

## **Incidence and Severity of Sclerotium rolfsii disease on Tomato Farms in Chile Island (Makurdi), Benue State, Nigeria.**

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**Abstract:** Incidence and severity of *S. rolfsii* disease on tomato farms in Chile Island (Makurdi), Benue State, Nigeria was conducted. This was based on inspection of tomato fields randomly selected at 1 – 2km intervals along accessible routes in the study area. Disease symptoms observed on tomato plants include chlorosis, wilting, leaf spot, early blight, root and foot rot, stem rot and necrosis. Incidence ranged from 4 – 33 for the tomato farms sampled. Analysis of Variance showed no significant difference in the incidence of *S. rolfsii* disease on the sampled farms at  $p=0.05$ . Severity of *S. rolfsii* infection ranged from 2 – 5 which indicate 21 – 100% of plant tissue damage. Analysis of Variance showed that severity of chlorosis, wilting and stem rot were significant across all sampled sites at  $p=0.05$  while leaf spot, early blight root and foot rot and necrosis were insignificant across all farms at  $p=0.05$ . This information will serve as baseline data for evaluating yield loss and determining effective management strategies.

**Keywords:** Incidence, *Sclerotium rolfsii*, severity, tomato, Chile Island.

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### **I. Introduction**

*Sclerotium rolfsii*, which causes stem rot disease and its associated symptoms is a destructive soil borne pathogen of tomatoes worldwide. [1] reported that *Sclerotium rolfsii* was responsible for an annual yield reduction of 68 - 70% in highly susceptible tomato varieties in Syria.

In Chile Island (Makurdi) Benue State, tomato is grown mostly during the rainy season and during the dry season as an irrigated crop. Through this system of farming, the crop is available throughout the year as a food and cash crop and contributes significantly to the economy of the local population. Despite the importance of the tomato crop at the local economy of peasant farmers in Chile Island (Makurdi) Benue State, its yield is bereft with diseases caused by nematodes, bacteria, fungi and sometimes by a cocktail of these agents. Some of the major diseases of the tomato plants in Chile Island (Makurdi), Benue State are caused by fungi. Such diseases include damping off of seedlings, wilting of plants, chlorosis, root and foot rot and necrosis.

Incidence and severity are commonly used as measures to estimate disease. Incidence is the proportion of plant units diseased while Severity is the proportion of plant units showing symptoms. The objective of this study is to obtain disease incidence and severity data from surveys of tomato farms with different amount of *Sclerotium rolfsii* disease in Chile Island (Makurdi), Benue State as a useful measure for the evaluation of yield loss and determining the effectiveness of disease management strategies.

### **II. Materials and Methods**

#### **Farm Monitoring and Survey**

During the surveys in each available tomato field, stops were made at 1 – 2km interval. The *S. rolfsii* disease assessment was made along two diagonals ('X' pattern) of fields using 1 x 1m quadrants. A minimum of five stops were made in each tomato field depending on the farm size. In order to collect data from tomato plants with *Sclerotium rolfsii* infection of different intensities, eight tomato production fields were sampled for assessment.

#### **Data Collection**

In each field, plants within the quadrants were counted and recorded as diseased/ infected and healthy/ non-infected. The total number of plants were also counted and recorded. Incidence and severity were calculated visually at the several systemically selected sampling sites. Incidence (I) was recorded as the proportion of diseased plants;

$$\frac{\text{No of infected plants}}{\text{Total number of plants}} \times 100$$

Severity (S) was calculated as the extent of damage caused by *S. rolfsii* diseases on each of five plants selected at random from each sampling site. This was subjected to a disease assessment key of 0 – 5;

Where 0 – No infection

- 1 – 1 – 20% of plant tissue damage
- 2 – 21 – 40% of plant tissue damage
- 3 – 41 – 60% of plant tissue damage
- 4 – 61 – 80% of plant tissue damage
- 5 – 81 – 100% of plant tissue damage

**Data Analysis:** Data collected from the study was analysed using Analysis of Variance (ANOVA) and the Fishers Least Significant difference (FLSD) was used to separate the means at 5% level of Significance.

