

ESTIMATION OF EXTENT PER CENT DISEASE INDEX (PDI) OF WEB BLIGHT DISEASE (*RHIZOCTONIA SOLANI* KUHN) IN RELATION TO ECONOMIC YIELD LOSS IN MUNGBEAN

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Abstract

A field experiment was carried out to find out the extent per cent disease index (PDI) at which economic yield loss starts due to web blight disease caused by *Rhizoctonia solani* Kuhn of mungbean for three years (2014-2016). Out of 7(seven) different PDI levels namely, 0%, 0.1 - 5%, 5.1 - 10%, 10.1 - 20%, 20.1 - 30%, 30.1 - 50% and > 50%; the PDI levels *i.e.*, 0%, 0.1 - 5% and 5.1 - 10% average yield 6.2, 5.26 and 4.39 q/ha, per cent yield loss 0%, 12.27% and 29.23% with positive BC ratio 1.80, 1.53 and 1.29 respectively were recorded. However, at 10.1 - 20% PDI level the yield was recorded 2.85 q/ha with a negative BC ratio (-1.13), which is not desirable for mungbean cultivation. Therefore, cultivation of mungbean upto 5.1 - 10% PDI of web blight disease may be done without any control measure as it will provide economically profitable yield with BC ratio 1.29 and also leads to environment friendly.

Keywords: Web blight, economic yield loss, per cent disease index, mungbean

Introduction

Mungbean is one of the most important leguminous crops for supplying dietary proteins in growth and development of human beings. Mungbean is popularly grown in Assam during two cropped seasons *summer* and *kharif* comprised an area of 11,285 ha with an average yield 687 kg/ha and production 7.7 thousand MT (Anonymous, 2014-15). In Assam, mungbean is found to be attacked by many fungal foliar diseases especially cercospora leaf spot (*Cercospora canescens* Ellis and Martin), web blight (*Rhizoctonia solani* Kuhn), anthracnose (*Colletotrichum capsis*), powdery mildew (*Erysiphe polygoni*) and viral diseases like yellow mosaic virus (Mungbean yellow mosaic virus). These diseases become hurdle to increase productivity level of mungbean. Among these diseases web blight disease is very severe (Dubey and Petel, 2001 a & b), it also leads to yield loss upto 20-30 per cent (Dubey, *et. al.*, 2007) and even total loss of the crop. There are many management strategies have been developed till date however, in this study with a view to examine the extent per

cent disease index (PDI) of web blight disease (*Rhizoctonia solani* Kuhn) at which economic yield loss starts.

MATERIALS and METHODS

Field experiments during *kharif* season were conducted at Regional Agricultural Research Station, AAU, Shillongani, Nagaon, Assam for the year 2014 to 2016. The experiment was laid out in randomised block design (RBD) in 3 replications with 7 (seven) treatments. The treatments at different per cent disease index (PDI) levels such as – 0%, 0.1 - 5%, 5.1 - 10%, 10.1 - 20%, 20.1 - 30%, 30.1 - 50% and > 50% were considered as individual treatment. To carry out the experiment a local susceptible variety was taken and sown in 2nd week of September with a spacing 30 x 10 cm row to row and plant to plant and all recommended practices were followed to raise a good crop (Anonymous, 2009). Seed treatment was done with carbendazim 50 WP @ 0.1% to protect the seedlings at early crop stage from different soil borne diseases consequently to maintain different PDI level, fungicidal sprayings were done time to time. To maintain PDI level ---

- i. 0 % = 15 days old seedlings were sprayed with fungicide Tebuconazole @ 0.2% at 10 days interval
- ii. 0.1 – 5 % = fungicide Tebuconazole @ 0.2% was sprayed just after appearance of symptom followed by propiconazole @ 0.2% need base to maintain disease pressure below 5% PDI level
- iii. 5.1 – 10 % = allow disease to progress upto 5 per cent PDI and then sprayed with Propiconazole @ 0.2% to maintain PDI level
- iv. 10.1 - 20% = allow disease to progress above 10 per cent PDI and then sprayed with Tebuconazole 0.2% to maintain PDI level
- v. 20.1 - 30% = allowed disease to progress above 20 per cent PDI and then sprayed with Tebuconazole 0.2% to maintain PDI level and further spray at need base
- vi. 30.1 - 50% = allowed disease to progress above 30 per cent PDI and then sprayed with Tebuconazole 0.2% to maintain PDI level and further spray at need base
- vii. > 50% - No fungicidal spraying was done for above 50 % PDI

Disease severity was calculated out by grading of randomly selected 50 leaves from 10 plants and disease severity was recorded in 1-9 scale adopted by All India Crop Research Improvement Programme on mungbean (mungbean), urdbean (blackgram), lentil, lathyrus

