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Smallholder farmers' local knowledge and challenges in management of sunflower fungal diseases: Experience from Ludewa district- Njombe, Tanzania

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Abstract

The objective of this paper was to investigate farmers' knowledge and management of sunflower fungal disease in Tanzania. Farmers' survey was conducted in one districts namely Ludewa District in July 2023 and September 2023. This study aims to assess farmers' knowledge and management practices regarding sunflower fungal diseases in Ludewa district. The research employees a simple random sampling technique to select 384 sunflower farmers from eight villages across the district. Data were collected through face-to-face interviews using semi-structured questionnaire, interviews and Focus group discussions. Farmers observed symptoms of sunflower fungal diseases through book of photographic pictures to show different symptoms of different diseases. The results revealed that sunflower diseases, including Rust, Alternaria leaf blight, Sclerotinia head rot, Rhizopus head rot, Charcoal rot, and Septoria leaf blight, were identified as the most significant production constraints, affecting over 70% of the respondents, Rust disease was most common disease while septoria leaf blight was less common at study area. Sunflower diseases were identified as the most significant constraint, affecting 70.625% of them. This was followed by a lack of knowledge on management of sunflower diseases (43.11%), drought (24.11%), and limited access to inputs (20.87%) and insects (14.57%) as additional challenges. On management about 80% were practicing weeding, 70% of respondents reported burning residuals as a disease control method, and over 75% tended to uproot infected plants. Lack of knowledge to identify the diseases, ability to afford to buy pesticides and to relay only on cultural control methods were reported to affect the management of the sunflower disease. Strengthening the capacity of farmers to identify the diseases and proper management practices will sustainably solve the problem of sunflower diseases in sunflower production.

Keywords: Rust; Alternaria leaf blight; Sclerotinia head rot; Charcoal rot; Rhizopus head rot; Septoria leaf blight

1 Introduction

Sunflower (Helianthus annuus) ranks second only to palm oil as a source of edible oil in Tanzania (Vilvert et al., 2018). Sunflowers thrive in arid climates, making them a suitable crop for Tanzania, (Beteri and Msinde 2024). In Tanzania, sunflowers are typically grown in plots ranging from 0.4 to 1.2 hectares, primarily by small farmers contributing up to 95% of production. These farmers often intercrop sunflowers with cowpeas, sorghum, and maize (Echarte et al., 2011). A small number of medium-sized and large farms account for 4% and 1% of sunflower cultivation, respectively. It is estimated that about 4 million smallholder farmers engage in sunflower production (Mchopa et al., 2020). The crop is cultivated in fifteen regions across Tanzania, including Singida, Iringa, Dodoma, Manyara, and Rukwa, with respective production capacities of 40%, 13.83%, 12.35%, 11.91%, and 11.18% (Chappa et al., 2022).

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Production of sunflowers in the Njombe region offers multiple livelihood opportunities because of the valuable vegetable oils and animal feeds that are sold to internal and external markets (Isinika and Jeckoniah 2021). In the 2020/2021 growing season, sunflower production in the area reached 2205 tons across 1992 hectares (source: Annually report submitted from agricultural officers to District Executive Director 2020/2021 at Ludewa district).

The major constraints affecting sunflower production in Njombe region are shortage of improved seed varieties for farmers for planting, harsh weather conditions, erratic/low rainfall, unreliable markets, price fluctuations, high cost of farm input, disease attack, insect-pest infestation on the plant-crop, birds attack, lack of farm machinery, unpredictable rainfall, ignorance/lack of awareness, poor extension services, and stiff competition from edible oil imports (Lyanga, 2024). For instance, farmers in Ludewa-Njombe reported poor sunflower production in 2019 due to above-normal rainfall, which adversely affected yields. Continuous planting on farmland, both in and out of season, may lead to disease buildup, including leaf spots and head rots. The major fungal diseases affecting sunflowers in Ludewa include Rust, Sclerotinia head rot, Alternaria leaf blight, Charcoal rot, Rhizopus head rot, and Septoria leaf blight (Gulya *et al*., 2016). Among these, Rust is the most prevalent, primarily due to the use of recycled seeds obtained from neighbours or friends (Baka, 2025). However, these diseases can be effectively managed through crop rotation, improved irrigation methods, and the use of bio pesticides (Adeleke and Babalola, 2020). Farmers in this area have attempted to manage sunflower crops and employed practices such as uprooting infected plants, weeding, applying fertilizers, and proper selection of seeds (Fernandes *et al*., 2011).

