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## Status of Turcicum leaf blight disease of maize in Manipur

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### Abstract

In Manipur, maize is the second most important crop next to rice and is used both for direct consumption and as well as feed ingredients for piggery and poultry farming. Northern corn blight or turcicum leaf blight caused by *Exserohilum turcicum* (Pass.) Leonard and Suggs (TLB) is one of the major diseases affecting maize (*Zea mays* L.) in different maize-growing regions of Manipur. The survey was conducted to determine the present status and to know the level of infection in five different districts of Manipur namely (Imphal East, Imphal West, Bishnupur, Senapati, and Kangpokpi districts) by the pathogen *Exserohilum turcicum* in maize and to determine the prevalence, incidence, and severity of this disease in those areas. A total of 57 farmer fields were surveyed by adopting a simple random survey from Imphal East, Imphal West, Bishnupur, Senapati, and Kangpokpi districts of Manipur during the cropping season of 2022 for the *Kharif* season. The disease was observed in almost all surveyed areas. The results of the survey revealed that the highest disease incidence was observed in the Senapati district (77%) and the least having the Imphal West district (40%). The disease severity was observed to be highest in the Senapati district (70%) and the least having the Bishnupur district (40%). The incidence and severity of the disease vary according to different environmental conditions and crop stages. The present study indicates the incidence and severity of Turcicum leaf blight disease of maize on which management strategies could be derived to improve maize production in the surveyed areas.

**Keywords:** Survey, Manipur, *Exserohilum turcicum*, Incidence, Severity, Maize

### 1. Introduction

Maize (*Zea mays* L.), is one of the most versatile emerging crops that originated in Mexico and Central America and belongs to the family Poaceae. It is among the few crops that find its use in a broad range of applications such as food, vegetable, fodder, and industries. It has wider adaptability under varied agro-climatic conditions and it has the highest genetic yield potential among all the cereals so it is also known as the queen of cereals (Dass *et al.* 2012) <sup>[5]</sup>. In comparison to other grains, maize is the most frequently farmed crop in the world and the demand for maize is increasing over the past years. It is cultivated in about 170 countries on an area of 205.87 million ha with a world total production of 1,210.24 Mt with the United States of America, China, and Brazil being the world's top 3 corn producing countries. Whereas India stands sixth in global maize production (faostat 2022) <sup>[7]</sup>. In Manipur, after rice, maize is the second-most popular cereal crop, produced in jhum fields and rain-fed hilly upland areas (Chongloi *et al.* 2021) <sup>[2]</sup>. Maize is the most potential and predominant rainy season crop in the hills of the North Eastern Region (NER) of India (Das *et al.* 2010) <sup>[4]</sup>. In the NER (North East Region) of India, maize is the most potential and predominant rainy season crop, which not only ensures food security but also used for direct consumption as well as for feed ingredients. In the case of maize, the estimated area, the average yield, and production for the agricultural year 2020-21 in Manipur were recorded as 25.53 thousand hectares, 2.34 Mt/ha, and 59.73 thousand tonnes respectively (Agriculture Department Manipur 2020-21) <sup>[6]</sup>. Globally around 112 different types of diseases were reported infecting the maize crop, caused by fungi, bacteria, viruses, and nematodes. In India, 16 diseases were identified infecting maize crops which cause 13.2% of yield loss, it includes Seed and seedling blights, Leaf blights, Leaf spots, Downy mildew, Rusts and Late wilt (Payak and Sharma 1985) <sup>[11]</sup>. Among all the foliar diseases affecting maize, the turcicum leaf blight also called as Northern leaf blight caused by *Exserohilum turcicum* (Pass.) Leonard and Suggs. (Syn. *Helminthosporium turcicum* Pass.) is of worldwide importance (Carlos 1997) <sup>[1]</sup>. It was reported earlier that the disease incidence of *E. turcicum* in different maize-growing areas of Manipur ranged from 51.0 to 70.0% during the *Kharif* seasons of 2018 and 2019 which is a major reason for the huge grain yield loss.