(grasspea), rajmash and pea (AICRP-MULLaRP) and Stonehouse (1994). Per cent disease index (PDI) was calculated as follows -

$$\text{PDI} = \frac{\text{Sum of all numerical rating}}{\text{Total number of leaves examined} \times \text{Maximum grade score}} \times 100$$

Plot yield were recorded and accordingly economic analysis was done to find out the PDI level from which economic yield loss starts. Average yield loss was calculated out by the following formula -

$$\text{Yield loss} = \frac{\text{Highest yield} - \text{Yield record (for which yield loss to be determined)}}{\text{Highest yield}} \times 100$$

The economic analysis of this experiment was done to find out the approximate PDI level from where economic yield loss may start. The economic analysis was done following benefit cost ratio method.

$$\text{BC ratio} = \frac{\text{Gross return} - \text{Total cost}}{\text{Total cost}} \times 100$$

RESULTS and DUSCUSSIONS

The data recorded for 3 (three) years (2014-2016) were analysed for per cent disease index, per cent yield loss, yield (q/ha) and benefit cost ratio individually and finally average value of all the parameters were discussed to find out the PDI level at which economic yield loss starts.

- 1. Per cent disease index(PDI) of web blight disease at different PDI level :** From fig 1, it was reveals that for three consecutive years, PDI of web blight disease recorded was found to be of increasing trend at different PDI level such as 0%, 0.1-5%, 5.1-10%, 10.1-20%, 20.1-30% 30.1-50% and >50%. The PDI of web blight disease 4.2%, 3.9% and 4.53% for the year 2014, 2015 and 2016 respectively were recorded at 0.1 - 5 % PDI level. However, in next PDI level (5.1 -10 %) recorded that the PDI of web blight disease 9.5, 8.5 and 9.17 for the year 2014, 2015 and 2016 respectively.

Maximum PDI of web blight disease was observed 74.7 per cent for the year 2014 followed by 74.57 per cent in the year 2015 (Table 1).

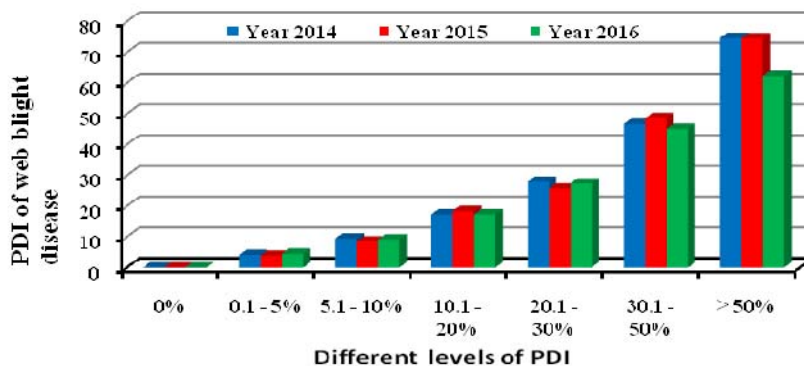


Fig 1 : Per cent disease index (PDI) of web blight disease for the year 2014-16

Table 1: Per cent disease index (PDI) of web blight disease for the year 2014-16

Different levels of PDIs	PDI of web blight disease		
	Year 2014	Year 2015	Year 2016
0%	0	0	0
0.1 - 5%	4.2	3.9	4.53
5.1 - 10%	9.5	8.5	9.17
10.1 - 20%	17.33	18.43	17.37
20.1 - 30%	27.93	25.73	27.37
30.1 - 50%	46.73	48.63	45.17
> 50%	74.7	74.57	62.47

2. Yield at different PDI level : It has obtained that the yield recorded for the individual year in same PDI level were not equal (fig 2). However, it has been observed with the increase of PDI level is inversely proportional to yield irrespective of year (2014-2016) and found statistically negatively highly significant (Table 3). The highest yields were recorded 5.6, 6.28 and 6.71q/ha in the year 2014, 2015 and 2016 respectively at 0 per cent PDI level (Table 2). However, highest yield in 0.1 - 5 % and 5.1-10% PDI levels recorded 5.67 q/ha and 4.72 q/ha respectively for the year 2015.

