Effect of Pathogenicity of Seed Borne Chilli (*Capsicum annuum* L.) Anthracnose Disease on Chilli Fruit

ABSTRACT

The current study was conducted at AICRP on Seed (Crops), National Seed Project, University of Agricultural Sciences, Gandhi Krishi Vigyan Kendra, Bangalore, Karnataka. To evaluate the pathogenicity, four different kinds of seeds were used *viz*., T_1: Naturally infected seed sample, T_2: Artificially inoculated seed sample, T_3: Apparently healthy seed sample and T_4: Surface sterilized apparently healthy seed sample. For inoculation of chilli fruits, pinprick method was used and treated seeds were used for sowing in poly house. From the present study, it was observed that plant height at 60, 90 DAT and at harvest was maximum in surface sterilized seed sample (37.00 cm, 60.50 cm and 63.25 cm respectively) and minimum was recorded innaturally infected seed sample (24.50 cm, 37.00 cm and 37.00 cm, respectively).Significantly higher number of fruits per plant was recorded in apparently healthy seed sample (18.75) which was on par with number of fruits per plant obtained in surface sterilized apparently healthy seed sample (18.00).Surface sterilized seed sample showed highest fruit length (15.25 cm), fruit diameter (5.10 cm), fruit weight (9.60g) and maximum fruit yield (172g/plant). Whereas, least value for fruit length (6.00 cm), fruit diameter (3.50 cm), fruit weight (5.75 cm) and fruit yield (35.98 g/plant) were recorded in naturally infected seed sample. Therefore, early seed health detection and suitable seed treatment before sowing would help in monitoring the yield loses caused by *Colletotrichum capsici* in chilli.

Keywords: Chilli, Anthracnose, Colletotrichum capsici, pathogenicity

1. INTRODUCTION

Chilli is one of the most valuable crops in India and it is primarily grown for its fruits. Indian cuisines are world widely known and celebrated for its spicy treat to the tongue. The flavor, zest and aroma of the food produced due to the usage of spices creates an indelible experience. Among the usually exploited spices to arouse the taste buds in Indian food, whole or powdered chilli contributes an inevitable position. In Indian food chilli is used as a basic ingredient while cooking and numerous different cuisines around the globe it adds taste, pungency, flavor and tint to the dishes. Indian chilli is worldwide known for two important commercial qualities; its pungency levels and colour of chillies. Pungency levels in chilli is due to the presence of alkaloid “capsaicin”. While, “Naga Jolokia” is the world’s hottest chilli and is cultivated in Tezpura small town in Assam, India. Some varieties are famous for their capsanthin pigment which gives them vibrant red colour and others are known for their capsaicin chemical compound which gives biting pungency(Saimbhi *et al*., 1977).

Anthracnose, originating from the Greek word meaning ‘coal’, denotes plant diseases distinguished by sunken, deeply pigmented lesions containing spores. In chillies, anthracnose can manifest on leaves, stems and both pre- and post-harvest fruits. The diseases in chilli plants are known to be present mainly in two phases: (i) leaf spot and dieback, and (ii) fruit rot. Characteristic symptoms of anthracnose on chilli fruit include sunken necrotic tissues with concentric rings of acervuli. Fruits with blemishes fetch lower prices in the market (Manandhar *et al*., 1995). Anthracnose causes huge loss to chilli farmers, yield losses of up to 50 per cent has been reported in chilli by Pakdeevaraporn *et al*. (2005). Accurate identification and understanding will ultimately result in more effective disease control and management such as the selection of suitable fungicides or resilient varieties with long-lasting resistance (Whitelaw-Weckert *et al*., 2007). By considering this criterion, a research work was framed to evaluate the pathogenicity of seed borne chilli anthracnose disease caused by *Colletotrichum capsici* on chilli fruit yield.

