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ASSESSING FARMERS' PRACTICES AND DISEASE OCCURRENCE IN PIGEONPEA CROPS IN NAGALAND, INDIA

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Abstract
A roving survey was conducted on pigeonpea growing areas of Nagaland state during the Kharif season of 2023-24 and 2024-2025 to ascertain the various diseases prevalence. The survey was conducted in 15 locations across 8 pigeonpea growing districts of Nagaland. The pooled mean disease intensity was observed to vary from 0-2.15% for Fusarium wilt (FW), 1-14.9% for Phytophthora stem blight (PSB), 0-10.8% Macrophomina stem blight (MSB), 3-63% for Alternaria leaf spot (ALS), and 1-22.15% for Collar rot (CR). MSB was observed in 2 locations (Medziphema and Pangtong) which is reported for the first time, and it ranged from 0-10.8% disease incidence. Survey indicated that ALS, MSB and collar rot incidence was observed to be highest in Medziphema under Chumoukedima district for both the years, whereas PSB was observed to be highest in Pangtong village under Wokha district during kharif season 2024-2025. The weather parameters like rainfall, humidity and suitable temperature must have been crucial for disease incidence in these areas. Therefore, different management strategies are necessary to curb the diseases in this region.

KEYWORDS: ALS; Collar rot; Disease Incidence; MSB; Pigeonpea; PSB.

INTRODUCTION
Pigeonpea (*Cajanus cajan* (L.) Millsp.) also known as red gram, tur, arhar, or angola pea is an important pulse crop in India, serving as a significant protein source to the human diet. In India, after chickpea, pigeonpea is the second most important pulse crop. India is considered as the primary center of origin of pigeonpea because of numerous wild relatives present in India and vast natural genetic variability in local germplasm (1). Pigeonpea is prone to many diseases and pests. The crop suffers from numerous pathogens, these include viz., fungi, bacteria, viruses, nematodes and phytoplasmas (2,3). Among the major soil borne diseases, the Fusarium wilt caused by *Fusarium udum* Butler, is one of the most important disease capable of causing 30-100% loss in grain yield (2,4). Phytophthora stem blight (PB), is considered the third potentially major disease of pigeon pea after Fusarium wilt and SMD (Sterility mosaic) which is incited by the fungus *Phytophthora drechsleri* Tucker f. sp. *cajani*.(5). In Nagaland, pigeonpea is grown in different climatic conditions under different cropping patterns. The existence of each disease has been reported based on their occurrences. The study had three objectives: (a) to examine and record incidence of different disease at farmers' field; (b) to determine agronomic practices and other cultural practices; and (c) to determine farmers' knowledge and perception of different diseases of pigeonpea.

MATERIALS AND METHODS
A roving survey was conducted in pigeonpea growing areas mainly Peren district, Chumoukedima district, Wokha district, Niuland district, Tseminyu district, Mokokchung district, Kiphire district, Phek district for various diseases during the year 2023-24 and 2024-2025. A total of 15 locations in 8 different districts were surveyed (Table 1) for various diseases prevailing at the farmers field in pigeonpea. Survey was conducted at active vegetative growth stage of the crop to physiological maturity. The questionnaire assessed the general agronomic practices, farmers' perceptions on production constraints, variety selection, disease, its causes, control and fungicide use, perceived yield loss and its management adopted by the farmers. In each field, five random spots of 10×10 sq. meter was randomly selected and the percentage of disease incidence for Fusarium wilt, PSB, Collar rot, ALS and MSB was assessed by recording the number of plants showing disease symptoms out of total number of sampled plants examined by using the formula mentioned below. (6).

$$\text{Disease incidence (\%)} = \frac{\text{number of plants infected}}{\text{total number of plants examined}} x\ 100$$

Further the disease incidence of individual fields was used for calculating the mean incidence of each district and the district average was used to calculate the mean incidence of the state. These averages indicate relative prevalence of PSB, Wilt, MSB, ALS and Collar rot during the assessed years and pooled of two years (Table 1). The other information such as, type of varieties grown, cropping system followed and type of symptoms exhibited by the crop etc., were also recorded for ease of management of disease-causing economic losses.