The advancement of crop production is closely linked to a critical understanding of the ecological requirements of crops, the threats posed by diseases and insect pests, and the effects of these threats, as well as the conditions that allow pests to thrive (Vilvert *et al*., 2018). Several researchers have highlighted the importance of understanding farmers' knowledge and perceptions of diseases and their management in developing effective control strategies. (Nyankanga *et al.,* 2004; Chabi *et al.*, 2024; Schreinemachers *et al.,* 2015; Hashim *et al.,* 2018; Massomo, 2019; Islam *et al.*, 2020). For instance, McDonald *et al*. (2009) showed that understanding the timing of sowing in relation to weather patterns can help to minimise disease outbreaks. A lack of understanding of appropriate agronomic methods contributes to the persistence of sunflower diseases (Gulya *et al*., 2019). Additionally, farmers who are aware of the effects, severity, and incidence of diseases are better equipped to manage them for optimal crop performance (Ghorbani *et al*., 2008).

There is a significant gap in information regarding farmers' knowledge of agricultural disease management, despite its importance (Chandhana *et al*., 2022). To develop effective control strategies that align with farmers' needs and expectations, it is crucial to assess their perceptions and knowledge of sunflower fungal disease management. Therefore, this study aimed to collect essential data on farmers' awareness and management practices for sunflower fungal diseases in Ludewa District, Njombe Region, Tanzania.

2 Materials and Methods

2.1 Description of the study area

The study was conducted in Ludewa district, in the southern highlands of Tanzania, from July 2023 to September 2023 (Figure 1). Ludewa is one of the four districts in the Njombe Region. The district was purposively selected because of its great potential in sunflower production (Andrew et al., 2023). It is located approximately 34°01' - 35°02' E and 09°03' – 10°03' S in Njombe Region and it lies between 500 and 2800 mm above sea level. The Ludewa district is characterized by a tropical climate with a unimodal rainfall pattern, with an annual range of 900 to 1600mm from November to May. The annual average rainfall in the zone ranges from 1000-1600 mm (the highlands), 1200 mm in the midlands and 900 mm in the lowlands (Mlengule, 2019). The area is characterized by woody plant assemblages mostly covered with loam soil and red soil in other parts and shading of landscape natured with several ups and downs (Andrew, 2023).

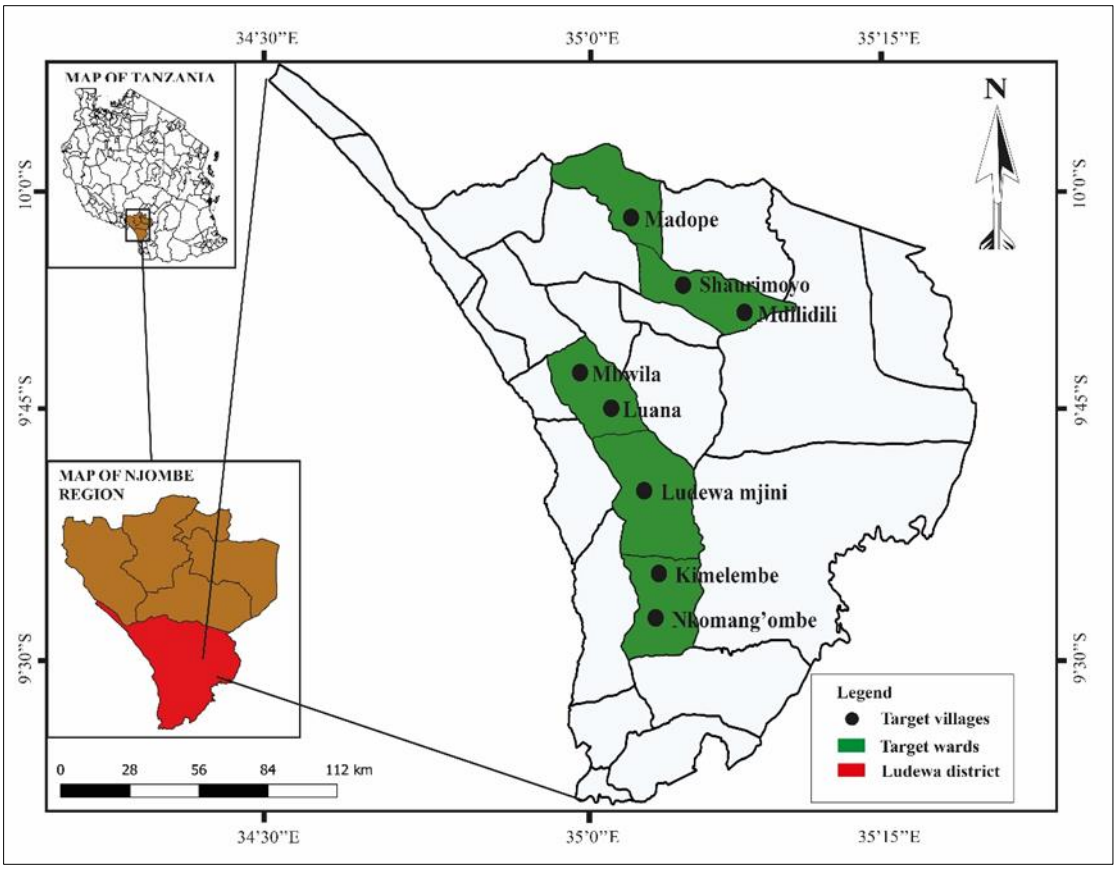

Figure 1 A Map of Tanzania, highlighting Njombe Region and Ludewa District, showing the eight villages in the study area