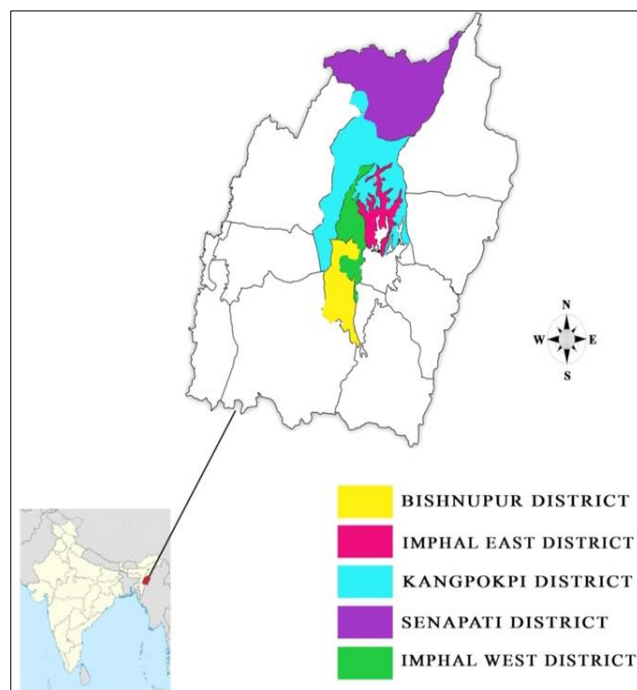
This disease not only affects the quantity of the product but also affects the quality of the produce. Hence a survey was undertaken to know the present status of this disease in different major maize-growing areas of Manipur and to observe the severity, and to formulate location-specific studies on turcicum leaf blight disease.

diagonally spaced about 10 m apart were sampled. At each field site, a W-pattern was used to cover the whole field, making five stops and evaluated for incidence and severity of the Turcicum leaf blight disease of maize. All sample fields belonged to smallholder farmers.

**2. Materials and Methods**

**2.1 Description of the surveyed areas**

Survey and surveillance of Turcicum leaf blight disease of maize were conducted in five different districts of Manipur viz. Imphal East, Imphal West, Bishnupur, Kangpokpi and Senapati districts “Fig. 1”. This survey was carried out by adopting a random sampling survey method during 2022 in the Kharif season on farmers’ maize fields. Before the survey, preliminary information was taken from KVK (Krishi Vigyan Kendra) about major maize-growing villages in the respective districts. Maize fields were randomly selected at intervals of 5-10 km along the main and accessible rural roads except where there is no suitable field available, and then the next maize field was sampled. A total of 57 maize fields were surveyed from which 16 places were from the Imphal East district, 15 places were from the Imphal West district, 4 places were from the Senapati district, 10 and 12 places were from Bishnupur and Kangpokpi districts respectively. Each sampling point coordinate was recorded with the help of a GPS camera. The detailed geographical coordinates of the surveyed areas are listed in “Table 1”. 100 plants from each chosen field were inspected in such a way that the whole field was covered. In a selected field five quadrants (2×3 m)



**Fig 1:** Map of Manipur showing the surveyed districts

**Table 1:** Geographical coordinates of the survey points of different villages of Manipur

Geographical coordinates of villages				
District	Villages	Altitudes (m)	Latitudes	Longitudes
Imphal East	Andro	902	24.7654	94.053
	Huikap	792	24.7104	94.0211
	Nongbram	777	24.7393	93.9627
	Nongpok Keithelmanbi Mayai Leikai	804	24.7305	94.1264
	Nongpok Keithelmanbi Mayai Leikai	804	24.7311	94.1268
	Nongpok Keithelmanbi Mayai Leikai	804	24.7317	94.1265
	Nongpok Keithelmanbi Mayai Leikai	804	24.7300	94.1255
	Nongpok Keithelmanbi Mayai Leikai	805	24.7302	94.1250
	Nongpok Keithelmanbi Mayai Leikai	804	24.7298	94.1250
	Nongpok Keithelmanbi Mayai Leikai	804	24.7299	94.1245
	Nongpok Keithelmanbi Mayai Leikai	807	24.7306	94.1247
	Sadu Yengkhuman	805	25.0349	94.0218
	Sadu Yengkhuman	804	25.0335	94.0216
	Sadu Yengkhuman	804	25.0331	94.0242
	Sadu Yengkhuman	804	25.0366	94.0241
Sadu Yengkhuman	804	25.0318	94.0243	
Imphal West	Shantipur	880	24.9829	93.8903
	Cau Campus	778	24.8125	93.8899
	Kanglatongbi	861	24.9691	93.8872
	Kanglatongbi	890	24.9744	93.8803
	Meisnam Kangmong	805	24.7214	93.7877
	Khongampat Mayai Leikai	792	24.8887	93.8983
	Kameng Sabal Leikai	772	24.7104	93.8293
	Kanglatongbi	849	24.9588	93.8725
	Lamsang	784	24.8178	93.8383
	Maklang	783	24.8059	93.8259
	Sangaitel	828	24.8041	93.7930
	Leirenkabi	791	24.8426	93.8375
	Phayeng	813	24.8502	93.8139
Kha Sanjenbam	1216	24.6816	93.8827	