RESULTS AND DISCUSSION

Cultivars used and cropping system followed

Pigeonpea is a non-traditional crop of the Nagaland state and it was intensively popularized among the farmers since 2010 after the establishment of erstwhile AICRP on pigeonpea and now renamed as AICRP on Kharif Pulses. Based on the socio-demographic and choices of food preference the bold seeded short to medium duration cultivars are being popularized for cultivation in the state. As the pigeonpea crop is being freshly promoted in the state, the farmers depend mainly for seed from the state agriculture department and SAS:NU, Medziphema campus. The popular varieties among the farmers are UPAS 120, PA 291 and NUPPC-7B. Initially the seed of these varieties were supplied to farmers through trainings. The state department has been distributing mostly UPAS120 to the farmers and the farmers has been growing it as a perineal standing crop consuming the fresh pods as vegetable or for chutney purposes. Besides UPAS 120, different seeds were distributed by AICRP on Kharif pulses, Nagaland Center, mainly, PA 291 and NUPP 7B (Table 2) for farmers after extensive research and formal trainings. Certified seed procurement was not known by the farmers, as no such mechanism is available in Nagaland yet. Farmers did not relate pest and disease resistance or susceptibility to yield. The Intervention of AICRP on Kharif Pulses, NU:SAS with the unending support of IIPR, Kanpur has been actively conducting Awareness programmes and trainings which is progressing with the aim to sensitize the farmers on the benefits of pigeonpea and also its usage as dal for consumption which has been adopted by most intervened villages so far.

Disease Incidence

Kharif 2023-2024

Disease incidence for PSB ranged from 0-15.5%, ALS ranged from 0-70.22% and collar rot ranged from 0-31% where Medziphema under Chumukedima district was recorded to be highest for all the three diseases of pigeonpea. (Table 3). The disease incidence for Wilt ranged from 0-2.5% where Ghotovi under Niuland district was found to be the highest. (Table 3). There was no Incidence of MSB during the surveyed year. The farmers that were interviewed had little to no knowledge regarding the occurrences of the different diseases in pigeonpea. The results indicated that that disease incidence ranged from 0-2.5% for Wilt, 0-15.4% for PSB,0%MSB, 0-70.2% for ALS, 0-31% during the surveyed year 2023-2024.

Kharif 2024-2025

Diseases such as PSB and ALS was found in all the 15 locations across 8 districts surveyed during the year 2024-2025.The farmers interviewed had no knowledge of the diseases but they had observed it in their fields. The farmers that were interviewed observed stem or canker formation or cracking of stem at infection point. The disease incidence for all the surveyed location for PSB ranged from 2-18.5% DI. It was recorded to be highest in Pangtong under Wokha district (18.5%) whereas the least disease incidence was recorded at Jalukie under Peren district for the surveyed year 2024-2025. As for ALS, the farmers that were interviewed commented that there were numerous spots on the lower leaves which later turns into a big spot. The disease incidence for ALS in all the surveyed location ranged from 7.5-55.78% DI. The disease incidence was recorded to be highest in Medziphema under Chumoukedima district where as the lowest incidence of disease was recorded in Pangtong under Wokha district for the surveyed year 2024-2025. (Table 4)

There was zero incidence of wilt in 7 locations but it ranged from 0.5-2.13% in 8 locations namely at Medziphema, Champang, Jalukie, New chalkot, Terogunyu, Ghotovi, Pangtong, Longpayimsen.(Table 4). The farmers interviewed observed that some seedlings dry and die out after emergence. Collar rot was found to be prevalent in all the locations except at Pangtong (0%). Here, the interviewed farmers mentioned white color threads found on the stem of pigeonpea crop after heavy rainfall. The disease incidence ranged from 0-13.3% where Medziphema had the highest disease incidence. MSB was observed for the first time in two different locations namely Medziphema and Pangtong under Chumoukedima district and Wokha district respectively during the surveyed year 2024-2025. The diseases incidence was recorded at 15.3% and 21.6% respectively. (Table 4) The results indicated that disease incidence ranged from 0-2.13% for wilt, 2-18.5% for PSB,0-21.6%MSB, 7.5-55.78% for ALS, 0-13.3% for collar rot and 0-21.6%PDI for MSB during the surveyed year 2024-2025.

Pooled mean

The pooled mean disease intensity was observed to vary from 0-2.15% for Fusarium wilt (FW), 1-14.9% for Phytophthora stem blight (PSB), 0-10.8% Macrophomina stem blight (MSB), 0-63% for Alternaria leaf spot (ALS), and 0-22.15% for

Collar rot (CR). MSB was observed in 2 locations (Medziphema and Pangtong) which is reported for the first time, and it ranged from 0-10.8% disease incidence. Survey indicated that ALS, MSB,PSB and Collar rot incidence was observed to be highest in Medziphema under Chumoukedima district for both the years, whereas Wilt was observed to be highest in Ghotovi village under Niuland district.

