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## Prevalence, distribution and symptomatology of anthracnose disease of soybean in Uttarakhand

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**Abstract**

A comprehensive survey of important soybean growing areas of northern hill and plain zone of Uttarakhand was conducted, during Kharif 2017 to 2019 to reveal the incidence and severity of soybean anthracnose. The survey studies showed that the anthracnose disease is distributed throughout eleven districts out of twelve districts surveyed. Highest disease incidence (37.64%) and severity (23.96%) was recorded in district Pithoragarh of Kumaun region while lowest disease incidence (6.56%) and severity (3.36%) was recorded at Dehradun and Nanital district, respectively. The anthracnose disease incidence and severity shows moderate positive correlation with rising altitude. The highest Disease incidence and severity of anthracnose was observed greatest at altitudes ranging from 1530 - 1734 m above sea level.

**Keywords:** Soybean, survey, percent disease index, *Colletotrichum truncatum*

**Introduction**

Soybean (*Glycine max* L. Merrill) is one of the oldest crops grown worldwide. With its 40% protein and 20% per cent oil, the plant is considered more as an oil seed than a pulse crop. In area and production of soybean, India ranks fifth in the world. For soybean cultivation India is divided into five agro-climatic zones. These are central zone, northern hill zone, northern plain zone, north eastern zone and southern zone [2]. Some part of northern hill and northern plain zone comes under Uttarakhand state. The state of Uttarakhand comprised of Kumaun and Garhwal divisions, and divided into four zones on the basis of altitude, these zones are tarai and bhabar (up to 1000 m), low hills (1000-1500m), high hills (1500-2400m) and very high hills (2400 m and above) (State Horticulture Mission, Govt. of Uttarakhand). Soybean (Black seed coat soybean variety) is an important and major kharif crop of Kumaon and Garhwal region of Uttarakhand and it plays an important role in the economy of farmers [7]. But presently many soybean areas are declining and there is hue and cry among the farmers because the crop suffers from number of diseases, among them anthracnose leaf and pod blight is considered as one of the most serious fungal disease. Anthracnose leaf spot and pod blight is incited by *Colletotrichum truncatum* (Schw) Andrus and Moore, found to be the most destructive and devastating disease, as it cause heavy economic losses to the crop, which may reach up to 100 per cent in conducive environmental conditions [9]. The disease often appears in epidemic proportion in major soybean growing areas resulting in extensive damage to the crop. In Uttarakhand the disease appears in moderate to epidemic proportion in many areas and is the main limiting factor for soybean production, especially in the mid hill region. The crop soybean is susceptible to the pathogen at all stages of development especially from bloom to pod fill stage. The occurrence of leaf spot causes irregular shaped brown spots on leaves; rolling leaves; and premature defoliation. At advanced stages of disease development (near soybean maturity) black fruiting bodies (Acervuli) that produce minute black spines (setae) are evident on infected pods and sometimes in infected stem and petiole. Infected seed often become discoloured and may die during germination [10]. The disease is more prevalent under humid and moderate temperature conditions. The disease causes severe damage by reducing plant stand, seed quality, seed germination, seedling vigour and yield [11].

Keeping in view, the huge losses caused by the pathogen in different soybean producing areas of India and other countries, the present studies were carried out to establish the status of the disease in the hill and plain region of Uttarakhand.

## Materials and Method

A systematic survey was carried out in different districts of Uttarakhand covering 82 villages in 11 districts during kharif 2017 to 2019 to assess the incidence and severity of the anthracnose and pod blight diseases. A systematic sampling method was adopted for the selection of fields, to provide an unbiased means of selecting crops for recording the presence of disease. Two fields at each location were randomly selected and numbers of infected plants were recorded at 1 m<sup>2</sup> area in four corners and centre of the field, comprising ten plants each. A series of parameters were assessed at each field like, altitude, cropping system, plant growth stage (VE-R8), incidence and severity of anthracnose and pod blight. Standard 0-9 grade rating scale given by Mayee and Datar [7] was used to record disease intensity (Table 1). Plants were diagnosed on the basis of typical symptoms of anthracnose disease on stem, leaves, petioles and pods.

