minimum PDI 41.0 in plants at 41 DAS. Though, plants at 20 DAS exhibited PDI 58.7 and that ageing 34 DAS, expressed PDI 54.3 (Table.1) this is clearly indicating that age and disease relation differs with pathogen and crop in question.

The present findings are in agreement with Agrios (2005), who reported that plant age is important in disease infection and young plants are more susceptible. He also reported that Plants in their reaction (susceptibility or resistance) to disease depends largely on age and for instance infections caused by *Pythium*; damping off and root rots, downy mildews, bacterial blights and viral infections, the host plants are susceptible only during the growth period and become resistant during the adult period. Also depending on the particular plant-pathogen combination, the age of the host plant at the time of arrival of the pathogen may affect considerably the development of infection and of an epidemic. Similarly, Rangaswamy and Venkatarao (1993) observed that there was progressive increase in Alternaria blight of cluster bean severity with increase in age of the host, high disease index (46.23) during 70 days old crop. This was further supported by Meena *et al.*, (2004) who found maximum severity of Alternaria blight at 45 DAS in Mustard. Deep and Sharma (2012), reported maximum infection of *Alternaria brassicae* at 60 DAS old leaves rather than 45 DAS. These findings clearly indicate the susceptibility of matured leaves in relation to age of the host.

Gandhi (1984) found similar results on cluster bean bacterium *X. campestris* pv. *cyamopsidis* and revealed that 20 day old

Table 1: Effect of age of host on Powdery mildew, Alternaria blight and Bacterial leaf blight development on cluster bean

S.No.	Date of sowing July 2014	Plant age in days	Powdery mildew (Per cent disease index) PDI*	Alternaria blight	Bacterial leaf blight
1.	1 st	41	50.3(45.1)	56.6(48.8)	41.0(39.8)
2.	7 th	34	18.6 (25.5)	37.2(37.5)	54.3(47.4)
3.	14 th	27	13.4 (21.4)	25.8(30.5)	62.4(52.1)
4.	21 st	20	0.0(0.0)	17.4(24.6)	58.7(50.0)
SEm +			0.487	0.600	0.721
C.D.5%			1.500	1.848	2.223
C.V. %			4.25	3.41	3.07

*Mean of five replication; Figures in parentheses are arcsine per cent angular transformed values.

plants had maximum disease index as well as severe symptoms than older plants. In another study by Gandhi and Chand, (1988) 15-30 days old cluster bean plants were inoculated by *X. axonopodis* pv. *cyamopsidis* resulted in mortality of many plants due to rotting of stem, whereas, in 60-75 days old plants infection was observed only on foliage. There was negative correlation between disease severity and age of host plant. Cluster bean could escape the infection of all three diseases by changing sowing pattern.

The results revealed that the susceptibility of cluster bean plants to powdery mildew and *Alternaria* blight gradually increased with an increase in plant age. However, susceptibility of bacterial leaf blight decreased with increase in age of the plants, younger plants exhibited more susceptibility than older plants.

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