	Langol	1242	24.5010	94.0723
Senapati	Vakho	1041	25.2882	94.0352
	Maram	1410	25.4196	94.1004
	Christian Colony	1407	25.4184	94.0998
	Lairouching	1249	25.3809	94.0840
	Leimaram	850	24.7159	93.7862
Bishnupur	Leimaram	852	24.7155	93.7861
	Leimaram	852	24.7157	93.7862
	Kumbi	754	24.4364	93.7992
	Kumbi	805	24.4333	93.7969
	Kumbi	800	24.4334	93.7969
	Kumbi	774	24.4318	93.8062
	Ngaikhong Khullen	780	24.6509	93.7671
	Kwaksiphai	774	24.6063	93.7786
	Kabowakching	781	24.7231	93.8057
	Kangpokpi	Chini Ingkhol	781	24.6304
Makhan		1018	24.9845	93.8707
G.Phalbung		852	25.0245	93.9025
Waroiching		901	24.7283	93.7715
Daili		1026	25.1425	93.9525
Daili		1220	25.1423	93.9528
Daili		1168	25.1422	93.9538
Thaldara		1069	25.2068	93.8437
Maohing Kuki		1407	25.1978	93.9193
Gorkha Harup		1278	25.1959	93.8876
Gorkha Harup		1227	25.1950	93.8793
Gorkha Harup		1096	25.1966	93.8744

**2.2 Assessment of Turcicum leaf blight**

**2.2.1 Disease incidence**

As explained above, during the survey in each field, 100 plants were observed based on the symptoms of turcicum leaf blight and the incidence was expressed as a percentage of the total number of stands per plot using the formula described by Nwanosike (Nwanosike *et al.* 2015) <sup>[10]</sup>.

$$\text{Disease incidence (DI)} = \frac{\text{Number of diseased plant}}{\text{Total number of plant examined}} \times 100$$

Where DI is disease incidence.

**2.2.2 Disease severity**

Disease severity on a whole plant basis was rated using a visual scale of 1-9 (Chung *et al.* 2010; Mitiku *et al.* 2014) <sup>[3, 9]</sup> (Table 2.) and the severity scores were converted to percent disease index (PDI) by using the formula given by (Mckinney 1923) <sup>[8]</sup>.

Percent disease index (PDI) =

$$\frac{\text{Sum of individual ratings}}{\text{No. of plants examined}} \times \frac{100}{\text{Maximum disease rating}}$$