Farmers perception about disease and measurement practices

The advantages of crop rotation were not clear to most farmers as practically all farmers used to sow the same field year after year because of limited land or small land holdings. Generally, farmers have good knowledge about entities that they can easily see like plants, soil and insects but farmers often have narrow knowledge about less noticeable things like disease causing pathogens. Thus, farmers rarely know the cause of plant diseases (7). The absence of farmers' knowledge on

diseases and pests highlights the necessity for education that can be beneficial in ascertaining the determinant causes of impending management of diseases and pests.
Majority of the farmers uses mostly cultural management for disease management like rogueing or removing the infected plants. Biological management of diseases i.e, *Trichoderma* or *Pseudomonas* are used when it is available to them through State Agriculture department or through KVK, AICRP trainings. Chemical management was not observed in all the farmers fields due to non-availability of chemicals in the vicinity. Farmers more often choose cultivars which provides higher productivity other than resistance to diseases or pests. Major failure of IDM programmes in developing countries has been attributed to the tendency to excessively concentrate on a particular pest or disease alone rather than on a broader spectrum of constraints including agronomic, social and economic constraints (8) and limited knowledge. Therefore, Integration of high yielding and resistant cultivars along with various trainings on IDM and IPM needs to be imparted to the farmers regarding the various diseases and pest prevailing in the state in order to improve the cultivation practices of pigeonpea along with the existing cultural practices.

CONCLUSION

The Incidence of diseases in pigeonpea have been on the rise due to vagaries in the environmental factors. Although awareness programmes and trainings are conducted to sensitize the farmers on the different diseases on pigeonpea, the fact remains that farmers are unable to manage the diseases due to unavailability of effective biological methods or chemicals in the vicinity when in urgent need. A state like Nagaland which is organic by default has its own drawbacks which challenges the farmer to adopt cultural and mechanical methods for disease management. Therefore, the need to survey and assess the farmers field is required to encourage,sensitize the farmers as well as be ready for any outbreak of diseases in the farmers' field.

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Table 1. Geographical Locations of Survey conducted.

Sl.no	Districts	Name of the location	Latitude	Longitude	Mean Sea Level
1.	**Chumukedima**	Medziphema	25.74969°N	93.8565°E	440.5m
2.	**Peren**	Jalukie	25.65534°N	93.7053°E	350 m
		B Jalukie	25.62315°N	93.6136°E	303 m
		New chalkot	25.62285°N	93.6135°E	324m
		Samzairam	25.63366°N	93.6644°E	337m
3.	**Kiphire**	Pungro	25.81302°N	94.8429°E	1519.1 m
4.	**Niuland**	Tesophenyu	25.93182°N	94.0048°E	237 m
		Ghotovi	25.95048°N	94.0235°E	465m
5.	**Wokha**	Champang	26.23847°N	94.0658°E	178m
		Pangtong	26.23592°N	94.0702°E	281.6 m
		Bhandari	26.24333°N	94.0694°E	152.6m
6.	**Tseminyu**	Terogvunyu	25.88517°N	94.1919°E	1450 m
		Sendenyu	25.90561°N	94.1214°E	1270m
7.	**Mokukchung**	Longpayimsen	26.55431°N	94.3868°E	174m
8.	**Phek**	Chizami	25.59322°N	94.3834°E	1431.5 m

Table 2. Distribution, Intercropping systems and Pigeonpea cultivars grown in Nagaland during Kharif season 2023-2024 & 2024-2025.

Sl.no	Districts	Name of the cultivar	Intercropping systems	Crop stage	Rainfed/ Irrigated
1.	Wokha	NUPPC-7B* UPAS 120	Pigeonpea + Arecanut Sole crop	Vegetative and physiological maturity	Rainfed
2.	Peren	NUPPC-7B* UPAS 120	Pigeonpea + Mungbean Pigeonpea + Ricebean Sole crop		
3.	Niuland	PA-291 UPAS 120	Pigeonpea + Arecanut Pigeonpea + Soybean Pigeonpea + Ricebean Sole crop		
4.	Chumukedima	PA-291 UPAS 120 NUPPC 7B*	Pigeonpea + Arecanut Sole crop		
5.	Kiphire	PA-291 UPAS 120	Pigeonpea + Rajmah + Ricebean Sole crop		
6.	Phek	PA-291 UPAS 120	Pigeonpea + Ricebean		
7.	Tseminyu	PA-291	Pigeonpea + Chilli + Ricebean Pigeonpea + Colacasia		
8.	Mokukchung	NUPPC-7B* UPAS 120	Pigeonpea + Colacasia + Chilli		

*Advanced breeding line developed by AICRP on Kharif pulses Unit, SAS:NU, Medziphema campus

Table 3. Percent Incidence of different diseases on pigeonpea during kharif season 2023-2024.