2.2 Methods and sample selection

The research population included all sunflower farmers from the eight villages in the Ludewa district of the Njombe Region. The survey was carried out through participatory methods namely (i) Interviews by questionnaires, (ii) Focus group discussions, (iii) Key informant interviews and (iv) Field observations, as described below;

2.1.1 Interviews by questionnaires

A total of 384 farmers were interviewed using a semi-structured questionnaire. Eight villages representing five wards were randomly chosen from the district. The villages were Kimelembe, Nkomang'ombe, Ludewa Mjini, Luana, Mbwila, Madope, Shaurimoyo, and Mdilidili (Figure 1). A simple random sampling process was used to choose the farmers who would be interviewed (Schreinemachers *et al.,* 2015), ending with 48 farmers interviewed from each village. The sample size was computed as per formula by Wonnacott & Wonnacott (1990) (as cited by Mghase *et al*., 2010). Thus, the sample size (S = number of farmers to be interviewed) was calculated.

$$S=Z^{\wedge 2} \times P \times ((1-p))/M^{\wedge 2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$S= (1.96^2 X 0.5\ (1-0.5))/0.05^2$$

$$S=384$$

Where S =sample size, Z = Z score, M=marginal error, and p=confidence level so z=1.96, p=0.5, M=0.05.

The questionnaire was designed to collect information on the sunflower varieties farmers prefer to cultivate and the methods they use to manage sunflower diseases. It also gathered data on farmers' socioeconomic profiles (including age, gender, and education), their preferred sunflower varieties, perceptions of disease causes, constraints in sunflower production, and knowledge of disease management

2.1.2 Focus group discussions

One focus group discussion (FGD) was conducted in each of the eight villages to assess farmers' awareness of diseases that affect sunflowers and the methods and strategies they employ to manage the diseases (Fig. 2). Each focus group comprised eight to twelve representative sunflower farmers. The farmers were randomly selected by ward agricultural extension officers and/or village executive officers from a list of farmers with known experience in sunflower production. The definition of knowledge includes farmers' knowledge of the diseases, the environmental factors that facilitate their spread, and management techniques. In contrast, “practices” refer to management decisions that reflect knowledge and views are referred to as practices.

An interview checklist for FGDs was used to gather information on the following: farmers' knowledge of sunflower diseases, sunflower production practices and inputs used, types and varieties of sunflowers grown, types of diseases and perceived crop losses, farmers' methods of control and challenges faced in managing diseases. During the conversations, coloured photos depicting the signs of various diseases were used to assess farmers' knowledge and ability to accurately identify plant diseases. Farmers were given photographs so they could view images of the symptoms of several diseases that could affect sunflower crops. The discussions were tape recorded and later transcribed to text.

Figure 2 Researcher with farmers during a focus group discussion at Nkomang’ombe Village

2.1.3 Key informant Interviews

Individual interviews were done with Key informants, namely; Village Executive Officers (n=8), three resident Ward Agricultural Extension officers, and two heads of farmer's associations. The interviewees were chosen through purposive sampling. A checklist of questions like those used in focus group discussions was employed..

2.1.4 Field observations

In order to supplement the data gathered from interviews and focus group discussions, participant field observations were conducted. Beginning in April 2023, the visits were conducted twice at intervals of two months. Documentation of (i) sunflower farming practices, including plant densities and cultivar types planted; (ii) the frequency, intensity, and distribution of disease symptoms in the fields; and (iii) photographs of crops and disease symptoms were among the observations made during field visits. In order to verify that the names of the types farmers cited were accurate, visits were also made to agro-input stores located throughout the villages of Ludewa area. The expression of each disease's distinctive symptoms served as the basis for disease identification in the field.

2.3 Data collection

Data was collected through face-to-face interviews and filled in a semi-structured questionnaire. The questionnaire was designed to gather information about the types of sunflower varieties that farmers choose to produce and the methods they use to control sunflower diseases. The socioeconomic profiles of farmers (such as age, gender, and education), their

favorite sunflower varieties, and their causes perceptions, constraints in sunflower productions, challenges faced in sunflower productions and knowledge of managing sunflower diseases were among the data gathered.