Disease incidence (DI) is defined as a measure of infected plants from total plants and calculated according to the following formula:

$$\text{Disease Incidence (DI\%)} = \frac{\text{Number of diseased plants}}{\text{Total number of plants observed}} \times 100$$

**Table 1:** Standard disease rating scale (Mayee and Datar, 1986; AICRP on soybean, 2008) [7].

| Rating | Description                                                                                                                     |
|--------|---------------------------------------------------------------------------------------------------------------------------------|
| 0      | No lesions                                                                                                                      |
| 1      | 1% leaf area covered with lesions                                                                                               |
| 3      | 1.1 – 10% leaf area covered with lesions, no spots on stem                                                                      |
| 5      | 10.1-25% leaf area covered, no defoliation; little damage.                                                                      |
| 7      | 25.1-50% leaf area covered; some leaves dropped; death of a few plants; damage conspicuous.                                     |
| 9      | More than 50% are covered, lesions very common on all plants, defoliation common; death of plants common; damage more than 50%. |

## Results

Systematic surveys of soybean growing areas in different districts of Uttarakhand revealed variable occurrence and distribution of anthracnose and pod blight disease in all the 11 districts surveyed except Haridwar district (no soybean cultivation). The distribution of the anthracnose leaf spot appears to be more clustered in the Kumaun (25.55% mean disease incidence and 12.78% mean disease severity) as compare to the Garhwal (16.46% mean disease incidence and 7.93% mean disease severity) (figure 4), and the greatest prevalence of the anthracnose disease was observed in Pithoragarh district of Kumaun region. The mean disease incidence and per cent disease index of anthracnose leaf blight in the eleven districts surveyed were ranged from 6.56 (Dehradun) to 37.64 (Pithoragarh) per cent and 3.36 (Nanital) to 23.96 (Pithoragarh) per cent, respectively (Table 2). At Chandak village of Pithoragarh, highest disease incidence (58.02%) and severity (39.52%) was recorded. Overall

## Total number of plants observed

The observations on disease severity were recorded on 0-9 scale and per cent disease index was calculated using the formula given by Wheeler (1969) [12].

$$\text{Percent Disease Index} = \frac{\sum(n \times v)}{N \times G} \times 100$$

## Where,

n = number of diseased leaves/pods in each category

v = Category value

N = Total number of leaves/pods examined

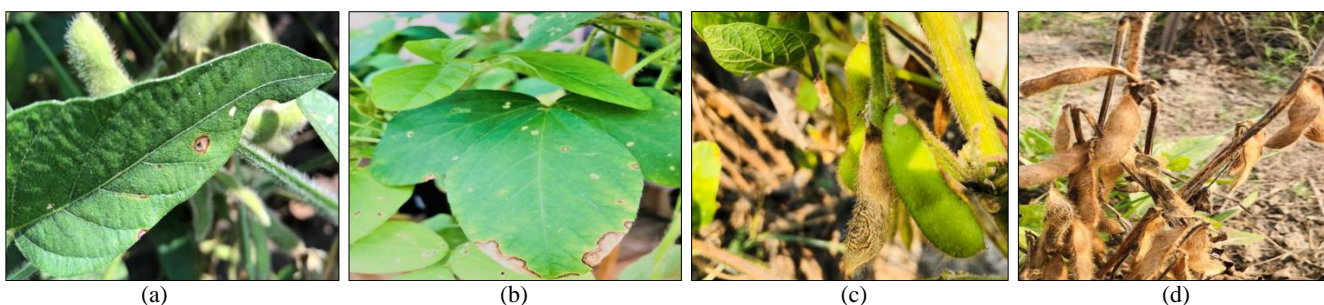
G = Highest category value

The study was conducted in low, mid and high hills zones of Uttarakhand, (covering main soybean growing areas in the state) altitude ranging from 259 to 1734 m above sea level.

The effect of increasing altitude on the disease pressure was determined with the use of correlation analysis in SPSS.

average anthracnose intensity (21.72%) as well as severity (11.48%) was found to be highest during kharif 2018.

The huge variation in the disease pressure can be due to various factors such as change in altitude, variable climatic conditions specifically temperature and precipitation, etc. The altitude ranges covered in the survey were from 259 to 1734 m above sea level and it was recorded that disease incidence as well as severity increased with rise in altitude except for Udham Singh Nagar district with 259.43 m average altitude (Figure 3). The sporadic incidence of the disease was observed in all the districts surveyed. The incidence and severity of anthracnose was observed greatest at altitudes of 1530 - 1734 m above sea level, at Pithoragarh and Champawat district, respectively and lowest at altitudes of 407.44 – 451.20 m, at Nanital district (low hill regions) and Dehradun district, respectively. Moderate positive correlation of 0.60 and 0.50 was observed between rising altitude and disease incidence and disease severity, respectively.