### III. Results

#### Incidence of *S. rolfii* disease on Farms

Incidence of *S. rolfii* on the tomato farms showed disease symptoms such as chlorosis, wilting, root and foot rot, stem rot and necrosis. Symptoms associated with other soil borne pathogens include leaf spot and early blight. For farm 1, incidence of all the above mentioned symptoms ranged from 5 – 22. For farm 2, it ranged from 6 – 14. For farm 3, it ranged from 5 – 17. For farm 4, incidence ranged from 7 – 18. For farm 5, it ranged from 4 – 22. For farm 6, it ranged from 8 – 23. For farm 7, incidence ranged from 5 – 24. For farm 8, incidence ranged from 5 – 33, as shown in table 1.

**Table 1: Incidence of *S. rolfii* Disease on Tomato farms in Chile Island (Makurdi), Benue State**

Farms	Chlorosis	Wilting	Leaf spot	Early blight	Root & foot rot	Stem rot	Necrosis
<b>1</b>	22	13	5	5	9	17	9
<b>2</b>	10	16	7	6	7	13	14
<b>3</b>	17	14	5	11	6	8	17
<b>4</b>	10	11	7	8	10	8	18
<b>5</b>	15	12	4	13	15	13	22
<b>6</b>	23	13	10	8	8	15	18
<b>7</b>	24	16	5	10	13	13	19
<b>8</b>	20	33	5	8	5	10	18

Analysis of Variance showed that there was no significant difference in the incidence of *S. rolfii* disease between the farms as shown in table 2.

**Table 2: Analysis of Variance in the incidence of *S. rolfii* disease on Tomato farms in Chile Island (Makurdi), Benue State.**

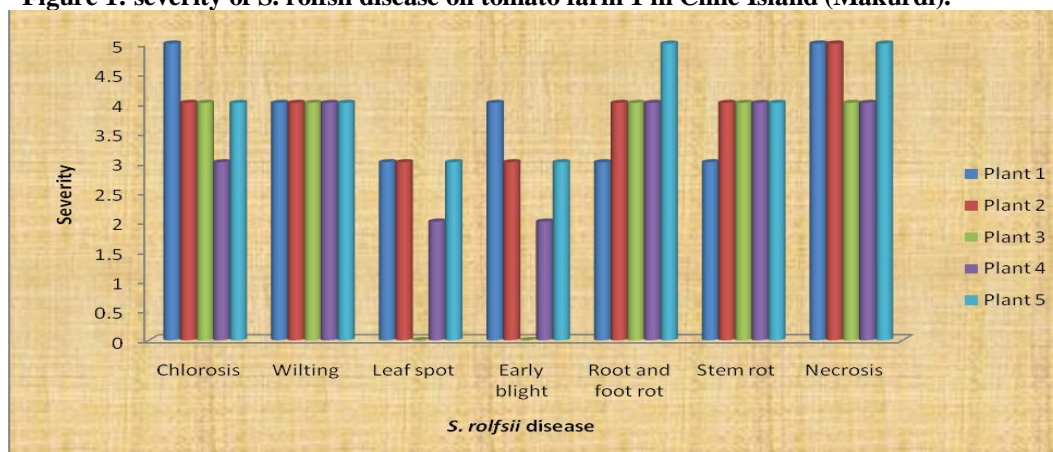
SV	Df	SS	MS	F cal	F tab
Block	6	8526.45	1421.08	77.99	2.25
Farms	7	139.12	19.87	1.09	2.17
Error	42	765.26	18.22		

**Footnote:** There is no significant difference in the incidence of *S. rolfii* disease on tomato farms in Chile Island (Makurdi) Benue State.

#### Severity of *S. rolfii* disease on Farms

Severity of *S. rolfii* disease including associate symptoms on five plants chosen at random on the tomato farms ranged from 2 – 5. For farm 1, severity of the chlorosis, wilting, leaf spot, early blight, root and foot rot and necrosis ranged from 2 – 5 which indicate 21 – 100% of plant tissue damage.