2.4 Data analyses

Quantitative and qualitative data collected through the interviews by questionnaires was coded and subjected to statistical analysis using the IBM SPSS Statistics version 20. Cross-tabulations and descriptive statistics were used to summarize data from the questionnaires. To make statistical inferences, contingency chi-square tests were computed at $P \leq 0.05$ levels of significance to analyze relationships between some of the variables. Data from focus group discussions and field observations were subjected to content and thematic analyses as described by (Vaismoradi *et al*., 2016)

3 Results

3.1 Description of the demographic characteristics

Statistical analysis revealed a significant variation in the ages of respondents, as detailed in (Table 1). The majority of respondents were aged between 45 and 64 years, particularly in Ludewa mjini where this age group constituted 67.4% of the population. The next largest group was those aged 35 to 44 years, prevalent across nearly all villages (Table 1). Notably, the youth group (under 35 years) was more prominent than the elderly (over 65 years). While the majority of respondents were men, the difference in the gender distribution across villages was not significant (Table 1). Educational attainment among respondents varied, with over 86% having only primary education, significantly outnumbering those with secondary or college education across the study areas. Notably, respondents from Ludewa mjini, Luana, Mbwila, and Shaurimoyo reported no college-level education.

Table 1 Social-demographic characteristics of farmers in the surveyed area (Ludewa District) (n = 384)

Item	**Villages**								**Mean (%)**	**df**	**$\chi 2$**	***P*-value**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**				
Age (Years)												
22-34	24	16.7	0	15.3	27.1	35.2	23.1	29.3	21.6			
35-44	28	30	28.3	40.3	12.5	22.2	11.5	39.7	28.4	21	54.1	0.01
45-64	38	53.3	67.4	43.1	56.2	38.9	53.8	27.6	45.6			
>64	10	0	4.3	1.4	4.2	3.7	11.5	3.4	4.4			
Sex												
Male	64	60	65.2	63.9	56.2	64.8	61.5	65.5	63	7	1.45	0.07
Female	36	40	34.8	36.1	43.8	35.2	38.5	34.5	37			
Education level												
Primary	94	86.7	91.3	97.2	91.7	96.3	91.3	94.6	94.3	21	42.46	0.04
Secondary	2	6.7	8.7	2.8	8.3	3.7	1	2	3.6			
College	4	6.7	0	0	0	0	7.7	3.4	2.1			
Farm size (Ha)												
0-1	38	26	30	51	40	46	24	54	38.625	42	178.1	0.01
>1.1	12	4	16	21	8	8	2	4	9.375			
Farm experience												
1-10 years	80	73.3	60.9	44.4	41.7	68.5	53.8	96.6	64.9	21	71.64	0.01
11-20 years	8	13.3	21.7	33.3	25	14.8	23.1	0	17.4			
21-30	8	13.3	13	9.7	20.8	13	7.7	3.4	11.11			

Above 30 years	4	0	4.3	12.5	12.5	3.7	15.4	0	6.55			
Key: Item, 1 = Nkomang'ombe (n=48), 2 = Kimelembe(n=48), 3 = Ludewa mjini (n=48), 4 = Luana (n=48), 5= Mbwila(n=48), 6 = Shaurimoyo (n=48), 7 = Mdilidili (n=48) and 8 = Madope (n=48)												
Note. df = degree of freedom Note, $\chi 2$ = Chi-Square test, $P \leq 0.05$ shows there was a significance difference. Source: Field survey data												

3.2 Sunflower cultivation practices in Ludewa district

Sunflower cultivation in Ludewa District dates back to the early 1970s, with farmers primarily using it as an ingredient for cooking vegetables. Most farmers in the district cultivated their land using ox-plows and hand hoes, often intercropping sunflower with maize or beans.

Regarding agricultural practices, many respondents (24–54%) cultivated fields of less than one hectare, while a smaller proportion (less than 22%) managed fields larger than one hectare across the study areas (Table 1). Additionally, a significant percentage of respondents (41.7–96.6%) had between 1 and 10 years of experience in sunflower farming, which was notably higher than those with 11–20 years or 30 years of experience (less than 33%). Only a small fraction (less than 15.4%) reported having over 30 years of experience (Table 1). Farmers in traditionally planted sunflowers at the onset of the rainy season, typically in November. However, due to climate change, the planting period has gradually shifted from November to December.

