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Estimation of AUDPC (Area under disease progressive curve) of RAB (Rhizoctonia aerial blight) disease for epidemiological studied in soybean crop

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Abstract

Rhizoctonia aerial blight is one of the precarious disease of soybean caused by fungus *Rhizoctonia solani*. In epidemiological studies calculation of AUDPC (Area under Disease Progressive Curve) is one of the important tools to predict the disease development. The study was conducted in year 2017 at G.B.P.U.A.T, Pantnagar, and Uttarakhand. Sixteen cultivars of soybean were studied against the disease. The base for calculation of AUDPC was disease rating. September and October were most favorable months for the initiation and development of disease. Disease progressive curve increase exponentially from the disease initiation (37th SMW) till (42th SMW). AUDPC is a useful tool for quantitative measure of disease intensity over time.

Keywords: RAB (Rhizoctonia aerial blight), AUDPC (Area under disease progressive curve), SMW (Standard meteorological week).

Introduction

Soybean (*Glycine max* (L.) Merrill), a major oilseed crop belongs to family Fabaceae and subfamily Papilionaceae. It is one of the oldest and most important crops grown worldwide. Soybean is attributed as a short day plant. The crop is mainly grown under rainfed conditions but supplemental irrigation can be given. Generally, it requires a warm environment for its growth. This also provides congenial conditions for the development of disease and pests. There are several reasons responsible for low yield of soybeans like lack of proper input, drought, flood, disease and pests. One of them is the decreasing productivity owing to several diseases.

Rhizoctonia aerial blight is a fungal disease caused by *Rhizoctonia solani* *Thanatophorus cucumeris* and causes heavy losses to the crop. The disease is usually considered sporadic but occasionally acquires a destructive form under favorable environmental conditions. AUDPC (Area under disease progressive curve) in crops is a parameter for the epidemiological study in plants. Generally, there is a reduction in shoot length, pod and seed formation, seed setting and seed weight (Patel and Bhargava, 1998) ^[1].

Materials and Methods

The field trial was conducted in Kharif season of 2017 at Norman E. Borlaug Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand (latitude 29.09° N, longitude is 79.28° E). Sixteen soybean varieties viz 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 screened against the disease under natural conditions in the experimental field. The row to row distance and plant to plant was 45-60 cm and 10cm, respectively. The varieties were planted in a Randomized Block Design (RBD) with three replications. The disease development was recorded by selecting 5 plants and tagged randomly. The disease progression was recorded on weekly basis. The effect of disease on different cultivars was recorded in the form of AUDPC (area under disease progressive curve). Area under disease progress curve (AUDPC) is a useful quantitative summary of disease intensity over time.

The most commonly used method for estimating the AUDPC, the trapezoidal method, is to check the time variable (hours, days, weeks, months, or years) and calculate the average disease intensity between each pair of adjacent time points. It is given by following formulas suggested by Wilcoxon *et al.*, (1975) [3].

$$\text{AUDPC} = \sum_{i=1}^k \frac{1}{2} (S_i + (S_i + 1)) (T_i - (T_i - 1))$$

Where, S_i = Percentage Disease Index (PDI) at the end of time i , k = Number of successive evaluations and $T_i - (T_i - 1)$ = Time interval between two evaluations i and $i-1$ of the disease.

Result and conclusion

Effect of cultivars on area under disease progress curve of RAB

Area under disease progress curve (AUDPC) is an effective tool for comparing the progression of disease in sixteen soybean cultivars. The data presented in the Table1 showed that maximum area under disease progression curve on leaves was cultivar JS-7546 (7.35) followed by JS-93-05 (6.57) and Shivalik (5.57) while minimum in cultivar JS-72-280 (1.72) during 37th SMW. Minimum AUDPC values were observed during 38th SMW but trend was almost similar to previous date of observation. The Maximum AUDPC value was observed on the cultivar JS-7546 (30.75) followed by JS-93-05 (15.50). From 26th -3rd October maximum AUDPC was calculated for cultivar VLS-58 (175.44) and minimum for cultivar PK-262(90.60), whereas it was maximum for cultivar

Shivalik (273.69) and minimum for cultivar Pk-262 (129) for 3rd to 10th October. AUDPC was maximum for cultivar VLS-58 (424.19) and minimum for cultivar PK-262 (160.99) for 10th October to 17th October.

Progression of AUDPC (area under disease progressive curve) with respect to meteorological week shown in (Figure 1). AUDPC was minimum for 38th meteorological week for all cultivars and after that it increased till 42th SMW and attained maximum value. AUDPC value increased every week up to maximum disease development. It was maximum for cultivar JS-58 (424.19) and minimum for cultivar PK- 262 (160.99) for 10th- 17th October.

The results based on weekly records of disease development showed that the disease remained low at reproductive growth stage (Table 2, Figure 2). Maximum progression was observed from pod initiation (R3) and full pod (R4) stage (69-76 days). The disease severity increased from 57 days at R1 (flowering) stage to 89 days when crop reached at maximum seed filling (R6) stage and further to 96 days at physiological maturity (R7) stage. The lowest disease severity of 0.00 per cent was recorded on 57 days old plots while it was highest (54.34%) on 96 days old plants. Thereafter, disease severity declined up to 103 days at full maturity (R8) stage. The results confirmed the findings of Verma (1996) [2], who also reported that *R. solani* infection increases at different crop stages as mentioned in the preceding results showing that the crop from flowering onwards becomes more vulnerable to the attack of *R. solani* and the disease develops at faster rate than the earlier growth stages.