**Figure 1: severity of *S. rolfii* disease on tomato farm 1 in Chile Island (Makurdi).**



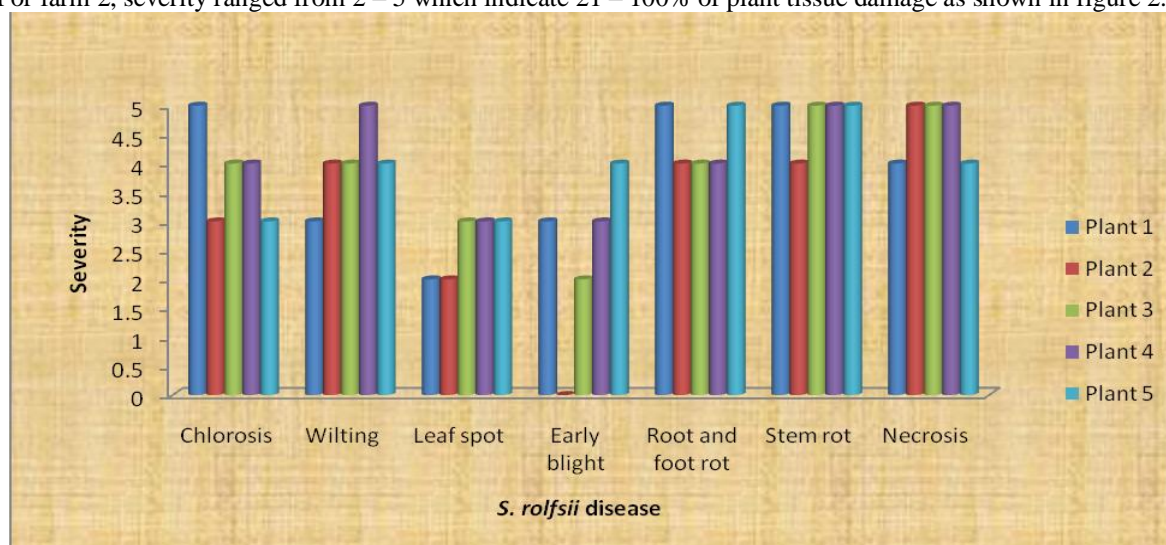
Analysis of Variance revealed significant differences in the severity of *S. rolfii* diseases on farm 1 as shown in table 3.

**Table 3: Analysis of Variance in the severity of *S. rolfii* disease on farm 1**

Disease symptoms	Severity Means
Chlorosis	2.20 <sup>a</sup>
Wilting	2.40 <sup>ac</sup>
Leaf Spot	3.75 <sup>bcd</sup>
Early blight	4.00 <sup>bed</sup>
Root and Foot rot	4.00 <sup>bed</sup>
Stem rot	4.00 <sup>bed</sup>
Necrosis	4.60 <sup>bee</sup>
<b>LSD(0.05)</b>	<b>6.37</b>

**Footnote:** Means not tagged by same letters are significantly different at  $p=0.05$  Otherwise, they are the same.

For farm 2, severity ranged from 2 – 5 which indicate 21 – 100% of plant tissue damage as shown in figure 2.



**Figure 2: severity of *S. rolfii* disease on tomato farm 2 in Chile Island (Makurdi).**

Analysis of Variance showed significant differences in the severity of *S. rolfii* diseases on farm 2 as shown in table 4.

**Table 4: Analysis of Variance in the severity of *S. rolfii* disease on farm 2.**

Disease Symptoms	Severity Means
Chlorosis	2.40 <sup>a</sup>
Wilting	2.60 <sup>a</sup>
Leaf Spot	3.80 <sup>bc</sup>
Early blight	4.00 <sup>bc</sup>
Root and Foot rot	4.40 <sup>bed</sup>
Stem rot	4.60 <sup>bede</sup>
Necrosis	4.80 <sup>bede</sup>
<b>LSD(0.05)</b>	<b>7.68</b>

**Footnote:** Means not tagged by same letters are significantly different at  $p=0.05$  Otherwise, they are same

For farm 3, severity ranged from 2 – 5 which indicate 21 – 100% of plant tissue damage as shown in figure 3.