2. MATERIAL AND METHODS

The current study was conducted at AICRP on Seed (Crops), National Seed Project, University of Agricultural Sciences, Gandhi Krishi Vigyan Kendra, Bangalore, Karnataka. To evaluate the pathogenicity, four different kinds of seeds were used *viz*., T_1: Naturally infected seed sample, T_2: Artificially inoculated seed sample, T_3: Apparently healthy seed sample and T_4: Surface sterilized apparently healthy seed sample. Treated seeds were used for sowing in poly house.

2.1 Seed source

The fresh seeds of paprika chilli variety OLA-1 were obtained from Omni Activa Private Limited, Bangalore. The infected chilli plant parts such as leaves, stems, twigs and fruits confirmed on the basis of typical symptoms exhibited by the pathogen were collected. Chilli fruits from OLA-1 variety both healthy and infected were collected from Punya Koti Farm Kotiganahalli, Kolar, Karnataka, India. Healthy seeds were extracted from the healthy fruits while, infected seeds were obtained from fruits exhibiting anthracnose symptoms. Surface sterilization of seeds was done by dipping them into 1 per cent sodium hypochlorite solution followed by adequate rinsing (2-3 times) in distilled water and were kept on sterilized blotter paper for drying.

2.2 Artificially inoculating seed sample

For inoculation, pinprick method on chilli fruit given by Naik and Rawal (2002) was followed. Seven days old cultures (Mention here pathogen name) were used for artificial inoculation. Red chilli fruits of OLA-1 variety harvested were surface sterilized with one per cent sodium hypochlorite solution and then washed in two changes of sterile water. Thereafter, the fruits were pricked with pin bundles specially designed for pricking. The pinpricked fruits were then dipped in spore suspension having 1 X 10^6 spores /ml for one minute. Further these fruits were kept for incubation on a perforated tray under humid chamber. The humid chamber was prepared by keeping water in the tray, which was placed below the perforated tray kept with inoculated fruits. Three wet cotton pieces were placed on the tray. The tray was covered with polythene sheet to maintain the relative humidity of over 90 per cent and then incubated at $25^o \pm 1^oC$ for eight days. After the development of symptom on the chilli fruits, reisolation of the fungus was made from the affected portion of the fruit as per the method described earlier (Mention where) and Koch's postulates (Need Reference) were proved. Then the seeds were extracted from fruits and kept on PDA(Mention it with Reference) for reisolation of pathogen for confirmation (Fig. 1& 2).> It is not Figure. It is plate

>Rearrange the Plate

Fig./ plate 1. Artificially inoculating fruit sample with *Colletotrichum capsici* (Specify the Plate like A &B)

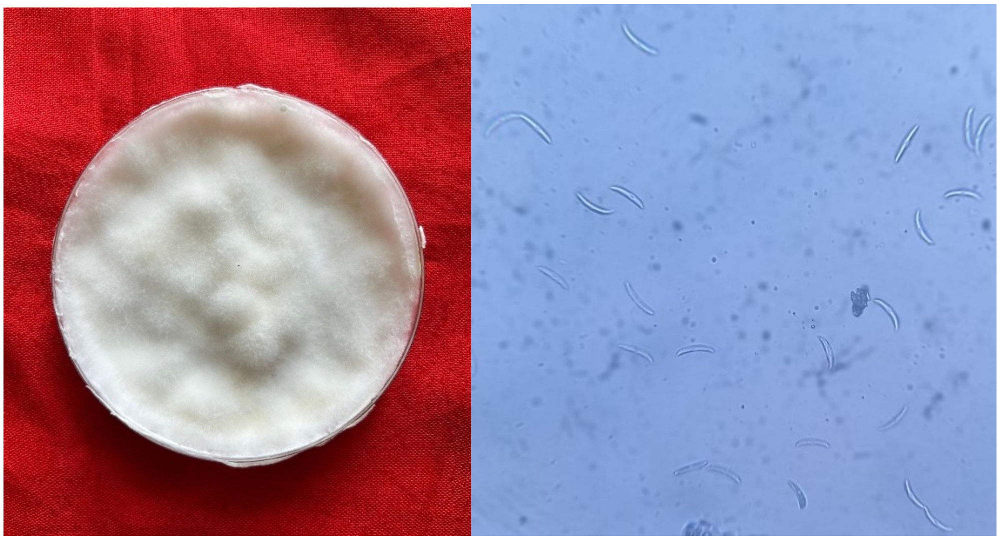

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Fig./ plate 2.Pure culture and spores of *Colletotrichum capsici* under microscope