Farmers primarily rely on two local sunflower varieties: Nyeupe and Nyeusi. They typically retain seeds from the previous season or obtain them from friends for the next planting cycle. When asked about their preferences, farmers noted that the Nyeupe variety produces more oil than Nyeusi but yields less sunflower seed cake. The price of a 20 L bucket of sunflower seeds is approximately Tsh. 5,000 during the harvest season, but it rises to Tsh. 10,000–12,000 per bucket in the off-season

3.3 Challenges in sunflower production in the study areas

There was a significant difference in the different challenges faced by sunflower farmers across the surveyed villages (Table 2). Some respondents from Nkomang'ombe (28%) and respondents from Madope (30%) and Mbwila (46%) highlighted a lack of knowledge regarding sunflower diseases as a significant issue (Table 2). Furthermore, respondents from Mdilidili (26%) and Shaurimoyo (54%) noted that the high cost of pesticides threatens sunflower farming, making it a major concern (Table 2). Lastly, respondents from Nkomang'ombe (22%) and Shaurimoyo (7%) expressed concerns about the high cost of sunflower varieties, identifying it as an important challenge in sunflower farming (Table 2).

Table 3 Challenges on sunflower production in the study areas

Challenge	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Mean (%)**	**df**	**χ^2**	
Lack of knowledge on awareness sunflower diseases	8	6	16	11	46	0	0	30	14.6	21	500.33	
High cost of sunflower pesticides	6	0	0	6	0	54	26	28	13.5			
High cost of sunflower hybrid varieties	22	12	13	0	14	7	5	3	9.5			
P-value											**0.01**	

* Name of villages 1-Nkomang'ombe, 2-Kimelembe, 3-Ludewa Mjini, 4-Luana, 5-Mbwila, 6-Shaurimoyo, 7-Mdilidili, 8-Madope.

3.4 Sunflower production constraints

The major production constraints faced by sunflower farmers are summarized in (Table 3). The majority of respondents (71 %) identified sunflower diseases as the most significant constraint, this was followed by a lack of knowledge (43 %), drought (24 %),lack of access to agriculture input 20.87% and insects 14.57%.The specific fungal diseases reported

included Rust (38 %), Alternaria leaf blight (21 %), Sclerotinia head rot (14 %), Rhizopus head rot (13 %), Charcoal rot (10 %), and Septoria leaf blight (4 %)(Figure 3).

Table 1 Major sunflower production constraints raised by farmers

			Villages								
Constraint	1	2	3	4	5	6	7	8	Mean (%)	df	χ^2
1. Sunflower diseases	79	63	90	92	90	10	28	113	70.625	28	1223.30
2. Drought	71	44	0	61	5	1	35	0	24.11		
3. Insects	12	17	27	35	3	3	1	4	14.57		
4. Lack of knowledge	10	0	59	0	88	108	6	117	43.11		
5. Lack of access to agriculture input	10	5	10	0	0	54	88	0	20.87		
P-value											0.000

Key; Name of villages 1-Nkomang'ombe, 2-Kimelembe, 3-Ludewa Mjini, 4-Luana, 5-Mbwila, 6-Shaurimoyo, 7-Mdilidili, 8-Madope,.

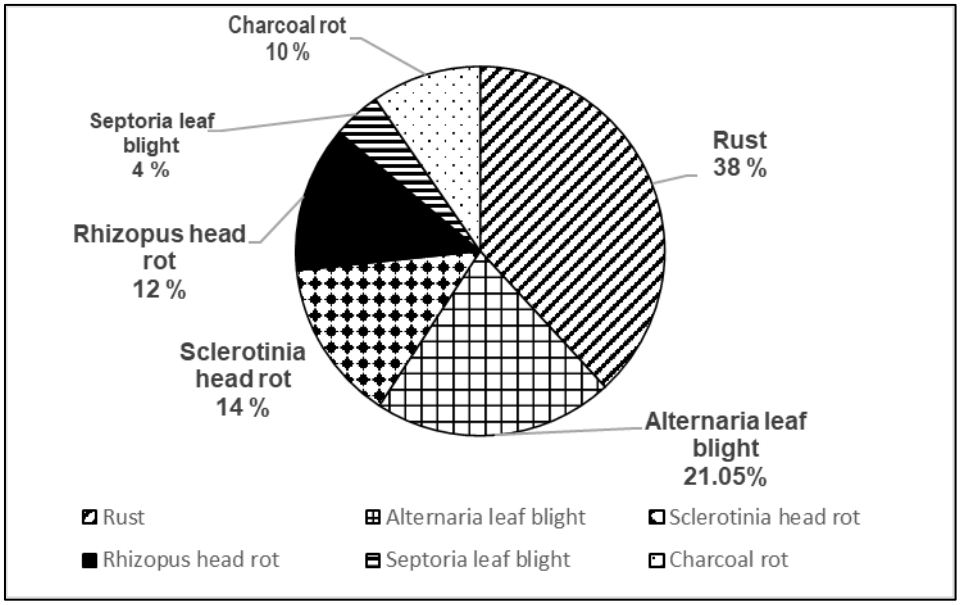

Figure 1 Important fungal diseases reported by farmers in the study area

3.5 Farmers knowledge of sunflower diseases

Significant differences were observed among farmers in their perception of sunflower diseases (Figure 4). About 40.13% of the respondents were not aware of the causes of sunflower diseases (Figure 4). When they were asked about the association of the diseases with other environmental factors, they reported that sunflower diseases were associated with high rainfall 35.49%, drought 13.27%, high temperature 9.61%, soil problems 0.78% and insects 0.72%. (Figure 4)

