Biological Forum – An International Journal **16(10): 130-134(2024)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Survey, Host Range Studies and Germplasm Screening Against Early Blight Disease of Potato caused by *Alternaria solani*

Manjamma D.[1], Prasad P.S.[1], H. Amarananjundeswara[2], Manjunath Hubballi[3] and Chandrashekhar G.S.[4]
[1]Department of Plant Pathology, College of Horticulture, Sirsi (Karnataka), India.
[2]Department of Vegetable Science, College of Horticulture, Sirsi (Karnataka), India.
[3]Department of Plant Pathology, College of Horticulture, UHS, Bagalkot (Karnataka), India.
[4]Department of Agricultural Entomology, Horticulture Research and Extension Centre, Arsikere (Karnataka), India.

(Corresponding author: Prasad P.S.)*
(Received: 19 July 2024; Revised: 20 August 2024; Accepted: 16 September 2024; Published: 15 October 2024)
(Published by Research Trend)

ABSTRACT: Potato (*Solanum tuberosum* L.) belongs to the family solanaceae is the most important crop among the vegetables. The crop stands prime position in the economy of poor and marginal farmers and plays a vital role in nutritional security by producing more bio-mass per unit area as compared to wheat, rice and maize in a short period of time. An investigation was carried out for roving survey was undertaken during 2018 to estimate the severity of early blight of potato in major potato growing districts of Southern Karnataka *viz*., Hassan and Chikkamagaluru during *kharif* and Kolar and Chikkaballapura districts in *rabi* 2018. The host range studies of solanaceous crops like tomato, capsicum, chilli and brinjal were inoculated artificially with spore suspension of the *Alternaria solani.* The natural incidence of early blight was recorded on different twenty potato germplasm grown in field conditions at Horticulture Research and Extension Centre, Hassan and artificial inoculation was done in polyhouse condition at College of Horticulture, Bengaluru during 2018-19. The early blight disease severity in potato was ranged between 5.13 to 30.33 per cent in all the districts. The host range studies of solanaceous crops like tomato, capsicum, chilli and brinjal were inoculated artificially with spore suspension of the *Alternaria solani.* The results indicated that *Alternaria solani* was effectively act as pathogen and infect all solanaceous crops. Besides, more disease symptoms were found on the tomato crop followed by capsicum and less symptoms were observed on brinjal and chilli. The screening of potato germplasms to find the resistance source against early blight of potato. The results related to both field and polyhouse screening revealed that, among the twenty germplasms screened none of them showed immune response. Only seven genotypes were noticed resistant reaction *viz*., CP-3352, CP-3377, CP-3376, CP-3318, CP-3337, CP-3322 and CP-3175. Whereas, six genotypes were showed moderately resistant *viz*., CP-3393, CP-3421, CP-3382, CP-3325, CP-3421 and CP-3210. But, four genotypes were moderately susceptible *viz*., CP-3420, CP-3083, CP-3415 and CP-3361. Whereas, three genotypes were showed susceptible reaction *viz*., CP-3395, CP-3112 and CP-3397. However, none of the genotypes were found to be highly susceptible.

Keywords: Germplasm, *Alternaria solani,* Polyhouse, Host range and Screening.

INTRODUCTION

Potato (*Solanum tuberosum* L.) belongs to the family solanaceae is the most important crop among the vegetables. The crop stands prime position in the economy of poor and marginal farmers and plays a vital role in nutritional security by producing more bio-mass per unit area as compared to wheat, rice and maize in a short period of time. Potato is considered as "The King" of staple foods. It is the only non-cereal food crop to command such a high position in the world. It is a rich source of calories and about 100 grams fresh weight of potato tuber yields 97 kilo calories, which is much higher than cereals. Potato is a good source of other nutrients like carbohydrates 20.60 per cent, protein 2.10 per cent, fat 0.30 per cent, 1.10 per cent crude fiber and 0.90 per cent ash. It also contains good amount of essential amino acids like leucine, tryptophan and isoleucine (Yadav and Srivastava 2014). Potato being a short duration crop gave ample and economical tuber yield in 80-90 days. In India it is grown over an area of 2176 ha ('000 Ha) with the production of 49344 MT ('000 MT) and an average national yield per hectare is 23.00 tonnes (Anon., 2017). An area under potato cultivation in Karnataka is 44,000 hectares with a total production of 6.98 lakh tonnes with productivity of 13.74 tonnes per hectare.