3. RESULTS AND DISCUSSION

The results of experiment entitled "Effect of pathogenicity of seed borne chilli (*Capsicumannuum* L.) anthracnose disease on "chilli fruit" conducted at the AICRP on Seed (Crops), National Seed Project, University of Agricultural Sciences, Gandhi Krishi Vigyan Kendra, Bangalore, Karnataka is presented here.

3.1 Effect of pathogenicity of *Colletotrichum* (Why here *truncatum* instant of *capsici)* on plant height

From the data recorded, it is clear that plant height at 60 DAT was influenced by pathogenicity of *Colletotrichum truncatum* in chilli seeds. Maximum plant height at 60 DAT was obtained in surface sterilized apparently healthy seed sample (37.00 cm) and was on par with apparently healthy seed sample (35.25 cm), it is followed by artificially inoculated seed sample (27.00 cm). The lowest plant height at 60 DAT was recorded in naturally infected seed sample (24.50 cm). Surface sterilized apparently healthy seed sample (59.75 cm) recorded maximum plant height at 90 DAT and it was on par with apparently healthy seed sample (60.50 cm), which was followed by artificially inoculated seed sample (40.00 cm). The lowest plant height at 90 DAT was recorded in naturally infected seed sample (37.00 cm). Statistically significant result was obtained for plant height at harvest, surface sterilized apparently healthy seed sample (63.25 cm) recorded maximum plant height at harvest and it was on par with apparently healthy seed sample (64.00 cm) and it was followed by artificially inoculated seed sample which recorded 41.25 cm of plant height at harvest. The lowest plant height at harvest was recorded in naturally infected seed sample (37.00 cm) (Table 1). The results are in line with Kumudkumar *et al*., (2004) **>add Reference section** in chilli. The reduction in plant height in chilli plants infected with *Colletotrichum truncatum* at all stages of growth is due to tissue damage, impaired nutrient and water uptake, decreased photosynthesis, and general stress-induced growth limitations (Than *et al*., 2008).

Table 1. Effect of pathogenicity of *Colletotrichum truncatum* on plant height in chilli

Treatments	[Add here Plant height in chilli (cm)]		
	60 DAT	90 DAT	At harvest (120 DAT)
T_1: Naturally infected seed sample	24.50	37.00	37.00
T_2: Artificially inoculated seed sample	27.00	40.00	41.25
T_3: Apparently healthy seed	35.25	60.50	64.00

sample			
T_4: Surface sterilized apparently healthy seed sample	37.00	59.75	63.25
Mean	30.94	49.31	51.38
S. Em±	0.673	0.997	0.669
CD (P=0.05)	2.074	3.073	2.891
CV (%)	4.35	4.05	2.60