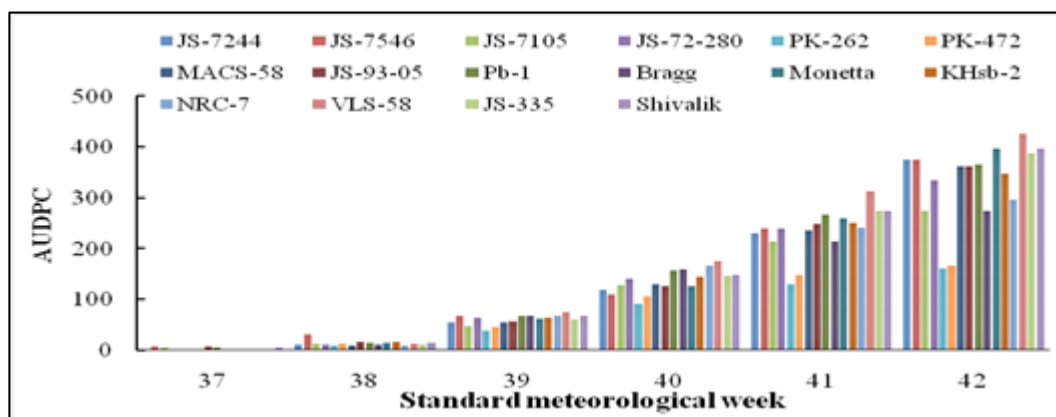


Fig 1: AUPDC for RAB of different cultivars of soybean

Conclusion

AUDPC is an effective tool for epidemiological studies. AUDPC increases gradually with different meteorological week, as the disease initiation and disease development started the area under disease curve increases. Disease

development is also depending on the several other factors such as weather. Disease development is also dependent on crop age. From the flowering stage development of disease gradually increases up to the maturity.

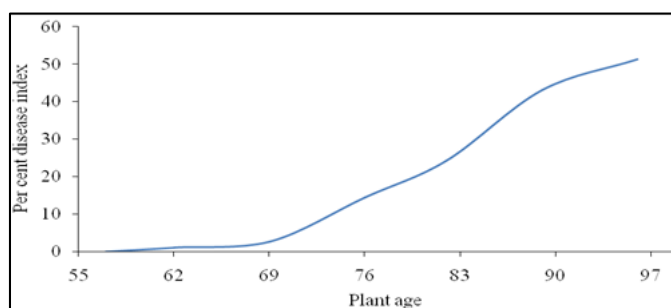
Table 1: Observation table for AUDPC for sixteen cultivars on weekly interval

Variety	5 th -12 th Sept	12 th -19 th Sept	19 th -26 th Sept	26 th Sept-3 rd Oct	3 rd -10 th Oct	10 th -17 th Oct	Mean AUDPC
	AUDPC	AUDPC	AUDPC	AUDPC	AUDPC	AUDPC	AUDPC
JS-7244	2.17	9.52	54.58	118.57	230.29	374.77	131.65
JS-7546	7.35	30.75	67.6	109.06	238.47	374.58	137.97
JS-7105	5.08	11.38	46.99	126.51	213.71	273.06	112.79
JS-72-280	1.72	11.09	63.9	140.2	238.21	332.85	131.33
PK-262	2.82	8.27	38.45	90.6	129	160.99	71.69
PK-472	2	11.25	45.77	104.81	147.19	164.75	79.29

MA-CS-58	2.43	8.2	53.31	129.9	235.06	361.85	131.79
JS-93-05	6.57	15.5	56.56	125.94	248	361.01	135.6
PB-1	4.92	13.91	66.65	157.23	265.53	364.3	145.43
BRAGG	3.43	9.42	67.31	157.64	213.71	273.41	120.82
MONETTA	3.71	14.41	61.96	125.93	258.22	395.01	143.21
KHSB-2	2.57	15.25	63.24	144.06	249.98	347.29	137.07
NRC	2.65	8.55	67.7	166.1	239.95	294.77	129.95
VLS-508	2.23	11.79	74.28	175.44	312.2	424.19	166.69
JS-375	2	10.74	60.19	144.66	273.33	385.86	146.13
Shivalik	5.57	14.46	66.92	148	273.69	396.05	150.78

Table 2: Susceptible stage of the plant in relation to PDI of RAB of Soybean

S. No.	Growth Stage	Plant age (days)	PDI (%)
1	R1-R2	57	0.00
2	R3	62	1.02
3	R3-R4	69	2.63
4	R4-R5	76	14.43
5	R5	82	24.22
6	R5-R6	89	43.04
7	R6-R7	96	51.34
8	R7-R8	103	48.52

**Fig 2:** Disease progress curve of RAB on soybean susceptible cultivars at given plant ages

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