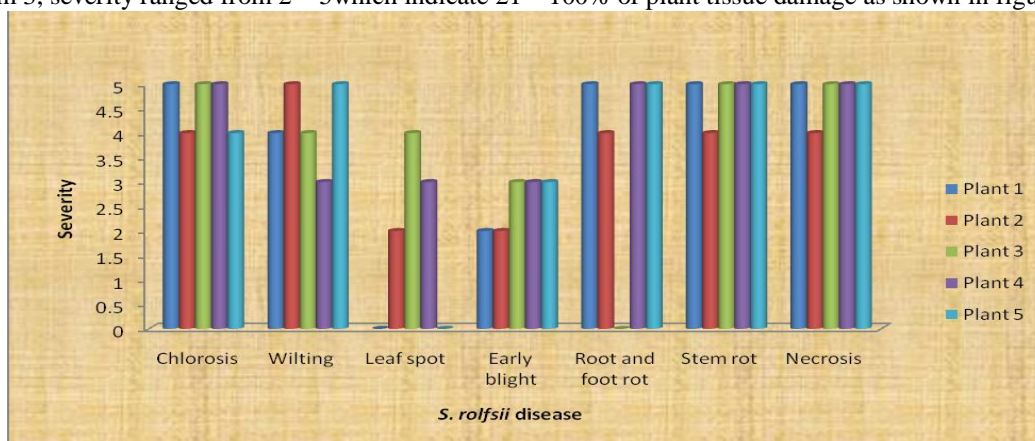


Figure 3: severity of *S. rolfsii* disease on tomato farm 3 in Chile Island (Makurdi).

Analysis of Variance showed significant differences in the severity of *S. rolfsii* diseases on farm 3 as shown in table 5.

Table 5: Analysis of Variance in the severity of *S. rolfsii* disease on farm 3.

Disease Symptoms	Severity Means
Chlorosis	1.80 <sup>a</sup>
Wilting	2.60 <sup>bc</sup>
Leaf Spot	3.80 <sup>bde</sup>
Early blight	4.20 <sup>bdeg</sup>
Root and Foot rot	4.60 <sup>bdfg</sup>
Stem rot	4.80 <sup>bdfg</sup>
Necrosis	4.80 <sup>bdfg</sup>
<b>LSD(0.05)</b>	<b>4.43</b>

Footnote: Means not tagged by same letters are significantly different at  $p=0.05$ , otherwise, they are the same.

For farm 4, severity ranged from 2 – 5 which indicate 21 – 100% of plant tissue damage as shown in figure 4.

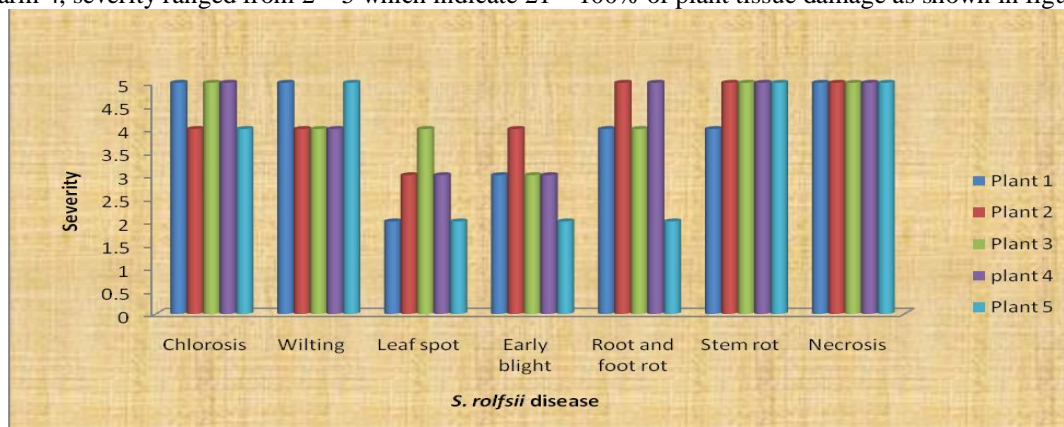


Figure 4: Severity of *S. rolfsii* disease on tomato farm 4 in Chile Island (Makurdi).