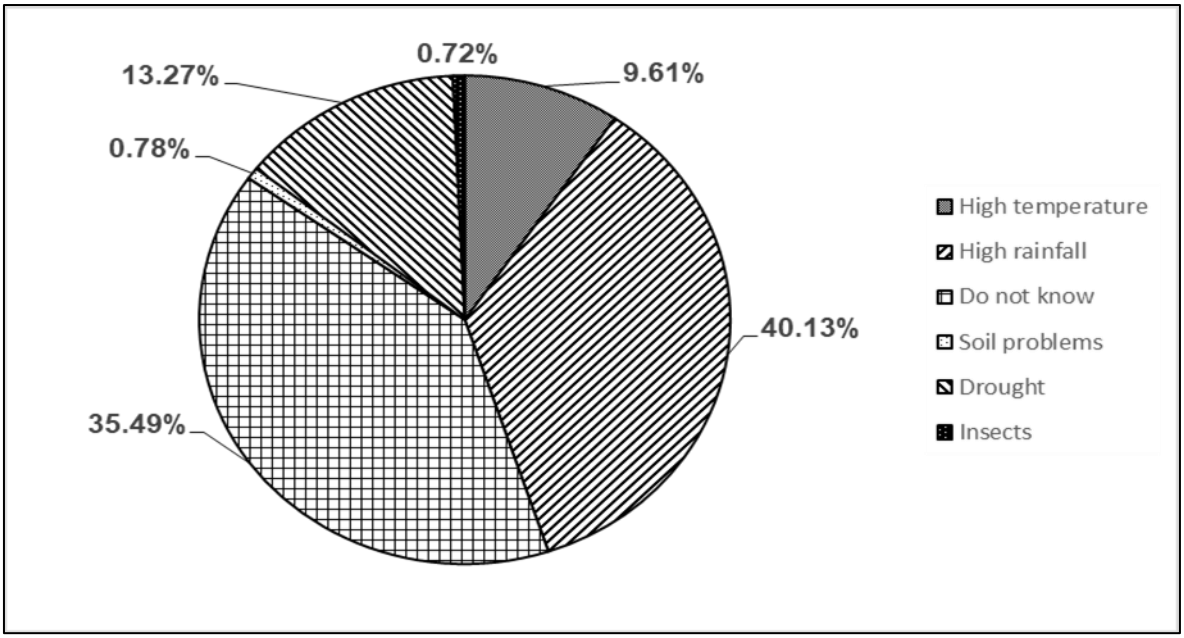

Figure 4 Farmers perception of the major causes of sunflower diseases (x^2= 7126.305: P=0.000)

3.6 Farmers' ability to identify diseases

The evaluation of farmers' knowledge of crop diseases during focus group discussions revealed the following observations. All farmers readily recognized the symptoms of the diseases and correctly related their description of three major sunflower diseases (Rust, Alternaria leaf blight and Sclerotinia head rot) with symptoms in the photographs the first disease is locally referred in Kiswahili as Kutu while the second one is called michirizi. Upon seeing the other photographs, they confirmed to have seen the diseases in their fields. Farmers could not relate the symptoms of the diseases with the actual causal agent or describe how the diseases are transmitted or spread in fields. However, they were able to associate increased incidence and severity of different diseases with environmental factors. For instance, severe Rust was associated with varietal susceptibility to warmer temperatures and intermittent rainfall. Farmers correctly related the incidence and severity of Sclerotinia head rot the extent of field contamination. Most of them acknowledged that as soil infestation increases, due to continuous cropping of sunflower, the amount of damage and yield loss also increases.

3.7 Farmers' strategies for management of sunflower diseases

Farmers' actions regarding strategies of managing diseases during sunflower production revealed notable trends. A significant difference was observed among farmers across the surveyed villages in terms of practicing timely weeding, with over 80% of respondents successfully conducting timely weeding. In contrast, there was no significant variation among farmers in the villages regarding using crop rotation practices as a disease control measure, although more than 84% of respondents reported attempting crop rotation. Seed selection practices showed no statistical difference with over 69.6% of farmers favoring uprooting of infected plants at Ludewa mjini. The varying awareness among respondents in different locations; for instance, Kimelembe (50%), Mbwila (56.2%),Shaurimoyo (55.6%), and Madope (55.2%) had limited knowledge, while over 60% of respondents in other areas engaged in fallowing. Additionally, more than 70% of respondents reported burning residuals as a disease control method, and over 75% tended to uproot infected plants, although this was less common in Ludewa mjini (69.6%) and Luana (73.2%). A significant majority (>80%) opted for fertilizer application as a disease control strategy. However, early planting was less prevalent, showing no statistical variation with less than 55% of respondents participating, except in Luana (61.1%), Shaurimoyo (55.6%), and Mdilidili (80.8%). (Table 4).