Sl.no	Districts	Location	Percent disease incidence				
			Wilt	PSB	MSB	ALS	CR
1.	**Chumukedima**	Medziphema	2	15.4	0	70.22	31
2.	**Peren**	Jalukie	0	0	0	12.5	0
		B Jalukie	0	0	0	16.67	0
		New chalkot	0	0	0	0	0
		Samzairam	0	7	0	0	0
3.	**Kiphire**	Pungro	0	0	0	0	0
4.	**Niuland**	Tesophenyu	0.5	0	0	0	0
		Ghotovi	2.5	11.3	0	36.11	18.6
5.	**Wokha**	Champang	0	0	0	0	0
		Pangtong	1.7	2.1	0	8.3	11.5
		Bhandari	0	0	0	0	0
6.	**Tseminyu**	Terogvunyu	0	0.8	0	2.78	0
		Sendenyu	0	1.2	0	0	0
7.	**Mokukchung**	Longpayimsen	1.4	2	0	11.4	9.6
8.	**Phek**	Chizami	0	0	0	0	0

Table 4. Percent Incidence of different diseases on pigeonpea during kharif season 2024-2025.

Sl.no	Districts	Location	Percent disease incidence				
			Wilt	PSB	MSB	ALS	CR
1.	**Chumukedima**	Medziphema	2.13	14.4	21.6	55.78	13.3
2.	**Peren**	Jalukie	0	2	0	40.89	5.4
		B Jalukie	0.5	17	0	35.55	7.6
		New chalkot	1.2	10.6	0	40.89	2.2
		Samzairam	0	12	0	24.67	10
3.	**Kiphire**	Pungro	0	11.3	0	9.56	4.4
4.	**Niuland**	Tesophenyu	1.8	10	0	26.22	8.8
		Ghotovi	1.8	13.2	0	26.22	9.5
5.	**Wokha**	Champang	2	7.6	0	38.22	6.7

		Pangtong	0.8	18.5	15.3	7.5	0
		Bhandari	0	8.1	0	17.56	3.1
6.	**Tseminyu**	Terogvunyu	0	4.5	0	8	4.4
		Sendenyu	0	3.3	0	13	5.9
7.	**Mokukchung**	Longpayimsen	0.8	4	0	9.11	6.5
8.	**Phek**	Chizami	0	9.5	0	6.67	5

Table 5. Pooled mean of Percent Incidence of different diseases on pigeonpea during kharif season 2023-2024 & 2024-2025.

Sl.no	**Districts**	**Location**	**Pooled mean**				
			Wilt	**PSB**	**MSB**	**ALS**	**CR**
1.	**Chumukedima**	Medziphema	2.06	14.9	10.8	63	22.15
2.	**Peren**	Jalukie	0	1	0	26.69	2.7
		B Jalukie	0.25	8.5	0	26.11	3.8
		New chalkot	0.6	5.3	0	20.44	1.1
		Samzairam	0	9.5	0	12.33	5
3.	**Kiphire**	Pungro	0	5.65	0	4.78	2.2
4.	**Niuland**	Tesophenyu	1.15	5	0	13.11	4.4
		Ghotovi	2.15	12.25	0	31.16	14.05
5.	**Wokha**	Champang	1	3.8	0	19.11	3.35
		Pangtong	1.25	10.3	7.65	7.9	5.75
		Bhandari	0	4.05	0	8.78	1.55
6.	**Tseminyu**	Terogvunyu	0	2.65	0	5.39	2.2
		Sendenyu	0	2.25	0	6.5	2.95
7.	**Mokukchung**	Longpayimsen	1.1	3	0	10.25	8.05
8.	**Phek**	Chizami	0	4.75	0	3.33	2.5

Fig. 1. Pictures of some farmers field survey with GPS coordinates