**DAT: Days After Transplanting*

3.2 Effect of pathogenicity of *Colletotrichum truncatum* on fruit parameters

Significantly higher number of fruits per plant was recorded in apparently healthy seed sample (18.75) which is on par with number of fruits per plant obtained in surface sterilized apparently healthy seed sample (18.00) and it was followed by artificially inoculated seed sample (8.31). Least number of fruits per plant was noticed in naturally infected seed sample (6.29).Fruit length was noticed to be significant among different kinds of seed samples. Surface sterilized apparently healthy seed sample showed highest fruit length of 15.25 cm and was on par with fruit length recorded in apparently healthy seed sample (14.63 cm) which was followed by artificially inoculated seed sample (7.00 cm). Lowest value for fruit length was observed in naturally infected seed sample (6.00 cm).Surface sterilized apparently healthy seed sample showed highest fruit diameter of 5.10 cm and was on par with apparently healthy seed sample (5.00 cm), it was followed by artificially inoculated seed sample (3.83 cm). Lowest value for fruit diameter was observed in naturally infected seed sample (3.50 cm).Fruit weight differed significantly among different treatments, significantly highest fruit weight of 9.60g was recorded in surface sterilized apparently healthy seed sample which was on par with fruit weight obtained from apparently healthy seed sample (9.00 g) and followed by artificially inoculated seed sample (6.35 g). Lowest value for fruit weight was noticed in naturally infected seed sample (5.75 cm). Fruit yield per plant differed significantly among the seed samples. Maximum fruit yield (g/plant) was obtained in surface sterilized apparently healthy seed sample (172.49 g) which is on par with apparently healthy seed sample (168.63 g/plant) and followed by artificially inoculated seed sample (52.81 g/plant). The lowest fruit yield (g/plant) was recorded in naturally infected seed sample (35.98 g/plant) (Table 2 and Fig. 3). Similar results were obtained by Lakshmesha *et al*., (2005) in chilli and Pakdeevaraporn *et al*., (2005) reported 80 per cent reduced fruit yield of chilli due to seed borne anthracnose. These results are in line with Saxena *et al*., (2014) in chilli.Anthracnose, caused by fungal pathogens, leads to the formation of lesions on various plant parts, including leaves and stems. These lesions disrupt the plant's ability to photosynthesize effectively, as damaged leaves have reduced photosynthetic capacity (Liao *et al*., 2012) **(>add Reference section)**. Consequently, the plant produces fewer nutrients and energy required for fruit growth. Additionally, the disease causes stress and damages the plant’s vascular system, impairing the efficient transport of water and nutrients to developing fruits (Latunde-Dada and Lucas, 2007). This disruption leads to stunted growth and shorter fruit length, fruit diameter and fruit weight (Prusky *et al*., 2000).

Table 2. Effect of pathogenicity of *Colletotrichum truncatum*on fruit parameters in chilli

Treatments	**Number of fruits per plant**	**Fruit length (cm)**	**Fruit diameter (cm)**	**Fruit weight (g)**	**Fruit yield (g/ plant)**
T_1: Naturally infected seed sample	6.29	6.00	3.50	5.75	35.98
T_2: Artificially inoculated seed sample	8.31	7.00	3.83	6.35	52.81
T_3: Apparently healthy seed sample	18.75	14.63	5.00	9.00	168.63
T_4: Surface sterilized apparently healthy seed sample	18.00	15.25	5.10	9.60	172.49
Mean	12.84	10.72	4.36	7.67	107.48
S. Em±	0.584	0.488	0.181	0.288	4.457
CD (P=0.05)	1.799	1.504	0.557	0.886	13.734
CV (%)	9.10	9.11	8.30	7.49	8.29

3.3 Correlation between different fruit yielding parameters in chilli

Correlation coefficients among various fruit traits, including the number of fruits per plant, fruit length, fruit diameter, fruit weight, and fruit yield (g/plant) (Table 3).

Fruit yield per plant shows the highest correlations with all parameters, including fruit length (r = 0.9995), fruit diameter (r = 0.9969), and number of fruits per plant (r = 0.9970) (Table 11)**>Where.** This suggests that fruit yield is heavily influenced by the number of fruits, as well as the size and weight of the fruits. The correlation coefficient between fruit yield and fruit length is almost perfect (r = 0.9995), indicating that longer fruits significantly contribute to higher overall yield. Similarly, fruit yield is highly correlated with number of fruits per plant (r = 0.9970), suggesting that an increase in the number of fruits directly increases the total fruit yield per plant. Heavier fruits with larger diameters and longer lengths contribute significantly to higher yield. These results suggest that selecting for larger and heavier fruits will likely lead to an increase in overall fruit yield.