**Table 2:** The disease rating scale for Turcicum leaf blight disease of maize

Rating scale	Degree of infection (% DLA**)	PDI*	Disease Reaction
1	Nil to very slight infection (≤10%).	≤ 11.11	Resistant (Score: ≤ 3.0) (PDI: ≤ 33.33)
2	Slight infection, a few lesions scattered on two lower leaves (10.1-20%).	22.22	
3	Light infection, moderate number of lesions on four lower leaves (20.1-30%).	33.33	
4	Light infection, moderate number of lesions scattered on lower leaves, a few lesions scattered on middle leaves below the cob (30.1-40%).	44.44	Moderately Resistant (Score: 3.1-5.0) (PDI: 33.34-55.55)
5	Moderate infection, abundant number of lesions scattered on lower leaves, moderate number of lesions scattered on middle leaves below the cob (40.1-50%).	55.55	
6	Heavy infection, abundant number of lesions scattered on lower leaves, moderate infection on middle leaves, and few lesions on two leaves above the cob (50.1-60%).	66.66	Moderately susceptible (Score: 5.1-7.0) (PDI: 55.56-77.77)
7	Heavy infection, abundant number of lesions scattered on lower and middle leaves, and moderate number of lesions on two to four leaves above the cob (60.1-70%).	77.77	
8	Very heavy infection, lesions abundantly scattered on lower and middle leaves and spreading up to the flag leaf (70.1-80%).	88.88	Susceptible (Score: > 7.0) (PDI: > 77.77)
9	Very heavy infection, lesions abundantly scattered on almost all leaves, plants prematurely dried or killed (>80%).	99.99	

**2.3 Statistical analysis**

The calculated incidence and severity values are transformed by using the arc sine method of transformation (Steel and Torrie 1980) <sup>[12]</sup> then the analysis of variance was done.

**3. Results and Discussion**

**3.1 Survey and surveillance of TLB/NCLB of maize**

The present article reveals the current status of Turcicum leaf blight disease of maize in the Imphal East, Imphal West,

Bishnupur, Kangpokpi, and Senapati districts of Manipur. A total of 57 maize fields were surveyed during the Kharif season in 2021. The survey was carried out in major maize-growing areas of five districts by adopting a random sampling survey methodology as mentioned in the materials and methods. The geographic location of surveyed areas of Imphal East and Imphal West were represented in “Fig. 2”

Kangpokpi and Senapati were represented in “Fig. 3” and Bishnupur in “Fig. 4”. The results revealed that turcicum leaf blight disease was prevalent in all the maize-growing areas of five districts in low to severe form and it can be stated as a major foliar disease infecting maize in different regions of Manipur.