Potato production is currently threatened by a number of biotic and abiotic factors. Among the biotic stresses, fungal diseases such as late blight (*Phytophthora infestans*), early blight (*Alternaria solani*), powdery scab (*Spongospora subterranea*), wart (*Synchytrium endobioticum*), watery wound rot (*Pythium ultimum*), silver scurf (*Helminthosporium solani*), pink rot

(*Phytophthora erythroseptica*), dry rot (*Fusarium spp*.), black scurf (*Rhizoctonia solani*), skin spot (*Polyscytalum pustulans*), wilt of potato (*Verticillium sp*.) and charcoal rot (*Macrophomina phaseolina)* were the most destructive fungal diseases. which has reduced the quality, quantity and market value of potato tubers. (Abbas *et al*., 2013). Among the fungal diseases, early blight is one of the most destructive disease of potato. The disease can damage both potato foliage and tubers and also cause yield loss up to 5 to 50 per cent. An early blight disease is prevalent at worldwide wherever potatoes, tomatoes, peppers and egg plants were grown. An early blight is a polycyclic disease that can cause more than one disease epidemics within a single cropping season (Tsedaley, 2014). An early blight of potato is caused by two pathogens *viz*., *Alternaria solani* (Jones & Grout) and *Alternaria alternata* (Fr.) Keissler, but in some areas only *A. solani* is considered as the causative organism of this disease. With their spores in abundance in the atmosphere and in the soil, the disease is always a threat when conditions become conducive for infection and thus represents a serious threat to potato production (Iglesias *et al*., 2007, Leiminger and Housladen 2012).

Depending upon the variety grown, weather condition and inoculum load in the soil this disease can cause an average annual yield loss of approximately 79 per cent of the total production of potato (Yadav *et al*., 2017). For effective management of this disease in early stage of crop growth, there is a need of management approaches in order to reduce the disease severity with increased tubers yield. Therefore, by considering the above factors the present investigation was taken for the management of early blight of potato by host range studies and germplasms as a resistance source.

MATERIALS AND METHODS

Survey for the severity of early blight in major potato growing areas of Southern Karnataka

A roving survey was conducted during *kharif* 2018-19 in different potato fields of Hassan and Chikkamagaluru districts and in *rabi* season in the fields of Kolar and Chikkaballapur districts, respectively. In each taluka five villages and in each village five fields were selected randomly. In each field randomly ten plants were examined and observations were recorded using 0-9 scale (Mayee and Datar 1986). The details of disease rating:

Numerical rating	Description
0	No symptoms on leaf
1	Small, irregular to brown spots covering 1 per cent leaf area
3	Small, irregular, brown spots with concentric rings covering 1-10 per cent of the leaf area
5	Lesions enlarging, irregular, brown with concentric rings covering 11-25 per cent of the leaf area
7	Lesions coalesce to form irregular brown patches with concentric rings covering 26-50 per cent of the leaf area. Lesions also on stem and petioles
9	Lesions coalesce to form irregular, dark brown patches concentric rings covering 51 per cent or more of the leaf area. Lesions seen on stem and petioles.

Per cent Disease Index (PDI) was calculated by using the following formula (Wheeler, 1969).

$$PDI = \frac{\text{Sum of numerical ratings}}{\text{Total number of plants observed} \times \text{Maximum disease score}} \times 100$$

Host range study of *A. solani* (AS3) on solanaceous crops. The host range of *A. solani* was studied on different solanaceous crops. The seeds of tomato (*Solanum lycopersicum*), capsicum (*Capsicum annuum*), chilli (*Capsicum annum* L.) and brinjal (*Solanum melongena*) were sown in pro-trays filled with cocopeat. The pots were filled with fertile soil, which was mixed with well decomposed FYM. About 25 days old seedlings were transplanted to the pots and five plants were maintained in each crop. Ten days old mycelial culture of *A. solani* was taken and mixed in one liter of sterile water and sprayed on 45 days old seedlings. The control (check) plants were maintained by spraying sterile water. Further, protected the inoculated seedlings with polythene sheet for 48 hours. A daily observations were made to check the symptoms initiation and development, PDI was calculated based on the symptom development.

Screening of potato germplasm for early blight disease. The natural incidence of early blight was recorded on different potato germplasm grown in field conditions at Horticulture Research and Extension Centre, Hassan and artificial inoculation was done in polyhouse condition at College of Horticulture, Bengaluru during 2018-19. About twenty potato genotypes were collected from the Central Potato Research Station, Jalandhar, Punjab under AICRP on Potato, Hassan were screened against early blight disease. An observations were recorded after the appearance of disease at an interval of 15 days by following 0 to 9 scale given by Mayee and Datar (1986).