**Fig 1:** Symptoms of anthracnose leaf and pod blight of soybean: (a) On leaf (under natural conditions), (b) On leaf (under artificial conditions), (c) On pod, and (d) On the stems and pods

The disease symptoms were found to appear on almost all above ground plant parts, viz; leaves, petiole, stem and pods. The characteristic symptoms observed in different plant parts are presented in figure 1. On leaves, the symptoms were characterised by irregular brown necrotic lesions and in later stages, the middle necrotic portion withered away and giving

a shot hole type of symptoms. Symptoms on petiole were also evident in the form sunken necrotic spots. At the host maturity the pods and stems were severely attacked by the fungus, numerous fruiting structures (acervuli) developed in rings on pod surface ultimately lead to blackening and failure of the pod to fill.

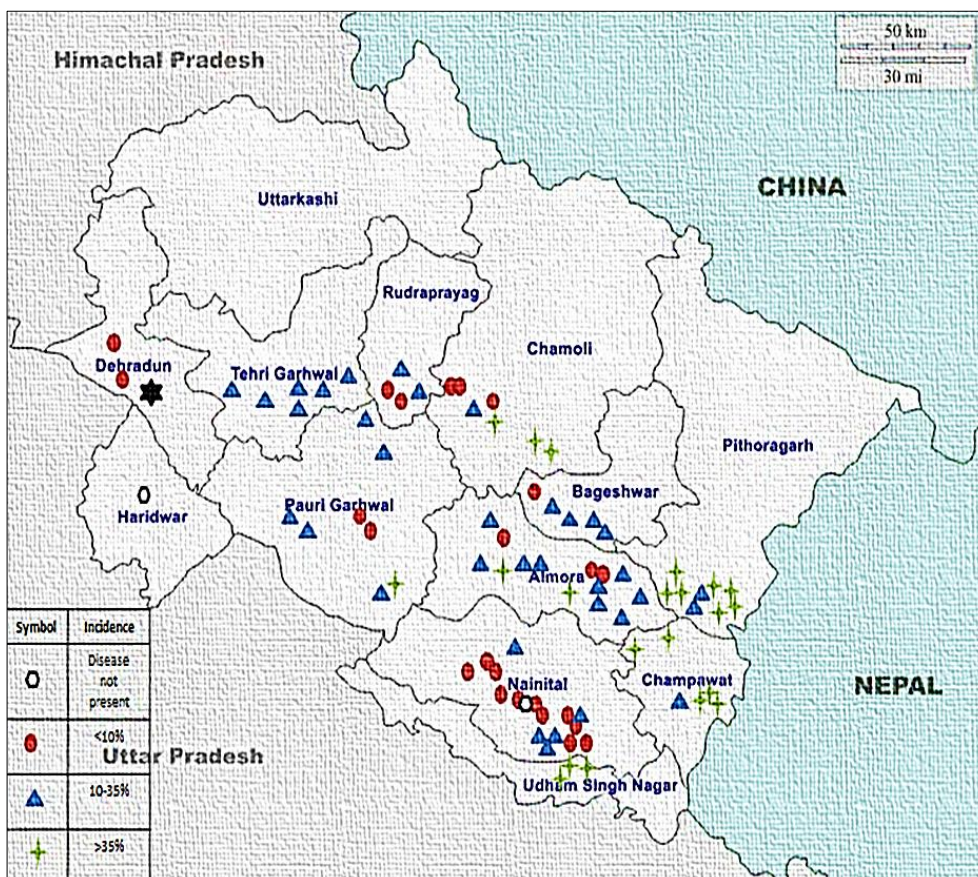
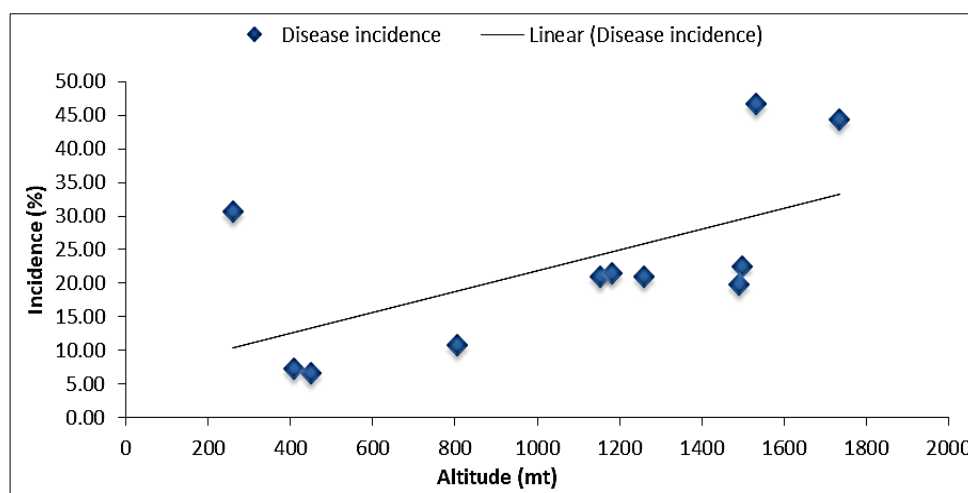


