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Short Communication

Development of weather based statistical models for Rhizoctonia aerial blight disease of soybean in Tarai region of Uttarakhand

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The cultivation of soybean (*Glycine max*) holds a crucial position in global agriculture, making substantial contributions to both the food and industrial sectors. Positioned as the foremost legume globally, soy serves dual roles as a provider of protein and vegetable oil (Hudson *et al*., 2022). Enhancing soybean production nationwide is within reach by concurrently elevating productivity and expanding cultivation areas (Sharma *et al*., 2022). Despite its high importance, soybean crops are susceptible to various diseases that can negatively impact both yield and quality. In this context, the percent disease index (PDI) serves as a valuable metric for quantifying Rhizoctonia aerial blight disease severity and assessing the impact of various factors on soybean health. The disease is characterized by the existence of light to dark brown spots, along with superficial mycelium resembling a web and sclerotia on the affected tissue (Verma and Thapliyal, 1976).

The Tarai region of Uttarakhand, known for its diverse agroclimatic conditions, stands as a significant soybean cultivation area. The region's distinctive climate and topography create an intriguing and challenging environment for soybean cultivation, with temperature, humidity, and precipitation acting as pivotal factors influencing disease dynamics. This research endeavours to address this gap by conducting a thorough investigation into the relationship between Rhizoctonia aerial blight disease's PDI and weather variables in soybean crops within the Tarai region of Uttarakhand. The primary objectives encompass the development and rigorous testing of diverse statistical models that incorporate various weather parameters to accurately predict PDI.

A field trial was conducted during the *kharif* season of 2021-22 at the Norman E. Borlaug Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. Sixteen soybean cultivars, namely JS-7244, JS-7546, JS-7105, JS-72-220, PK-262, PK-472, MACS-52, JS-93-05, Pb-1, Bragg, Monetta, KHSb-2, NRC-7, VLS-58, JS-335 and Shivalik, were employed for the study. All phenological parameters and disease progression were systematically recorded at fixed interval on weekly basis. Daily weather data were collected from agrometeorological observatory. The statistical package for the social sciences (SPSS) was employed for statistical analysis. The multiple regression equations were developed between PDI and weather parameters. The coefficient of multiple correlations (R^2) was computed to assess the impact of independent variables, including maximum air temperature (X1), maximum relative humidity (X2), rainfall (X3), and sunshine hours (X4), on the dependent variable, Rhizoctonia aerial blight disease index (Y).

The regression equations, thus developed, are presented in Table 1. The coefficient of determination (R^2) ranged from 0.56 to 0.748. The highest (R^2=0.748) was observed for the cultivar PK-472 (0.748), followed by VLS-58 (0.715) and NRC (0.71), indicating well-fitted equations for predicting PDI. Conversely, the lowest coefficient of determination was found for cultivar JS-7244 (0.562). The results indicated that these weather variables played a pivotal role in disease prevalence and spread, collectively accounting for 56 to 75% of the variability in Rhizoctonia aerial blight disease index. Throughout the crop season, the primary contributors to RAB development across all cultivars in constructing the regression model were identified as maximum temperature (>34 ºC), morning relative humidity (93%), rainfall (76.2 mm) and sunshine hours.

The present study's findings align with Fagodiya *et al.,* (2022), who observed varying severity of Alternaria leaf spot disease influenced by meteorological conditions during the *kharif* seasons of 2018 and 2019. The study revealed an increase in percent disease index after the disease onset, with early sown crops exhibiting higher

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Table 1: Statistical models for PDI with weather variables for soybean

Variety	Regression equation	R^2
JS-7244	Y=444.874-2.743 (X_1) -3.819 (X_2) +0.121 (X_3) +1.650 (X_4)	0.562
JS-7546	Y=427.598-1.540 (X_1) -4.074 (X_2) +0.127 (X_3) +1.624 (X_4)	0.671
JS-7105	Y=302.146-0.451 (X_1) -2.876 (X_2) -0.55 (X_3) -1.196 (X_4)	0.710
JS-72-220	Y=453.094-3.275 (X_1) -3.607 (X_2) +0.065 (X_3) +0.298 (X_4)	0.679
PK-262	Y=213.200-1.619 (X_1) -1.578 (X_2) -0.010 (X_3) -0.664 (X_4)	0.652
PK-472	Y=228.205-1.402 (X_1) -1.755 (X_2) -0.011 (X_3) -1.367 (X_4)	0.748
MACS-52	Y=423.045-2.376 (X_1) -3.633 (X_2) +0.22 (X_3) +0.781 (X_4)	0.583
JS-93-05	Y=428.941-1.833 (X_1) -3.909 (X_2) +0.047 (X_3) +0.834 (X_4)	0.697
Pb-1	Y=454.013-2.490 (X_1) -3.836 (X_2) +0.081 (X_3) -0.192 (X_4)	0.664
Bragg	Y=398.228-3.971 (X_1) -2.667 (X_2) +0.004 (X_3) -0.685 (X_4)	0.633
Monetta	Y=497.842-2.746 (X_1) -4.376 (X_2) +0.101 (X_3) +1.422 (X_4)	0.688
KHSb-2	Y=415.003-1.809 (X_1) -3.663 (X_2) +0.019 (X_3) -0.287 (X_4)	0.651
NRC-7	Y=417.488-3.214 (X_1) -3.102 (X_2) -0.008 (X_3) -1.221 (X_4)	0.710
VLS-58	Y=544.946-2.690 (X_1) -4.773 (X_2) +0.41 (X_3) -0.175 (X_4)	0.715
JS-335	Y=455.719-1.492 (X_1) -4.244 (X_2) +0.021 (X_3) +0.035 (X_4)	0.690
Shivalik	Y=501.354-2.827 (X_1) -4.317 (X_2) +0.066 (X_3) +0.841 (X_4)	0.692

severity. Similar investigations were conducted by Verma *et al.,* (2023) on black pepper, indicating that meteorological conditions significantly affected the occurrence of anthracnose disease. Key weather variables, such as rainfall, minimum temperature, rainy days and morning relative humidity, were identified as statistically significant factors influencing disease occurrence and spread. In contrast, maximum temperature, evening relative humidity and bright sunshine hours showed no impact on disease occurrence. Amrate *et al.,* (2021) have also reported that maximum temperature, rainfall and relative humidity played a significant role in initiation and development of aerial blight disease in soybean. Analysing the positive or negative contributions of the studied meteorological factors to PDI increase, this study corroborates findings by Rini *et al.,* (2017) regarding the inverse relationship between maximum temperature and PDI.

This study has demonstrated the utility of multiple regression models in assessing the relationship between weather variables and Rhizoctonia aerial blight (RAB) progression in sixteen soybean cultivars. The coefficient of determination (R^2) revealed significant variations in disease development among the cultivars, indicating a well-fitted equation for predicting Percentage Disease Index (PDI). Overall, the results contribute valuable insights into understanding and predicting RAB progression, aiding in the development of targeted strategies for disease management in soybean cultivation.

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