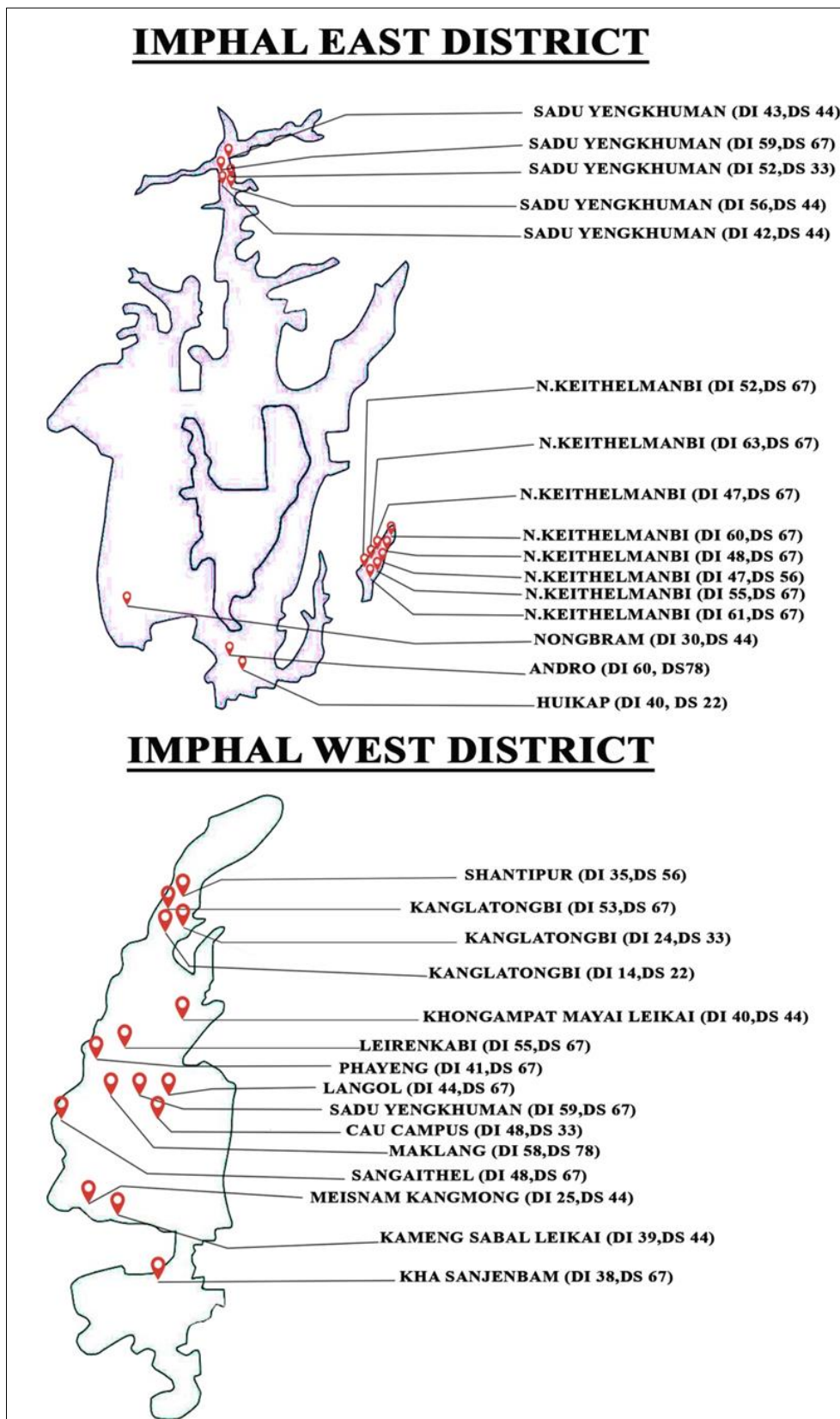


Fig 2: Map of Imphal East and Imphal West districts showing