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Determination of seed borne nature of *Colletotrichum lindemuthianum* from stored seeds of green gram

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Abstract
Green gram is an important short duration pulse crop grown in India and its seed yield is the most potential part in crop production. Seeds free from fungal infection are essential for good plant production and seeds infected with any fungal pathogen act as primary source of inoculum when such seeds are sown. Anthracnose of green gram caused by *Colletotrichum lindemuthianum* is a serious soil as well as seed borne pathogen. The stored seed samples of green gram variety Gujarat Mung-4 (GM-4) was used to know the seed borne nature of *Colletotrichum lindemuthianum* employing standard blotter method. The results indicated that the seeds collected from diseased plants yielded pure culture of *Colletotrichum lindemuthianum* from October to June. It was recorded that in month of October, there were 38.52 per cent infected seeds which decreased to 11.08 per cent in month of June and about five per cent seeds were infected with other fungi.

Keywords: Anthracnose, *Colletotrichum lindemuthianum*, green gram, seed borne

Introduction
Green gram [*Vigna radiata* (L.) Wilczek] commonly also known as mung bean is an important short duration pulse crop grown in India. Being a short duration crop, it fits well in many intensive crop rotations. It is also considered as "Golden Bean" because of its nutritional values and suitability for increasing the soil fertility by way of addition of nitrogen (30 kg/ha/annum). In India green gram is grown mainly as a *kharif* season crop. However, its cultivation in *rabi* season is restricted to the western and southern parts of the country. The major green gram growing states are Orissa, Maharashtra, Gujarat, Rajasthan, Karnataka and Andhra Pradesh. In spite of having vast area of 4.24 m ha under green gram with a production of 2.02 MT, the average yield of green gram in our country is very low. It has the yield potential of 11 to 12 q/ha as against the national average of 4.77q/ha. In Gujarat, green gram occupies 1.52 lakh ha area with a production of 0.85 lakh tonnes mainly grown in Kutch, Banaskantha, Saurashtra, Mehsana, Dahod, Panchmahal and Mahisagar districts in *kharif* season under inadequate and erratic rainfall (Anonymous, 2018) [2].
The methods of survival and spread of the pathogen need to be worked out to delink the infection chain at appropriate time in order to manage the disease effectively. Seeds are the most potential part in crop production. Seeds free from fungal infection are essential for good plant production and seeds infected with any fungal pathogen act as primary source of inoculum when such seeds are sown. In recent years, anthracnose of green gram caused by *Colletotrichum lindemuthianum* (Sacc. & Magn.) Briosi and Cavara has become one of the serious diseases of green gram. *Colletotrichum lindemuthianum*, is a serious soil as well as seed borne pathogen of many pulse crops throughout the world and has been reported to occur on *kharif* pulses in severe condition (Kulkarni, 2009) [3]. Therefore, the present study was conducted to know the seed borne nature of *Colletotrichum lindemuthianum* causing anthracnose of green gram, under the stored condition of seeds from the previously harvested crop.

Material and Methods
The stored seed samples of green gram variety Gujarat Mung – 4 (GM-4) was collected from Plant Pathology farm, JAU, Junagadh. The test was carried out for seed mycoflora by employing standard blotter method as per the International Rules for Seed Testing described by ISTA (Anonymous, 1996) [1]. Four hundred seeds were submerged in a solution of 1 per cent sodium hypochlorite for 10 min and allowed to drain. After that, seeds were placed equidistantly in plastic dish containing sterile moist paper towel moistened with sterile

distilled water. There were two layers of paper towel placed on bottom and lid of the plastic dish to facilitate moist condition. Then seeds were covered with lid of plastic dish having paper towel soaked in water. These plastic dishes were kept in three replications. After that, these plates were kept in incubator for seven days under diurnal cycles of 12 h light and 12 h darkness at room temperature of 28±1 °C.

After 7 days, plastic dishes were examined by naked eyes for dark depressed area with well delimited outlines. Also, presence of any fungal body *i.e.* mycelium was checked. Then further observations were taken in light microscope to confirm identification of test fungus. This experiment was repeated periodically though out the year (October to June) to check the survival of *Colletotrichum lindemuthianum* on seeds of green gram.

Results and Discussion

The role of seeds in perpetuation of anthracnose disease of green gram and the survival of the pathogen (*Colletotrichum lindemuthianum*) was studied during present investigation. To study the seed borne nature of pathogen, monthly isolations were made from stored seeds of naturally infected plants of green gram as well as from the disease free seeds sterilized with sodium hypochlorite. The results have been presented in Table-1.

The results indicated that the seeds collected from diseased plants yielded pure culture of *Colletotrichum lindemuthianum* from October to June. Pure culture of *C. lindemuthianum* was isolated from the stored seeds collected from diseased plants of green gram, which showed the association of the pathogen even after harvest and in storage condition pathogen survived from October till June. It was recorded that in month of October, there were 38.52 per cent infected seeds which decreased to 11.08 per cent in month of June and about five per cent seeds were infected with other fungi. Thus, it was evident that seeds were the carriers of pathogen from one season to another as pathogen survived till June month and farmers use seeds from previous harvest in most of the cases. The present observations indicate the potentiality of green gram seed as a carrier of primary inoculum. This study suggests that since *Colletotrichum lindemuthianum* can survive for longer period, the care is needed to be taken while exchanging the green gram seeds for sowing purpose.

Table 1: Survival of pathogen in green gram seeds

Sr. No.	Month	Infected seed from diseased plant (%)	Other fungi (%)	Per cent infection in healthy seeds
1	October	38.52	7.6	
2	November	35.80	4.1	-
3	December	31.04	2.2	-
4	January	27.92	-	-
5	February	24.37	-	-
6	March	21.16	-	-
7	April	17.61	-	-
8	May	14.83	-	-
9	June	11.08	-	-

To summarise, the pathogen was externally seed transmitted, and primary disease infection was caused by infected seeds. The appearance of tiny acervuli bearing conidia on the seed coat further proved *Colletotrichum lindemuthianum* seed-borne origin. These conidia will grow alongside seeds and infected radicals, infecting seeds and seedlings, confirming the disease's seed-borne transmission through the seed coat to seedlings. It's possible that when the seeds germinated, the pathogen's dormant mycelium became active and developed alongside the seedlings, causing post-emergence mortality and harm to the seeds and seedlings. These findings are consistent with those of Kumud *et al*. (2004) [4], Singh and Vishunavat (2007) [6], Madhusudhan (2002) [5], Sunil and Benagi (2012) [7] and Tandel *et al*. (2015) [8] who worked with *Colletotrichum dematium*, *Colletotrichum capsici*, *Colletotrichum truncatum* and *Colletotrichum* sp. in chilli, soybean and green gram crop, respectively.

Conclusion

Hence, it was observed that the seed borne fungi *Colletotrichum lindemuthianum* was pathogenic and long lasting in green gram seeds and from present study it was also detected that pathogen is seed transmissible nature.

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