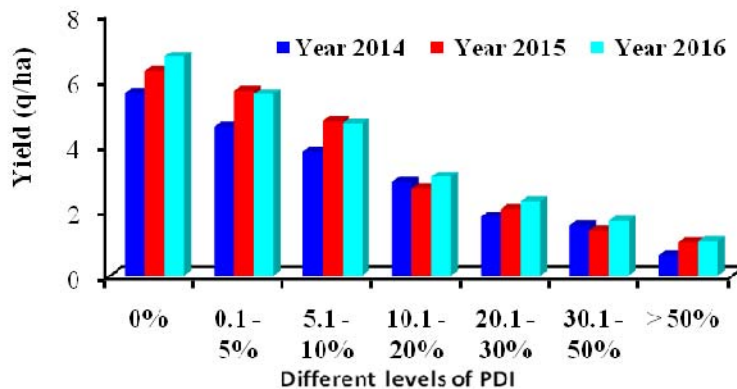


Fig 2 : Yield at different level of PDI for the year 2014-2016

Table 2: Yield (q/ha) at different PDI level for the year 2014-16

Different levels of PDIs	Average yield(q/ha)		
	Year 2014	Year 2015	Year 2016
0%	5.6	6.28	6.71
0.1 - 5%	4.56	5.67	5.56
5.1 - 10%	3.8	4.72	4.65
10.1 - 20%	2.86	2.67	3.03
20.1 - 30%	1.8	2.04	2.26
30.1 - 50%	1.53	1.38	1.67
> 50%	0.63	1.01	1.04

Table 3: Correlation between PDI and Yield

Parameters	Years		
	2014	2015	2016
PDI x yield	-0.914	-0.876	-0.920

3. Yield loss : The per cent yield loss observed to be directly proportional to PDI where minimum per cent yield loss where least per cent yield loss 18.45% at 0.1-5% PDI level and maximum per cent yield loss 88.69 per cent at > 50% PDI level was recorded. However, yield loss 18.45, 32.14, 67.86 and 88.69 per cent were found to be higher at PDI level 0.1-5%, 5.1-10%, 20.1-30% and >50% respectively for the year 2014 in comparison to other years. Per cent yield loss is observed to be of increasing trend (fig 3 & table 4) and found to be statistically positive and highly significant.

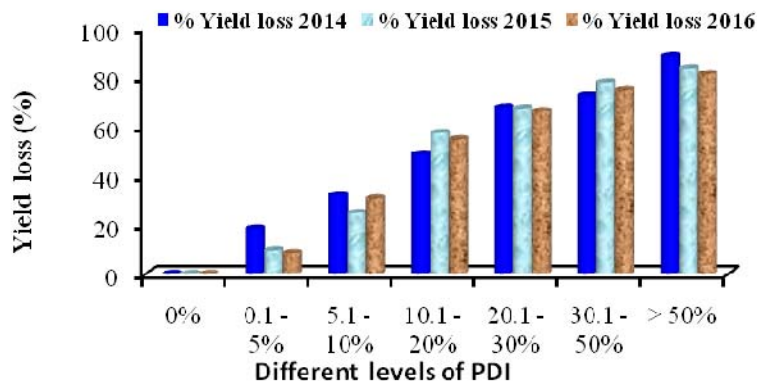


Fig 3 : Per cent yield loss at different level of PDI during 2014-2016

Table 4: Per cent yield loss at different PDI level during 2014-2016

Different levels of PDIs	Yield loss (%)		
	Year 2014	Year 2015	Year 2016
0%	0	0	0
0.1 - 5%	18.45	9.71	8.64
5.1 - 10%	32.14	24.84	30.7
10.1 - 20%	48.81	57.48	54.84
20.1 - 30%	67.86	67.51	66.31
30.1 - 50%	72.68	78.03	75.11
> 50%	88.69	83.92	81.5

4. Benefit Cost Ratio: It was revealed that the BC ratio of first three PDI levels viz., 0%, 0.1 - 5% and 5.1 - 10% were found to be high and positive for 3 consecutive years (2014, 2015 and 2016) and further increase in the PDI level lead to negative BC ratio (fig 4). However, within same PDI level, variation in BC ratio has also been observed. In table 4, BC ratio recorded for 3 successive years 2014, 2015 and 2016 were 1.61, 1.81 and 1.97 respectively at 0% PDI level. The positive BC ratio was found upto 10% of PDI calculated out as 1.11, 1.38 and 1.39 for the years 2014, 2015 and 2016 respectively at 5.1-10% PDI level; thereafter negative BC ratio was recorded for subsequent PDI levels. The maximum negative BC ratio -1.81 was recorded in > 50% PDI level in the year 2014 (table 5).