the surveyed areas

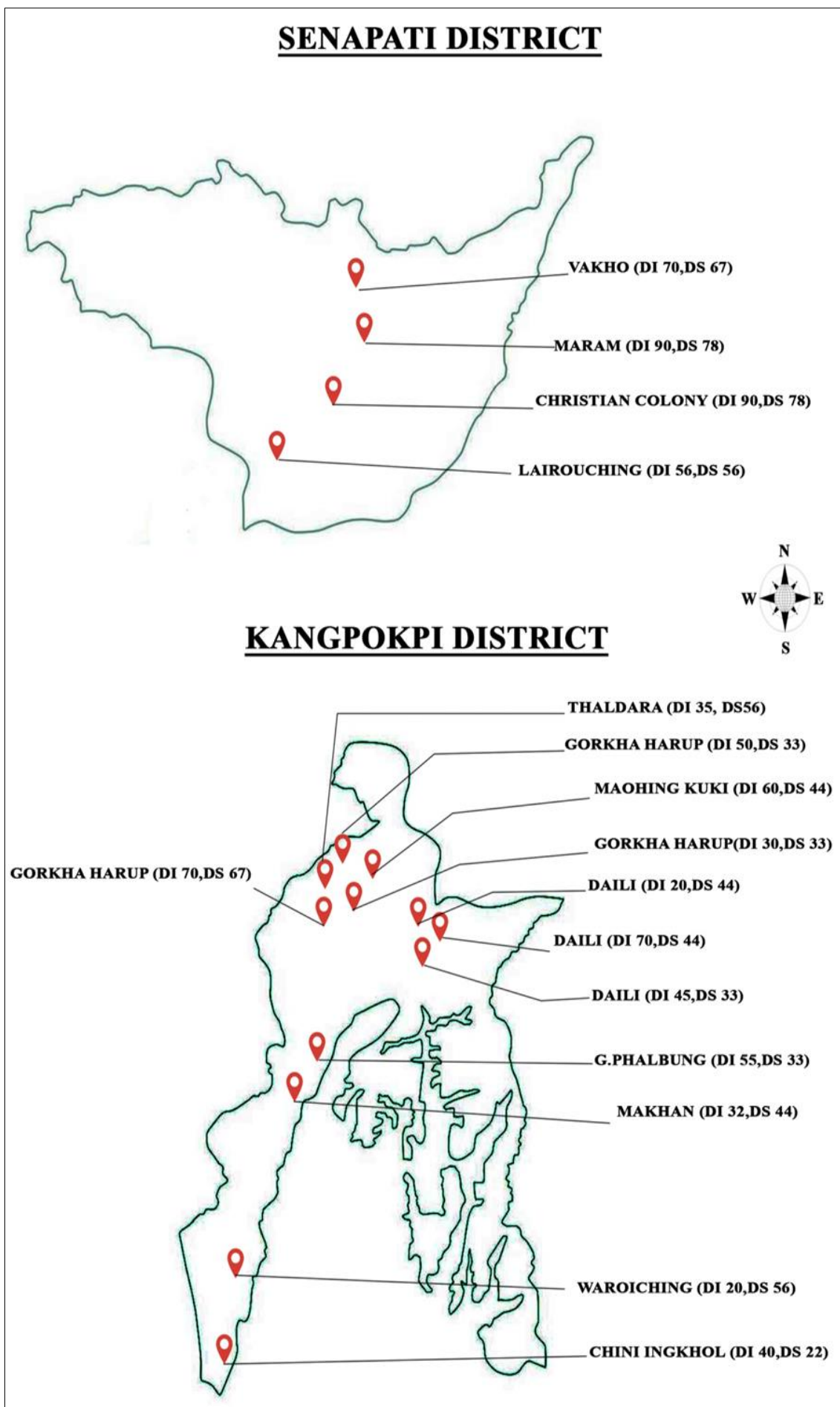
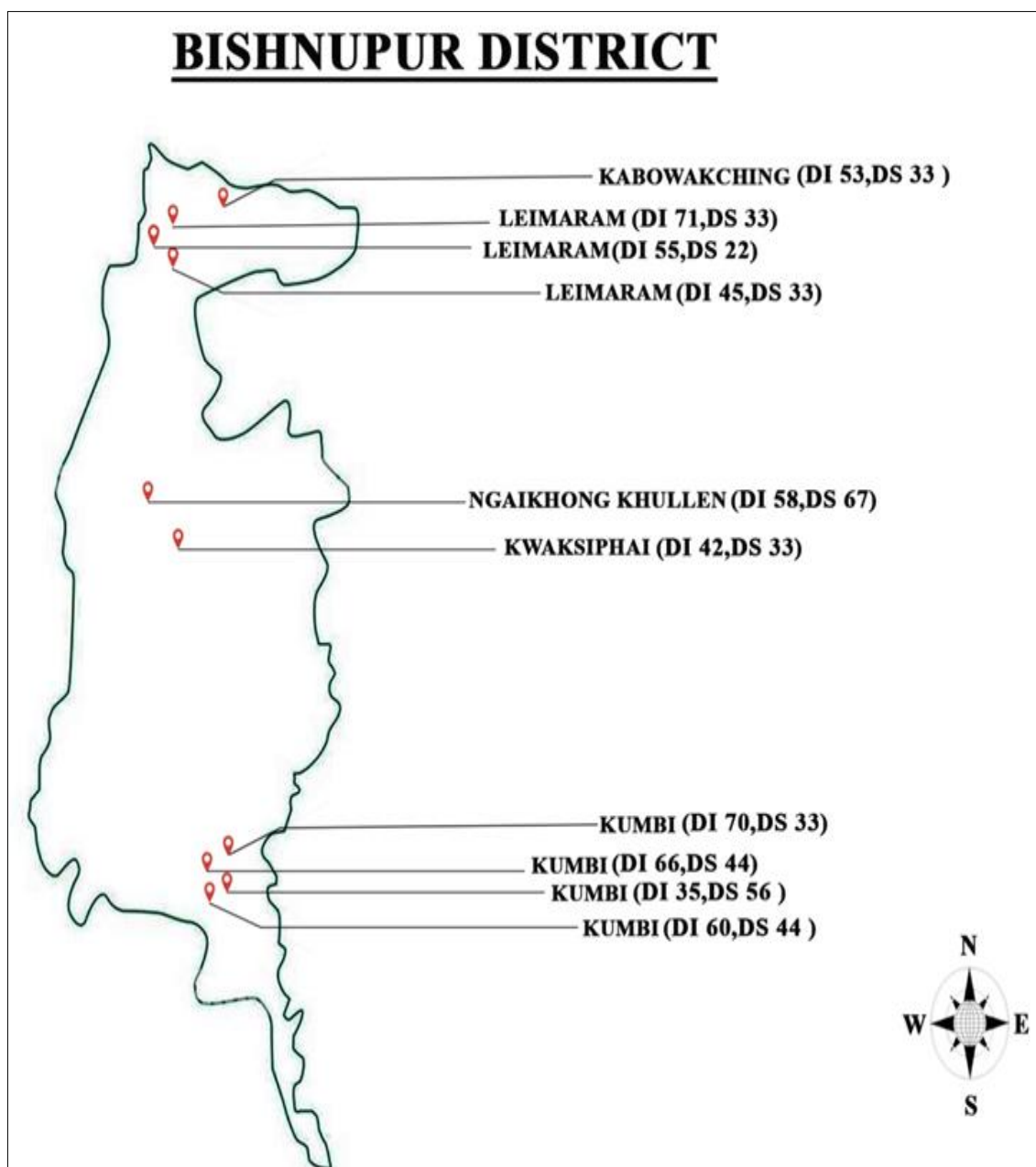