Fig 2: Distribution of anthracnose disease in major soybean growing areas of Uttarakhand during 2017 to 2019

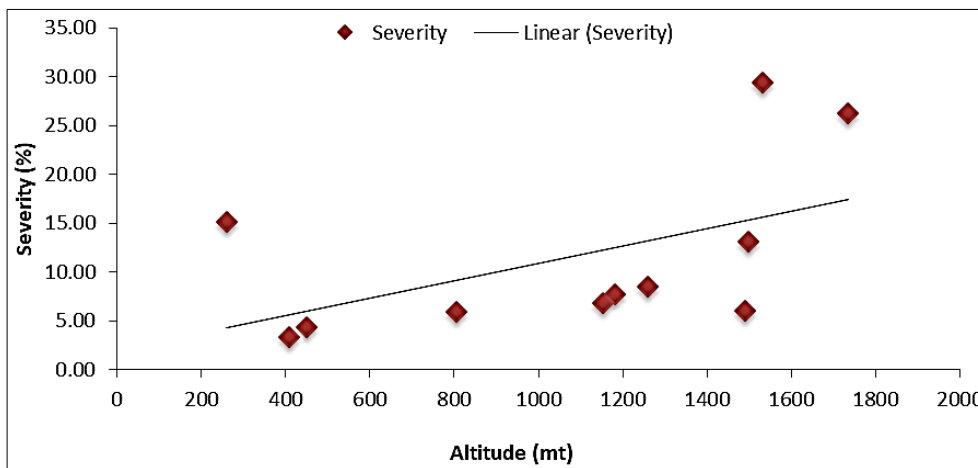
**Discussion**

The study demonstrated that the disease is more prevalent in high hilly Zones than the low hills or plain region. In the districts where soybean anthracnose was observed, the prevalence was greatest in 2018 and least in 2017. The results showed that locations falling within the altitude range of 1530-1734 m were more prevalent for anthracnose than locations at altitudes below 1000 m except for Udhum Singh

Nagar district. The reason behind this exception can be the congenial environmental conditions of the district for the disease. It comes in the tarai region of Uttarakhand, where from July to October the temperature is moderate (25 – 30 °C) and relative humidity is high (more than 90%), and these conditions are very favourable for the development of anthracnose, as described by various investigators (Chandra *et al.* 1989, Fitzell and Peak, 1987, Aggarwal *et al.*, 2017) <sup>[1, 3, 5]</sup>.



(a)

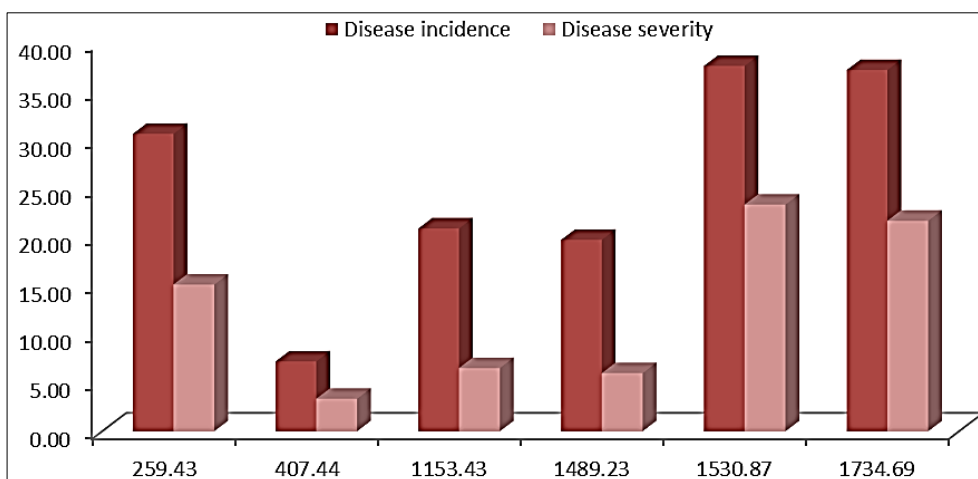


(b)