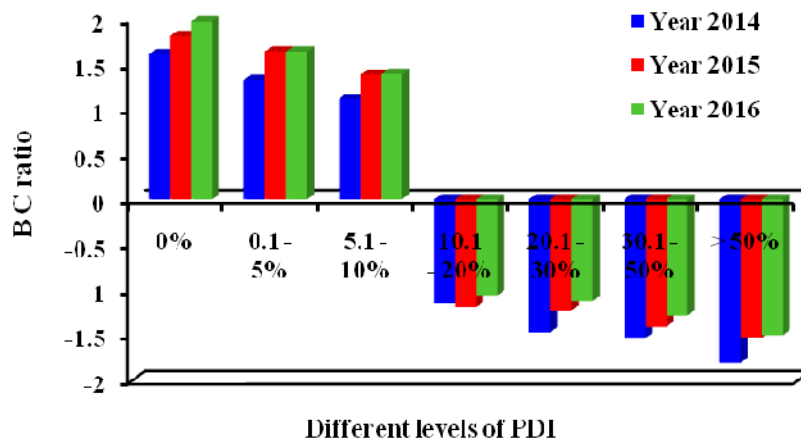


Fig 4 : Benefit cost ratio at different level of PDI during 2014-2016

Table 5: Benefit cost ratio at different PDI level during 2014-2016

Different levels of PDIs	BC ratio		
	Year 2014	Year 2015	Year 2016
0%	1.61	1.81	1.97
0.1 - 5%	1.32	1.64	1.64
5.1 - 10%	1.11	1.38	1.39
10.1 - 20%	-1.15	-1.19	-1.06
20.1 - 30%	-1.47	-1.23	-1.13
30.1 - 50%	-1.54	-1.41	-1.28
> 50%	-1.81	-1.53	-1.5

5. Overall analysis: In average data of 3 years (2014 - 2016) for different PDI levels of web blight disease of mungbean observed that highest yield 6.2 q/ha with highest B C ratio 1.80 at 0% PDI level followed by 5.26 and 4.39 q/ha with B C ratio 1.53 and 1.29 at 0.1-5% and 5.1-10% PDI levels respectively (table 6). A negative BC ratio - 1.13 was observed at 10.1 - 20% PDI level reflected in the fig 5, where the line diagram of BC ratio goes beyond X-axis towards negative zone. Further, it has been observed that the value B C ratio increases negatively as the PDI level increases. Therefore, the PDI level upto 5.1 - 10% with BC ratio 1.29 will be economically profitable particularly for the crop mungbean. Thus, in mungbean cultivation PDI level of web blight disease upto 5.1 - 10% may be done without any control measure as it will provide in economically profitable yield leads to environment friendly.

Table 6: Effect of average per cent disease index of web blight disease on average yield, per cent yield loss and BC ratio in mungbean (2014 - 2016)

Level of per cent disease index	Average PDI	Average yield (q/ha)	% loss in yield	B : C
0%	0	6.2	0	1.80
0.1-5 %	4.21	5.26	12.27	1.53
5.1-10 %	9.06	4.39	29.23	1.29
10.1-20 %	17.71	2.85	53.71	-1.13
20.1-30 %	27.01	2.03	67.23	-1.27
30.1-50 %	46.84	1.52	75.23	-1.41
> 50%	70.58	0.89	75.27	-1.61

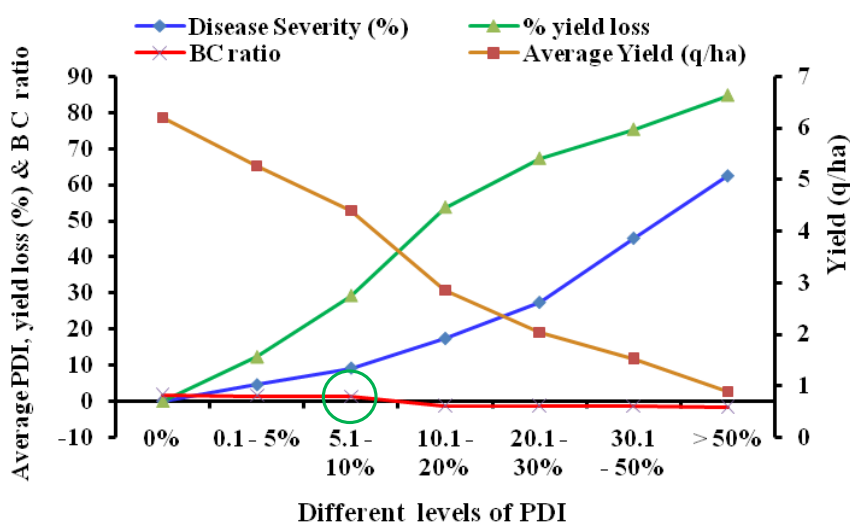


Fig 5 : Economic yield loss level for web blight disease

Conclusion

It may be concluded, however, beyond 5.1 – 10% PDI level the economic yield loss will occur. Therefore, the PDI level of web blight disease upto 5.1 - 10% with BC ratio 1.29 will be economically profitable for mungbean. Thus, in mungbean cultivation PDI level of web blight disease upto 5.1 - 10% may be done without any control measure as it will provide in economically profitable yield that also leads to environment friendly. Further, this finding also supports the moderately resistant recommended varieties are of economically viable in cultivation.

Acknowledgement

The authors hereby would like the thanks Chief Scientist, Regional Agricultural Research Station, AAU, Shillongnai, Nagaon-782002, Assam, India for providing necessary facilities during the course of investigation.

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