Table 4 Management practices conducted by the farmers to control diseases on sunflower production

Managements	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Mean (%)**	**df**	**χ2**	***P*-value**
Weeding at proper time												
Yes	84	100	97.8	98.6	95.8	100	84.6	100	95.8	7	33.75	0.01

No	16	0	2.2	1.4	4.2	0	15.4	0	4.2			
Crop rotation												
Yes	84	96.7	87	90.3	89.6	87	88.5	86.2	88.3	7	3.68	0.816
No	16	3.3	13	9.7	10.4	13	11.5	13.8	11.7			
Seed selection												
Yes	82	80	69.6	80.6	79.2	87	88.5	86.2	81.5	7	7.40	0.388
No	18	20	30.4	19.4	20.8	13	11.5	13.8	18.5			
Fallowing												
Yes	64	50	60.9	70.8	56.2	55.6	80.8	55.2	61.5	7	10.88	0.144
No	36	50	39.1	29.2	43.8	44.4	19.2	44.8	38.5			
Burning of residuals												
Yes	82	83.3	71.7	79.2	83.3	87	88.5	86.2	82.3	7	6.19	0.519
No	18	16.7	28.3	20.8	16.7	13	11.5	13.8	17.7			
Uprooting of infected plants												
Yes	76	80	69.6	73.6	79.2	79.6	88.5	81	77.6	7	4.89	0.673
No	24	20	30.4	26.4	20.8	20.4	11.5	19	22.4			
Fertilizer Application												
Yes	82	86.7	89.1	94.4	97.9	100	84.6	100	93	7	25.35	0.001
No	18	13.3	10.9	5.6	2.1	0	15.6	0	7			
Early Planting												
Yes	52	50	50	61.1	52.1	55.6	80.8	53.4	56	7	9.13	0.244
No	48	50	50	38.9	47.9	44.4	19.2	46.6	44			

** Key:1* = Nkomang'ombe 2 = Kimelembe(n=48) 3 = Ludewa Mjini (n=48), 4= Luana (n=48), 5= Mbwila (n=48), 6 = Shaurimoyo (n=48), 7= Mdilidili (n=48) and 8= Madope (n=48) Note. df = degree of freedom, $\chi 2$ = Chi-Square test, $P \leq 0.05$ shows there was a significance difference.

4 Discussions

The results on age profile suggest that the high youth population compared to the elderly in sunflower farming may be due to the strong interest of young people in this sector, driven by market opportunities in Ludewa District. Youth are highly encouraged to participate in agriculture, as it remains a primary source of employment (Kabungo, 2008). This finding aligns with research by Gulamiwa (2015), which indicates that most young individuals are engaged in horticulture and crop production.

The non-significant statistical difference between the proportion of men and women in sunflower farming, although men comprised 63% of participants compared to 37% of women. This balance may be attributed to the growing awareness of gender equality among Ludewa residents, as well as encouragement from various international organizations (Doss *et al.*, 2015). A study by Mlelwa (2013) also highlighted this trend, noting that the majority of men are engaged in vegetable production, particularly onions, which require more intensive care than other vegetables.

In terms of agricultural practices, most of the respondents cultivated crop fields of less than one hectare, while only a small fraction (less than 22%) operated fields larger than one hectare across the study areas (Table 1). This observation aligns with a report by Tibanyama *et al.* (2022), who noted that 95% of sunflower farmers in Tanzania are smallholders who cultivate less than two hectares of land with sunflowers.

Furthermore, a significant proportion of respondents (41.7%-96.6%) reported having 1-10 years of experience in sunflower farming, which was significantly different from those with 11-20 years and 30 years of experience (less than

33%) and the study revealed that the farmers who were more experienced were abled in identified of symptoms of diseases. This study agreed with that of (Gulya *et al.,* 2019), which revealed that the more knowledgeable and experienced farmers were in sunflower production, the more the experienced they were aware of the identification of the symptoms of sunflower diseases.

In this study, many respondents reported that sunflower diseases pose a significant threat to production in the area. This threat may be exacerbated by using seeds from neighbours and expanding sunflower fields, which could lead to an increase in disease prevalence (Gulya *et al*., 2016). Additionally, a study by Gebeyaw (2020) noted that smallholder farmers who store their seeds for the next planting season often face contamination from seed-born fungi, including pathogenic varieties during storage, which can diminish seed germination and vigour.