The various genotypes were arbitrarily categorized into six different reactions group as follows.

Category	Reactions
0	Immune
1	Resistant
3	Moderately resistant
5	Moderately susceptible
7	Susceptible
9	Highly susceptible

RESULTS AND DISCUSSION

Survey for the severity of early blight disease in major potato growing areas of Southern Karnataka. A roving survey was conducted during *kharif* and *rabi* 2018 to assess the severity of early blight of potato in major potato growing districts of Southern Karnataka *viz*., Hassan, Chikkamagaluru, Kolar and Chikkaballapura.

The data revealed that among different talukas surveyed, severity of early blight was found higher in Mulabagilu taluk with disease severity of 29.92 per cent

followed by Kolar (21.60%) and Shidlaghatta (20.52%) of Kolar and Chikkballapura districts, respectively. The lowest disease severity was noticed in talukas like Kadur (5.72%) and Channarayapatna (6.75%) of Chikkmagaluru and Hassan districts respectively. Among the villages, highest disease severity was registered in Khadripura (31.12%) and Maraktani (30.21%) of Mulabagilu taluk and Girnalli of Kolar taluk (30.90%). The least disease severity was revealed in Kalyadi of Arsikere taluk in Hassan district and Belaguli of Channarayapatna taluk in Hassan district showed disease severity of 5.00 per cent in both the villages followed by Balliganavuru of Kadur taluk belongs to Chikkamagalur districts with disease severity of 5.30 per cent. Of different districts, Kolar district recorded highest per cent disease severity of 19.92 per cent followed by Chikkaballapura with disease severity of 16.42 per cent (Fig. 1 and Plate 1a & 1b). However, Chikkamagaluru and Hassan districts were showed comparatively lower disease severity of about 6.23 and 7.56 per cent, respectively.

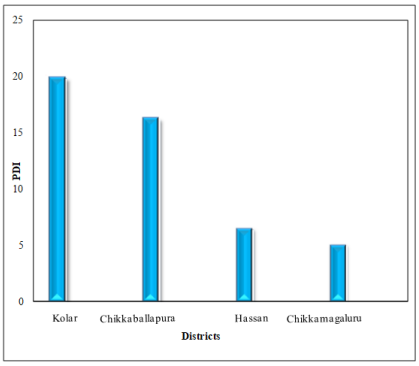

Fig. 1. Survey on disease severity of early blight of potato in Southern Karnataka during 2018-19.

1a. Early blight disease severity on foliage.

1b. A view of early blight symptom on leaves

The highest per cent disease index in Kolar was due to the favourable environmental and pathogen factors. Further, it was observed that continuous growing of alternate host crops in the same piece of land has also led to over loading of the pathogen factors in the field. The changes in weather conditions and amount of initial inoculum of *Alternaria solani* may be responsible for varying disease intensities at different locations (Vanderwalls *et al*., 2003). The high relative humidity, rainfall or dew accumulation in the atmosphere can increase conidial germination and pathogen infection (Rotem, 2004). An alternative low and high humidity conditions have also been showed to favour disease development. These observations were supported by Bains *et al*. (2000); Prasad (2002); Hossain *et al*. (2010). Rao *et al*. (2016) reported that early blight disease in tomato and chilli with disease severity of 20 and 60 per cent, respectively.

Study on host range of *A. solani* (AS3) on different solanaceous crops. A host range of *Alternaria solani* was studied on solanaceous crops. About five plants in each solanaceous crops like tomato, chilli, brinjal and capsicum were screened for the symptom expression against *Alternaria solani*.

The results obtained are shown in the Table 1 and Plate 2. It was observed that all the solanaceous crops, which were inoculated with spore suspension of *Alternaria solani* (AS3) exhibited the early blight symptoms. The more and early symptoms were exhibited in tomato plants with maximum PDI of about 8.51 per cent after 7 days of inoculation. Though other crops expressed the disease symptoms, but PDI was very less. PDI in capsicum was about 3.25 per cent and in chilli 1.30 per cent, which were expressed after 12 and 13 days of inoculation of pathogen, respectively. However, very low early blight symptoms were expressed in brinjal leaves with PDI of 0.22 per cent at 15 days after pathogen inoculation was documented.