Table 3.Correlation between different fruit parameters in chilli

Sl. No.	Correlation Coefficients	Number of fruits per plant	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Fruit yield (g/plant)
1.	**Number of fruits per plant**	1.000				
2.	**Fruit length (cm)**	0.9941	1.000			
3.	**Fruit diameter (cm)**	0.9945	0.9965	1.000		
4.	**Fruit weight (g)**	0.9845	0.9960	0.9962	1.000	
5.	**Fruit yield (g/plant)**	0.9970	0.9995	0.9969	0.9936	1.000

Fig.3.Surface sterilized apparently healthy seed sample and naturally infected seed sample at harvest (Show A & B and mark seed sample)

4. CONCLUSION

The study demonstrates the importance of seed health in chilli. From the present study, it was observed that plant height at 60, 90 DAT and at harvest is maximum in surface sterilized seed sample (37.00 cm, 60.50 cm and 63.25 cm respectively) and minimum is recorded in naturally infected seed sample (24.50 cm, 37.00 cm and 37.00 cm respectively).Significantly higher number of fruits per plant was recorded in apparently healthy seed sample (18.75) which was on par with number of fruits per plant obtained in surface sterilized apparently healthy seed sample (18.00). Surface sterilized seed sample showed highest fruit length (15.25 cm), fruit diameter (5.10 cm), fruit weight (9.60g) and maximum fruit yield (172g/plant). Whereas, least value for fruit length (6.00 cm), fruit diameter (3.50 cm), fruit weight (5.75 cm) and fruit yield (35.98 g/plant) were recorded in naturally infected seed sample.Therefore, early seed health detection and suitable seed treatment before sowing would help in monitoring the yield loses caused by ***Colletotrichum capsici*** in chilli.

REFERENCES

Lakshmesha, K. K., Lakshmidevi, N., & Mallikarjuna, S. A. (2005). Changes in pectinase and cellulase activity of *Colletotrichum capsici* mutants and their effect on anthracnose disease on capsicum fruit. *Archives of Phytopathology and Plant protection*, *38*(4), 267-279.

Latunde-Dada, A. O., & Lucas, J. A. (2007). Localized hemibiotrophy in *Colletotrichum*: cytological and molecular taxonomic similarities among *C. destructivum, C. linicola* and *C. truncatum*. *Plant Pathology*, *56*(3), 437-447.

Manandhar, J. B., Hartman, G. L., & Wang, T. C. (1995). Anthracnose development on pepper fruits inoculated with *Colletotrichum gloeosporioides*. 380-383.

Naik, M. K., & Rawal, R. D. (2002). Disease resistance in horticultural crops.*Farm Science Journal*, 13 (2): 152-153.

Pakdeevaraporn, P., Wasee, S., Taylor, P. W. J., &Mongkolporn, O. (2005). Inheritance of resistance to anthracnose caused by *Colletotrichum capsici* in *Capsicum*. *Plant Breeding*, 124(2), 206-208.

Prusky, D., Koblier, I., Ardi, R., Beno-Moalem, D., Yakoby, N., & Keen, N. (2000). Resistance mechanisms of subtropical fruits to *Colletotrichumgloeosporioides*. *Colletotrichum: Host Specificity, Pathology, and Host-Pathogen Interaction*, 232-244.

Saimbhi, M. S., Kan, G., &Nandpuri, K. S. (1977). Chillies are rich in vitamins especially vitamin C. Qualita Plantarum, 27, 171-175.

Saxena, A., Raghuwanshi, R., & Singh, H. B. (2014). Molecular, phenotypic and pathogenic variability in *Colletotrichum* isolates of subtropical region in north-eastern India, causing fruit rot of chillies. *Journal of applied microbiology*, *117*(5), 1422-1434.

Than, P. P., Jeewon, R., Hyde, K. D., Pongsupasamit, S., Mongkolporn, O., & Taylor, P. W. J. (2008). Characterization and pathogenicity of *Colletotrichum* species associated with anthracnose on chilli (*Capsicum* spp.) in Thailand. *Plant pathology*, *57*(3), 562-572.

Whitelaw-Weckert, M. A., Curtin, S. J., Huang, R., Steel, C. C., Blanchard, C. L., & Roffey, P. E. (2007). Phylogenetic relationships and pathogenicity of Colletotrichum acutatum isolates from grape in subtropical Australia. *Plant Pathology*, *56*(3), 448-463.

####Note: Please note red and yellow color.