Analysis of Variance showed significant differences in the severity of *S. rolfsii* disease on farm 4 as shown in table 6.

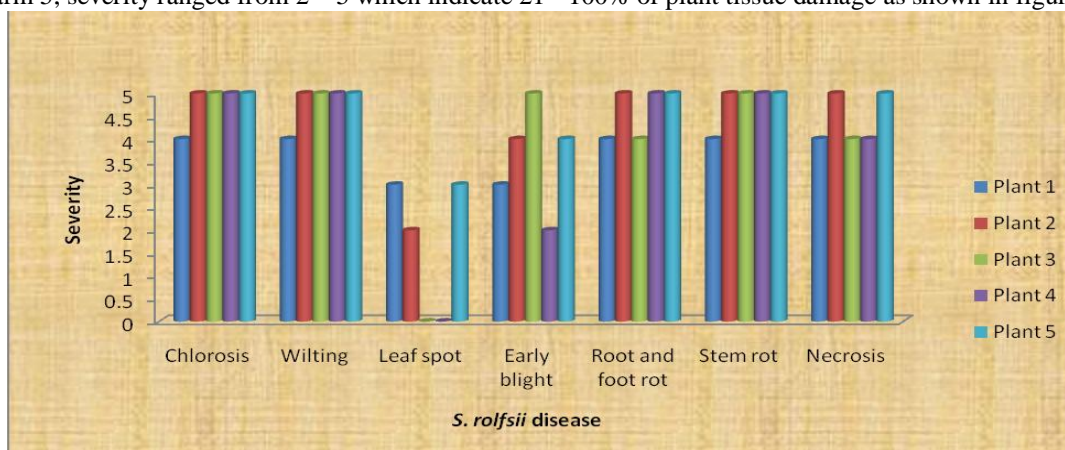
Table 6: Analysis of Variance in the severity of *S. rolfsii* disease on farm 4

Disease Symptoms	Severity Means
Chlorosis	2.80 <sup>a</sup>
Wilting	3.00 <sup>ac</sup>
Leaf Spot	4.00 <sup>bce</sup>
Early blight	4.40 <sup>bde</sup>
Root and Foot rot	4.60 <sup>bde</sup>
Stem rot	4.80 <sup>bde</sup>
Necrosis	5.00 <sup>bde</sup>
<b>LSD(0.05)</b>	<b>8.06</b>

Footnote: Means not tagged by same letters are significantly different at  $p=0.05$  otherwise, they are the same.



For farm 5, severity ranged from 2 – 5 which indicate 21 - 100% of plant tissue damage as shown in figure 5.



**Figure 5: Severity of S. rolfsii disease on tomato farm 5 in Chile Island (Makurdi).**

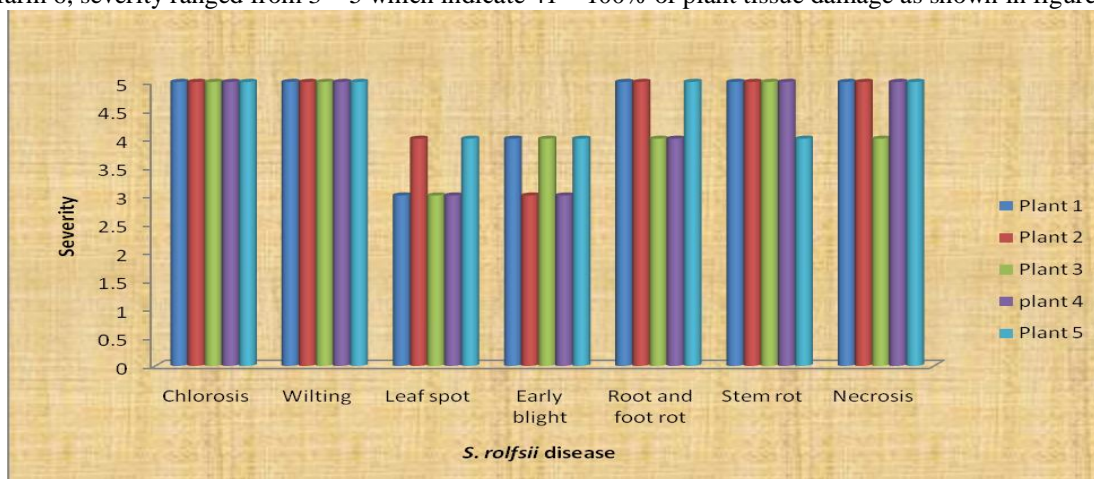
Analysis of Variance showed significant differences in the severity of S. rolfsii disease on farm 5 as shown in table 7.