About challenges of sunflower production, some respondents from Nkomang'ombe (28%), and respondents from Madope (30%) and Mbwila (46%) reported highlighted a lack of knowledge regarding sunflower diseases as a significant challenge (Table 2). Furthermore, respondents from Mdilidili (26%) and Shaurimoyo (54%) noted that the high cost of pesticides threatens sunflower farming, making it a major concern (Table 2). Lastly, respondents from Nkomang'ombe(22%) and Shaurimoyo (7%) expressed concerns about the high cost of sunflower varieties, identifying it as an important challenge in sunflower farming. A study by (Sousa, 2019) supported that among of challenges facing small holder farmers in sunflower production were poor knowledge of farmers regarding sunflower diseases most of farmers before they were not knowledgeable with symptoms of diseases of sunflower this supported by study of (Gulya *et al.,* 2019) who said farmers were lacked knowledge of identification of sunflower disease symptoms. A study of (Lyanga 2024) highlighted high cost of pesticides as an important challenge in sunflower production and a study of (Tibamanya *et al*., 2022) highlighted high cost of sunflower hybrid varieties as an important challenge in sunflower production

The majority of respondents (71 %) identified sunflower diseases as the most significant constraint. This was followed by a lack of knowledge (43 %), a drought 24%,Lack to access to agriculture input (20.87%) and insects (14.57%) also the study by (Debaeke *et al.,* 2017) supported that sunflower diseases were among of constraint faced by small farmers who were engaged in sunflower production and lack of knowledge regarding sunflower diseases. Also a study of (Vilvert *et al.,* 2023; Lyanga, 2024; Nungula *et al*., 2023; Harsányi *et al.,* 2021) supported that drought is among of constraint in sunflower production, Also the study of (Tibanyama et al., 2022) reported lack to access to agriculture input as amoing of constraint in sunflower production and a study by (mola, 2022) reported insects as among of sunflower constraint in sunflower production.

In the study area the specific fungal diseases reported included Rust (38 %), Alternaria leaf blight (21 %), Sclerotinia head rot (14 %), Rhizopus head rot (13 %), Charcoal rot (10 %), and Septoria leaf blight (4 %).Also the study by (Bahadur and Dutta, 2023; Gulya *et al.,*2019) supported that most of fungal diseases in sunflower were Rust, Alternaria leaf blight, Sclerotinia head rot Rhizopus head rot, Charcoal rot ,Septoria leaf blight.

Farmers could not relate the symptoms of the diseases with the actual causal agent or describe how the diseases are transmitted or spread in fields. However, they were able to associate increased incidence and severity of different diseases with environmental factors, this supported by study of (Gulya *et al*., 2019).

While some farmers attempt to remove diseased plants to prevent further spread, others discard dead plants in the field without proper disposal, leaving the area vulnerable to additional outbreaks due to pathogens spreading through soil and seeds (Howard, 2020). Additionally, Palt (2012) reported that neglecting proper disposal of diseased plants heightens the risk of disease spread. Neindow *et al*. (2018) provided evidence supporting this assertion, demonstrating that farmers with limited technical knowledge struggle to control disease outbreaks in agricultural fields.

The study revealed that many farmers they were doing cultural practices methods in controlling sunflower diseases (Table 4) for stance with over 80% of respondents successfully conducting timely weeding, although more than 84% of respondents reported attempting crop rotation and more than 70% of respondents reported burning residuals as a disease, A study of (Rudska.,2022) who used early weeding as among of the technique in cultural control and a study of (sodikov *et al*.,2022) who said use of crop rotation as the way of cultural technique in controlling sunflower diseases.

Overall, the level of knowledge, technical expertise, and perceptions of farmers significantly impact the preferred sunflower varieties and productivity in the study area. Certain farming practices employed by farmers in the region may hinder effective disease control and management. Therefore, to minimize disease spread, farmers need to enhance their agronomic literacy and adhere to Sunflower Good Agronomic Practices (GAPs). The IPM strategy should also be implemented to manage diseases effectively

5 Conclusion and Recommendation

Generally, lack knowledge on sunflower diseases and ability to afford the cost of buying pesticides and unavailability of effective control methods were the main reasons limiting the effective management of sunflower fungal diseases. The use of recycled seeds from their friends also were the sources of inocula and to depend on cultural only as the only way on management of sunflower diseases.This study recommends providing training for farmers on disease management. Additionally, it is essential for the government to supply agricultural inputs, including fertilizers, pesticides, and improved seeds, ensuring timely delivery through a subsidy program in order to increase production of sunflower. Furthermore, it is crucial to involve government decision-makers to address the challenges faced by farmers effectively

Compliance with ethical standards

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No conflict of interest to be disclosed.

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