Fig 3: Map of Senapati and Kangpokpi districts showing the surveyed areas



**Fig 4:** Map of Bishnupur district showing the surveyed areas

### 3.2 Disease incidence

The average percent disease incidence was worked out based on the field observations. Among different districts, the Senapati district has recorded the highest disease incidence of Turcicum leaf blight among all the five surveyed districts. The result of the survey conducted showed that Turcicum leaf blight was widely distributed and caused greater disease incidence damage by 77% in Senapati followed by 56% in Bishnupur, 51% in Imphal East, 44% in Kangpokpi district on farmers' maize fields. While the minimum disease incidence is 40% in the Imphal West district. In the Imphal East district, the highest disease incidence was recorded as 63% in Nongpok Keithelmanbi Mayai Leikai village and the lowest having 30% in Leitambi village, Imphal West district, having the highest disease incidence of 58% in Maklang village and the lowest was 14% in Kanglatongbi village, Senapati district, having the highest disease incidence of 90% in Maram and Christian colony village whereas the lowest was recorded as

56% in Lairouching village, Bishnupur district having highest disease incidence of 71% in Leimaram village and the lowest is having 35% in Kumbi village, and Kangpokpi district having the highest disease incidence of 70% in Gorkhaharup village and the lowest having 20% in Waroiching village "Table 3".

### 3.3 Disease severity

Among the different villages surveyed, the disease severity varied from lower to severe form in different villages. Among different districts, the highest disease severity was recorded as 70% from the Senapati district and the lowest having 40% from the Bishnupur district. In the Imphal East district, the highest disease severity was recorded as 78% in Andro village and the lowest having 22% in Huikap village, Imphal West district, having the highest disease severity of 78% in Maklang village and the lowest was 22% in Kanglatongbi village, Senapati district, having the highest disease incidence

of 78% in Maram and Christian colony village whereas the lowest was recorded as 67% in Vakho village, Bishnupur district having highest disease incidence of 67% in Ngaikhong Khullen and the lowest is having 22% in Leimaram village, and Kangpokpi district having the highest disease incidence

of 67% in Gorkhaharup village and the lowest having 22% in Chini-ingkhol village "Table 3". The severity varied from one locality to another, due to varied environmental conditions and cropping patterns.