This investigation was supported by Tsedaley (2014) and reported that an early blight of potato was prevalent across worldwide, wherever potatoes, tomatoes, peppers and eggplants were grown. Cardoso (2014) conducted pathogenicity tests on 28 species of solanaceae, among them thirteen solanaceous crop species were found susceptible to *Alternaria solani*.

Table 1: Host range study of *Alternaria solani* (AS3) on different solanaceous crops.

Sr. No.	Crops	Scientific name	Days for symptom expression	Per cent Disease Index (PDI)
1.	Tomato	*Solanum lycopersicum*	7	8.51
2.	Capsicum	*Capsicum annuum* var. *frutescense*	12	3.25
3.	Chilli	*Capsicum annuum* L.	13	1.30
4.	Brinjal	*Solanum melongena*	15	0.22

Plate 2. Host range study of *Alternaria solani* (AS3) on solanaceous crops.

Screening of potato germplasms against early blight disease. The results related to both the field and polyhouse screening of potato genotypes were presented in Table 2 & Plate 3. Among twenty genotypes screened, none of them showed immune response. Only seven genotypes were gave resistant reaction *viz*., CP-3352, CP-3377, CP-3376, CP-3318, CP-3337, CP-3322 and CP-3175. Whereas, six genotypes were showed moderately resistant *viz*., CP-3393, CP-3421, CP-3382, CP-3325, CP-3421 and CP-3210. But, four genotypes were indicated moderately susceptible *viz*., CP-3420, CP-3083, CP-3415 and CP-3361. Whereas, three genotypes were showed susceptible reaction *viz*., CP-3395, CP-3112 and CP-3397. However, none of the genotypes were found to be highly susceptible.

Kumar *et al*. (2015) reported that cultivars KDTS-71, DVRT-1-2, CO-3, PANT-T-3 and VFN-8 were found to be highly resistant to early blight in field screening as well as polyhouse conditions. A similar attempts were made by Ghani and Ganie (2013) who reported that, three genotypes *viz*., Kufri Himalini, SM/96-27 and SM/94-44 were moderately tolerant. Whereas, nine genotypes *viz*., Kufri Giridari, Kufri Shailaja, Kufri Chandramukhi, SM/98-239, SM/93-237, SM/90-45, HB/82-18, HB/50-45 and Shalimar potato-1 were moderately susceptible. Mehboob *et al*. (2013) reported that FD-18 potato was found to be resistant. Whereas, two lines such as F3-39 and FD-48-41 were showed moderately resistant response to early blight disease of potato.

Table 2: Screening of potato germplasms against early blight disease.

Grade	Disease reaction	Genotypes	No. of genotypes
0	Immune	—	0
1	Resistant	AICRP-CP-3352, AICRP-CP-3377, AICRP-CP-3376, AICRP-CP-3318, AICRP-CP-3337, AICRP-CP-3322 and AICRP-CP-3175	7
3	Moderately resistant	AICRP-CP-3393, AICRP-CP-3421, AICRP-CP-3382, AICRP-CP-3325, AICRP-CP-3421 and AICRP-CP-3210	6
5	Moderately susceptible	AICRP-CP-3420, AICRP-CP-3083, AICRP-CP-3415 and AICRP-CP-3361	4
7	Susceptible	AICRP-CP-3395, AICRP-CP-3112 and AICRP-CP-3397	3
9	Highly susceptible	—	0
Total number of germplasms			**20**

Plate 3. Potato germplasms screening under natural condition.

CONCLUSIONS

A roving survey was carried out to know the status of early blight diseases severity in Southern Karnataka. The severity of early blight was found higher in Mulabagilu taluk with disease severity of 29.92 per cent followed by Kolar (21.60%) and Shidlaghatta (20.52%) of Kolar and Chikkballapura districts, respectively. Host range studies of solanaceous crops revealed that, more and early symptoms were exhibited in tomato plants with maximum PDI of about 8.51 per cent after 7 days of inoculation. Among the twenty genotypes screened, no genotypes were showed immune response to early blight disease. Only seven genotypes indicated resistant reaction *viz*., CP-3352, CP-3377, CP-3376, CP-3318, CP-3337, CP-3322 and CP-3175. Whereas, three genotypes were showed susceptible reaction *viz*., CP-3395, CP-3112 and CP-3397 and none of the genotypes were found to be highly susceptible. Hence, some of resistant and moderately resistant germplasms can be exploited in the breeding programme and recommended to the farming community as resistant sources for effective management of early blight disease of potato.