**Table 7: Analysis of Variance in the severity of S. rolfsii disease on farm 5**

Disease symptoms	Severity Means
Chlorosis	1.60 <sup>a</sup>
Wilting	3.60 <sup>bc</sup>
Leaf Spot	4.40 <sup>bde</sup>
Early blight	4.60 <sup>bde</sup>
Root and Foot rot	4.80 <sup>bde</sup>
Stem rot	4.80 <sup>bde</sup>
Necrosis	4.80 <sup>bde</sup>
<b>LSD(0.05)</b>	<b>11.34</b>

**Footnote:** Means not tagged by same letters are significantly different at p=0.05 otherwise, they are the same.

For farm 6, severity ranged from 3 – 5 which indicate 41 – 100% of plant tissue damage as shown in figure 6.



**Figure 6: Severity of S. rolfsii disease on tomato farm 6 in Chile Island (Makurdi).**

**Table 8: Analysis of Variance in the severity of S. rolfsii disease on Farm 6.**

SV	DF	SS	MS	F cal	F tab
Severity	6	13.49	2.25	-11.25	2.51
Treatment	4	9.98	2.50	-12.50	2.78
Error	24	-4.78	-0.20		
<b>Total</b>	<b>34</b>	<b>18.69</b>			

**Footnote:** There is no significant difference at p=0.05 in the severity of S. rolfsii disease on farm 6.

For farm 7, severity of S. rolfsii diseases ranged from 2 – 5 which indicate 21 - 100% of plant tissue damage as shown in figure 7.

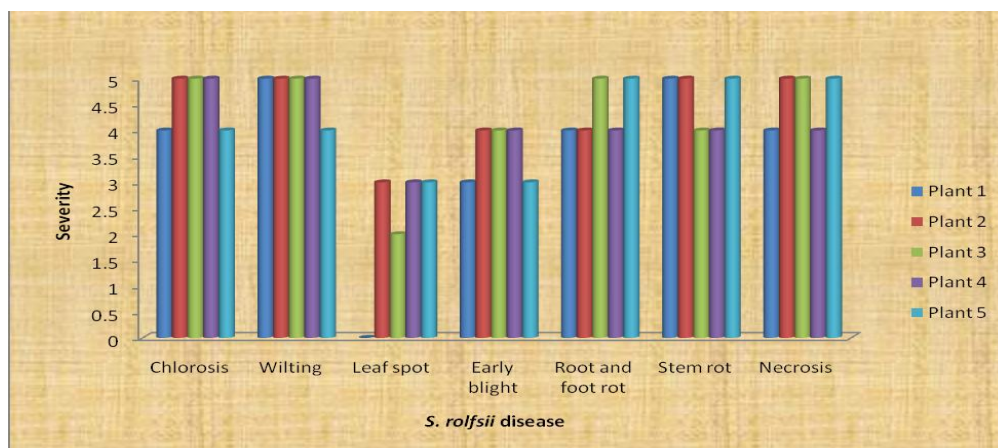


Figure 7: Severity of *S. rolfsii* diseases on tomato farm 7 in Chile Island (Makurdi).

Analysis of Variance revealed significant differences in the severity of *S. rolfsii* disease on farm 7 as shown in table 9.

Table 9: Analysis of Variance in the severity of *S. rolfsii* disease on farm 7.

Disease symptoms	Severity Means
Chlorosis	2.20 <sup>a</sup>
Wilting	3.60 <sup>bc</sup>
Leaf Spot	4.40 <sup>bd</sup>
Early blight	4.60 <sup>bd</sup>
Root and Foot rot	4.60 <sup>bd</sup>
Stem rot	4.60 <sup>bd</sup>
Necrosis	4.80 <sup>bd</sup>
<b>LSD(0.05)</b>	<b>9.28</b>

Footnote: Means not tagged by same letters are significantly different at  $p=0.05$  Otherwise, they are the same.