**Table 3:** Percent Disease Incidence and Percent Disease Severity of the surveyed areas

District	Villages	Disease Incidence (%)	Disease Severity (%)
Imphal East	Andro	60	78
	Huikap	40	22
	Nongbram	30	44
	Nongpok Keithelmanbi Mayai Leikai	47	56
	Nongpok Keithelmanbi Mayai Leikai	48	67
	Nongpok Keithelmanbi Mayai Leikai	60	67
	Nongpok Keithelmanbi Mayai Leikai	55	67
	Nongpok Keithelmanbi Mayai Leikai	63	67
	Nongpok Keithelmanbi Mayai Leikai	61	67
	Nongpok Keithelmanbi Mayai Leikai	52	67
	Nongpok Keithelmanbi Mayai Leikai	47	67
	Sadu Yengkhuman	59	67
	Sadu Yengkhuman	42	44
	Sadu Yengkhuman	52	33
Sadu Yengkhuman	43	44	
Sadu Yengkhuman	56	44	
Mean		51	56
Imphal West	Shantipur	35	56
	Cau Campus	48	33
	Kanglatongbi	14	22
	Kanglatongbi	24	33
	Meisnam Kangmong	25	44
	Khongampat Mayai Leikai	40	44
	Kameng Sabal Leikai	39	44
	Kanglatongbi	53	67
	Lamsang	42	67
	Maklang	58	78
	Sangaitheh	48	67
	Leirenkabi	55	67
	Phayeng	41	67
Kha Sanjenbam	38	67	
Langol	44	67	
Mean		40	55
Senapati	Vakho	70	67
	Maram	90	78
	Christian Colony	90	78
	Lairouching	56	56
Mean		77	70
Bishnupur	Leimaram	45	33
	Leimaram	71	33
	Leimaram	55	22
	Kumbi	35	56
	Kumbi	70	33
	Kumbi	66	44
	Kumbi	60	44
	Ngaikhong Khullen	58	67
	Kwaksiphai	42	33
	Kabowakching	53	33
Mean		56	40
Kangpokpi	Chini Ingkhol	40	22
	Makhan	32	44
	G.Phalbung	55	33
	Waroiching	20	56
	Daili	20	44
	Daili	70	44
	Daili	45	33
Thaldara	35	56	

	Maohing Kuki	60	44
	Gorkha Harup	30	33
	Gorkha Harup	70	67
	Gorkha Harup	50	33
	Mean	44	42

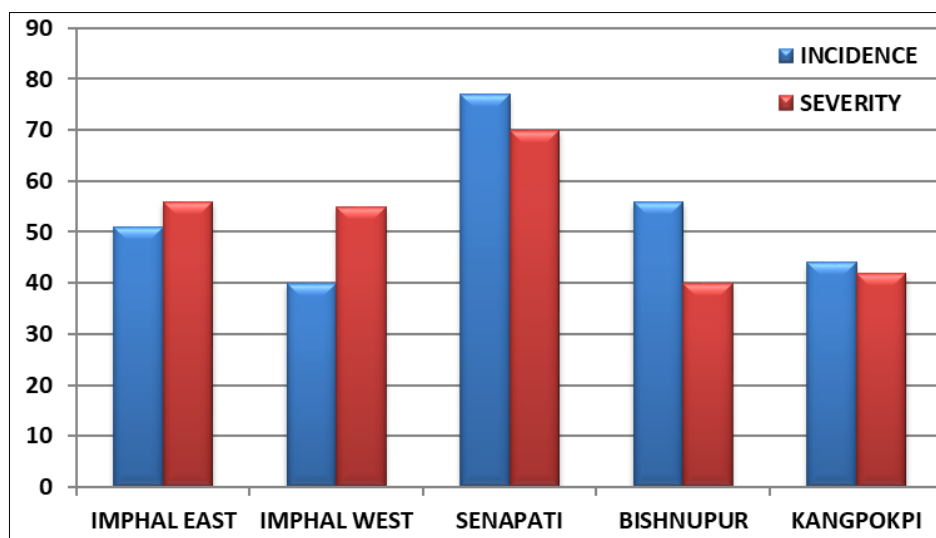


Fig 5: Graph representing the incidence and severity of five surveyed districts

#### 4. Conclusion

From the statistical analysis, it was concluded that there is no significant difference in the incidence and the severity, as the P-value is 0.168 and 0.080 respectively. The comparative study of the graph in "Fig. 5" defines that the infection of TLB is very severe in the Senapati district whereas Imphal west is the least infected among the surveyed districts. TLB is considered as one of the major foliar diseases affecting maize plants in Manipur and is a major cause of huge economical loss. Hence based on the present status of the disease in Manipur further management of this disease should be investigated to reduce the economic losses.

#### 5. Acknowledgement

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