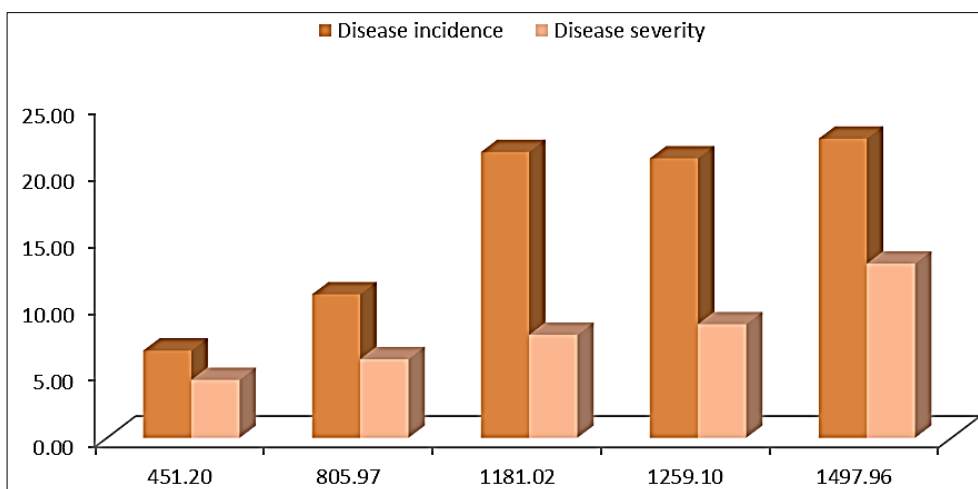
**Fig 3:** Effect of changing altitude on (a) incidence and (b) severity of anthracnose disease of soybean

Moderate positive correlation was observed between rising altitude and disease pressure, same results were found by olatinwo *et al.*, (1999) [8] in the survey studies of *Stenocarpella macrospora* (Earle) leaf blight of maize in the mid-altitude zone of Nigeria. They also reported moderate positive correlation of disease incidence and severity with altitude. Same studies of survey were conducted by various

investigators in different crops and diseases; Chavan and Dhutraj, 2017, on anthracnose and pod blight of soybean in Marathwada region of Maharashtra, Kulkarni and Benagi, 2013, on anthracnose of greengram in Northern Karnataka, Mathpal and Singh, 2017, on rhizoctonia aerial blight of soybean in Uttarakhand.



(a)



(b)

**Fig 4:** Graphical representation of anthracnose disease in (a) Kumaun and (b) Garhwal region

**Table 2:** Status and distribution of soybean anthracnose disease in Uttarakhand during 2017- 2019

| District          | Altitude (m) | Number of location | Mean percent disease incidence (%) | Mean percent disease index (%) |
|-------------------|--------------|--------------------|------------------------------------|--------------------------------|
| Bageshwar         | 1153.43      | 5                  | 20.90                              | 6.52                           |
| Nanital           | 407.44       | 17                 | 7.20                               | 3.36                           |
| Udham Singh Nagar | 259.43       | 3                  | 30.64                              | 15.12                          |
| Pithoragarh       | 1530.87      | 10                 | 37.64                              | 23.35                          |
| Almora            | 1489.23      | 14                 | 19.73                              | 6.00                           |
| Champawat         | 1734.69      | 6                  | 37.21                              | 21.69                          |
| Pauri Garhwal     | 1181.02      | 8                  | 21.48                              | 7.74                           |
| Tehri Garhwal     | 1497.96      | 6                  | 22.48                              | 13.09                          |
| Dehradun          | 451.20       | 2                  | 6.56                               | 4.36                           |
| Chamoli           | 1259.10      | 7                  | 21.00                              | 8.54                           |
| Rudraprayag       | 805.97       | 4                  | 10.79                              | 5.92                           |

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