For farm 8, severity of *S.rolfsii* disease ranged from 2 - 5 which indicate 21 - 100% of plant tissue damage as shown in figure 8.

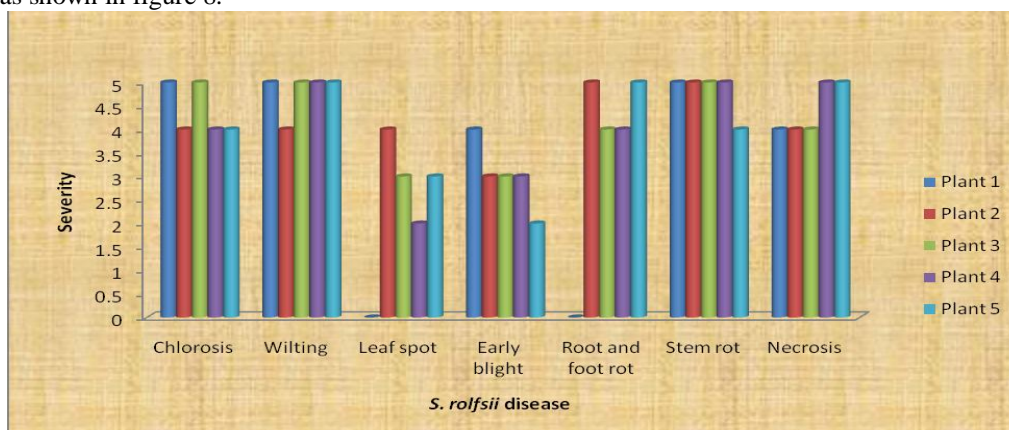


Figure 8: Severity of *S. rolfsii* disease on tomato farm 8 in Chile Island (Makurdi).

Analysis of Variance revealed significant differences in the severity of *S. rolfsii* disease on farm 8 as shown in table 10.

Table 10: Analysis of Variance in the severity of *S. rolfsii* disease on farm 8.

Disease symptoms	Severity Means
Chlorosis	2.40 <sup>a</sup>
Wilting	3.00 <sup>ac</sup>
Leaf Spot	3.60 <sup>bc</sup>
Early blight	4.40 <sup>bde</sup>
Root and Foot rot	4.40 <sup>bde</sup>
Stem rot	4.40 <sup>bde</sup>
Necrosis	4.80 <sup>bde</sup>
<b>LSD(0.05)</b>	<b>3.66</b>

Footnote: Means not tagged with same letters are significantly different at  $p=0.05$  otherwise, they are the same.

Grand mean severity showed that chlorosis, wilting and Stem rot were significantly different across all farms while Leaf spot, early blight, root and foot rot and necrosis were not significantly different across the farms as shown in table 11.

**Table 11: Grand mean severity of *S. rolfsii* disease on tomato farms in Chile Island (Makurdi).**

	Chlorosis	Wilting	Leaf Spot	Early blight	Root and Foot rot	Stem rot	Necrosis
<b>Table 3</b>	4.00 <sup>a</sup>	4.00 <sup>a</sup>	2.20	2.40	4.00	3.80 <sup>a</sup>	4.60
<b>Table 4</b>	3.80 <sup>b</sup>	4.00 <sup>a</sup>	2.60	2.40	4.40	4.80 <sup>bi</sup>	4.60
<b>Table 5</b>	4.60 <sup>ci</sup>	4.20 <sup>b</sup>	1.80	2.60	3.80	4.80 <sup>di</sup>	4.80
<b>Table 6</b>	4.60 <sup>di</sup>	4.40 <sup>c</sup>	2.80	3.00	4.00	4.80 <sup>di</sup>	5.00
<b>Table 7</b>	4.80 <sup>e</sup>	4.80 <sup>dh</sup>	1.60	3.60	4.60	4.80 <sup>ei</sup>	4.40
<b>Table 8</b>	5.00 <sup>f</sup>	5.00 <sup>e</sup>	3.40	3.60	4.60	4.80 <sup>fi</sup>	4.80
<b>Table 9</b>	4.60 <sup>gi</sup>	4.80 <sup>h</sup>	2.20	3.60	4.40	4.60 <sup>g</sup>	4.60
<b>Table 10</b>	4.40 <sup>h</sup>	4.80 <sup>gh</sup>	2.40	3.00	3.60	4.80 <sup>hi</sup>	4.40
<b>LSD(0.05)</b>	<b>0.15</b>	<b>0.15</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>0.13</b>	<b>NS</b>