FUTURE SCOPE

To study of *Alternaria* species complexity in potato and studies on molecular variability of different isolates of *Alternaria solani.*

Acknowledgements. The authors are very much thankful to Department of Plant Pathology, College of Horticulture, Bengaluru for providing lab facilities to conduct the experiment.

REFERENCES

Abbas, M. F., Naz, F. and Irshad, G. (2013). Important fungal diseases of potato and their management- A brief review. *Mycopathology*, *11*(1), 45-50.

Anonymous (2017). Horticultural statistics at a glance. Department of Agriculture, Co-operation and farmers, *Horticulture Statistics Division*. New Delhi

Bains, P. S., Holley, J. D., Bennypaul, H. S., Lazowski, Y. M. and Calpas. J. (2000). A survey for early blight disease in potato fields of Alberta in 1999. *Canadian Plant Disease Survey*, p. 80.

Cardoso, C. R. (2014). Potato and tomato early blight, molecular identification of *Alternaria spp*., host range and epidemics, Minas Gerais Brasil.

Ghani, M. Y. and Ganie, S. A. (2013). Field evaluation of potato germplasm for resistance to *Alternaria solani*. *Indian Journal Plant Protection, 41*(2), 152-155.

Hossain, M. T., Hossain, S. M. M., Bakr, M. A., Matiar Rahman and Uddin, S. N. (2010). Survey on major diseases of vegetable and fruit crops in Chittagong region. *Bangladesh Journal of Agriculture Research*, *35*(3), 423-429.

Iglesias, I., Rodriguez-rajo, F. J. and Martinez, J. (2007). Evaluation of the different *Alternaria* prediction models on potato crop in a Limia (NW of Spain). *Aerobiologia*, *23*, 27-34.

Kumar, V., Faiza, N. and Ajay K. (2015). Evaluation of different germplasms/ cultivars of tomato against early blight (*Alternaria solani*) in field conditions and by artificial inoculation method. Open Access *Library Journal, 2*(6)

Leiminger, J. H. and Housladen, H. (2012). Early blight control in potato using disease-orientated threshold values. *Plant Disease*, *96*, 124-130.

Mayee, C. D. and Datar, V. V. (1986). *Phytopathometry* technical bulletin-1, Marathwad Agriculture University Parbhani. p. 25.

Mehboob, S., Khan, M. A., Rehman, A. and Idrees, M. (2013). Role of epidemiological and biochemical factors against early blight of potato. *Esci Journal of Plant Pathology, 2*(1), 114-118.

Prasad, Y. (2002). Studies on variability, pre and postharvest management of early blight of tomato, M. Sc. (Agri.) Thesis. University Agricultural Sciences. Dharwad (India).

Rao, S, Syed, D., Sham, K., Haben, T., Rahwa, T. and Tomas, H. (2016). Pathological survey on disease incidence and severity of major diseases on tomato and chilli crops grown in sub Zoba Hamelmalo, Eritrea, *International Journal of Research Studies and Agricultural Science*, 2(1), 2454-6224.

Rotem, J. (2004). The genus *Alternaria* biology, epidemiology and pathogenicity, American Phytopathological Society. St. Paul. MN, USA.

Tsedaley, B. (2014). Review on early blight (*Alternaria spp*.) of potato disease and its management options. *Journal of Biology and Agriculture Health Care, 4*(27).

Vanderwaals, J. E., Korsten, L. and Aveling, T. A. S. (2003). A review of early blight on potato. *African Plant Protection*, *7*(2), 91-102.

Wheeler, B. E., J. (1969). An introduction to plant diseases. John Wiley and Sons Ltd, London.

Yadav, S. K. and Srivastava, A. K. (2014). A review on agronomical aspects of potato production in north-eastern region of India. *International Journal of Applied and Pure Science*, *1*(6), 2394-5532.

Yadav, V. K., Kumar, V. and Arghya Mani (2017). Evaluation of fungicides, bio-control agents and plant extracts against early blight of potato caused by *Alternaria solani*. *International Journal of Chemical Studies*, *6*(1), 1227-1230.

How to cite this article: Manjamma D., Prasad P.S., H. Amarananjundeswara, Manjunath Hubballi and Chandrashekhar G.S. (2024). Survey, Host Range studies and Germplasm Screening Against Early Blight Disease of Potato caused by *Alternaria solani*. *Biological Forum – An International Journal, 16*(10): 130-134.