**Footnote:** Means tagged with different alphabets are significant at p=0.05 otherwise, they are the same.

#### IV. Discussion

The results of this study show that *S. rolfsii* disease is among the most widely distributed and important disease in Chile Island (Makurdi), Benue State. In most farms, the severity of *S. rolfsii* infection reached 100%. The high epidemic of *S. rolfsii* infection noticed in Chile Island (Makurdi), Benue State was most probably due to environmental conditions such as rainfall and temperature suitable for the development and survival of the pathogen. This is in agreement with [2] who reported that suitable moisture and temperature favour the development of *S. rolfsii*.

In this study, incidence and severity were used as measures to estimate *S. rolfsii* disease in Chile Island (Makurdi), Benue State. This is in agreement with [3] who stated that incidence is a binary measurement of only one or two possible states; diseased or not diseased. It was observed that incidence was quicker and easier to measure than severity under field conditions. This is in agreement with [4] who reported that assessment of leaf stripe severity under field conditions is tedious and time consuming and may be prone to experimental error. Also [5] reported that measures of incidence are often more accurate, precise and reproductive than measures of severity.

Since measures of incidence are more easily acquired and more reliable than measures of severity and since severity is more useful than incidence for certain objectives, a combination of incidence and severity would greatly facilitate the evaluation of disease intensity.

It was observed that not all tomato plants in each farm were infected with *S. rolfsii* disease. This is similar to observations made by [6] who reported that incidence and severity analysis is directly useful in evaluating resistance response. In particular, the incidence and severity could be used to draw conclusions about the relative rate of disease increase among cultivars with different levels of resistance.

Differences in the means of increase in incidence and severity of *S. rolfsii* disease on tomato farms as observed in this study is attributed to allo and auto infection. This is in agreement with [7] who stated that an increase in incidence results from allo-infection (spread among plant unit- plants), whereas an increase in mean severity within a sampling unit results from both allo and auto infection (spread within infected plant units-leaves, stem, branches).

#### V. Conclusion

Results obtained from this study clearly show a high incidence and severity of *S. rolfsii* disease on tomato plants in Chile Island (Makurdi), Benue State. This result will serve as baseline data for evaluating yield loss and determining effective control strategies.

#### References

- [1]. R.T. Michail, and E.H. Alcorn, An epidemiological simulation model with three scales of spatial hierarchy. *Phytopathology*, 94, 1984, 883 – 891.
- [2]. Z.K. Punja, The biology, ecology and control of *Sclerotium rolfsii*. *Annual review of Phytopathology*, 23, 1985, 96 – 127.
- [3]. L.V. Madden, and G. Hughes, An effective sample size for predicting plant disease incidence in a spatial hierarchy. *Phytopathology*, 89, 1999, 770 – 781.
- [4]. A. Tekuaz, and A.W. Chiko, Leaf Stripe of barley caused by *Pyrenophora graminea*: occurrence in Canada and comparisons with barley stripe Mosaic. *Plant pathology*, 2, 1980, 152 – 158.
- [5]. C.L. Campbell, and L.V. Madden, *Introduction to plant disease epidemiology*. John Wiley and sons, New York, NY, USA, 1999.
- [6]. N. McRoberts, G. Hughes, and L.V. Madden, The theoretical basis and practical application of relationships between different disease intensity measures in plants. *Annals of Applied Biology*, 142, 2003, 191 – 211.
- [7]. R.C. Seem, Disease Incidence and Severity relationships. *Annual Review of Phytopathology*, 22, 1984, 133 – 150.