**International Journal of Research Studies in Agricultural Sciences (IJRSAS)**
*Volume 7, Issue 10, 2021, PP 16-26*
*ISSN No. (Online) 2454–6224*
*DOI: http://dx.doi.org/10.20431/2454-6224.0710003*
*www.arcjournals.org*

# Sweet Potato Leaf Spot Diseases and Farmer's Indigenous Knowledge in Parts of Western Kenya

**Adera A. Norah[1*], Onyango O. Benson[2], Nyunja Regina[3], Ogolla O. Fredrick[4]**

[1,2,3]*Jaramogi Oginga Odinga University of Science and Technology (JOOUST), Bondo, Department of Biological Sciences*

[4]*Chuka University, Department of Biological Sciences, Chuka, Kenya*

***Corresponding Authors:** ***Adera A. Norah,*** *Jaramogi Oginga Odinga University of Science and Technology (JOOUST), Bondo, Department of Biological Sciences*

**Abstract:** *Sweet potato (Ipomoea batatas L.) is a starchy, tuberous root with worldwide consumption. Production of sweet potatoes in Kenya is low due to disease constraints, such as fungal sweet potato leaf spot (SPLS), which is not well studied in the region. The infection results in reduced photosynthetic leaf area through premature defoliation and senescence. Effective management of SPLS presents an opportunity for increased production, improved food security and enhanced income. Farmers' indigenous knowledge on plant disease control can provide a framework to refine current integrated management practices. This study evaluated SPLS occurrence, and assessed farmer's indigenous knowledge. A multi-stage sampling technique was used to identify sampling plots and disease incidence and severity evaluated using quadrats. Disease incidence significantly ($p < 0.05$) ranged from 11% to 30.38% at Kakelo and Kamollo villages respectively, while severity was significantly ($p < 0.05$) highest at Kokwanyo (28.37%) and lowest at Rapogi (15.27%). Most farmers (90.91%) reported SPLS-like symptoms on their farms, although more females were able to differentiate between the diseases. Farmers' education on sweet potato diseases such as SPLS is recommended to enhance disease management and boost yield.*

**Keywords:** *Sweet Potato Leaf Spot, Western Kenya*

## 1. INTRODUCTION

Sweet potato (*Ipomoea batatas L.*) is a starchy tuber enriched with fibers, proteins, vitamins (A and C) and amino acids such as methionine and cysteine [1] [2]. China is the world's largest producer and consumer of sweet potatoes with over 517,900,000 tons in 2019 [3]. In Africa, sweet potato production is under exploited and regarded as a poor man's food, grown mainly under marginal conditions [4]. In East Africa, Uganda with 1.75 million metric tons and Ethiopia with 1.76 million metric tons are top producers while Kenya produces about 0.8 million metric tons [3]. Kenya has the potential to produce up to 38 tons/ha with average yield ranges of 20-50 tons/ha [5]. However, sweet potato production in Kenya is below 10 tons/ha due to several constraints, including pests and diseases [6] [7]. Diseases and pests contribute to 75 percent of sweet potato yield losses [8], while diseases alone contribute 11.9% loss [9]. Low sweet potato production is exacerbated by scarcity of improved varieties and disease-free planting materials [6] [9].

In western Kenya, sweet potato is cultivated by small scale farmers in Busia, Kakamega, Siaya, Kisumu, Homa Bay, Nyamira, Kisii and Migori counties [6]. Little work has been done to evaluate SPLS occurrence in the region. Studies on disease incidence is necessary for adequate disease management, improved yield and enhanced earning to farmers. Further, studies may provide knowledge on the extent of disease spread. The infection was reported in China and Nigeria [10] [11] [12]. Investigations of sweet potato diseases in Kenya have been skewed towards viral infections [13] [14] [15] [16] and *Alternaria* blight [17] [18]. Yet SPLS infection has a devastating effect on sweet potato yield. Symptoms include irregular or circular brown lesions on the margin or center of lower leaves and sometimes upper leaves [10]. The spots enlarge gradually and join together to form grey, brown necrotic lesions with yellowish halos. Diseased leaves eventually become senesced and drop off [19].

Sweet potato farmers in western Kenya counties of Kisumu and Homabay utilize traditional farming technologies [20]. Modernization of agriculture may result in increased yields, however, it rarely

incorporates farmers' indigenous knowledge. Understanding the local farmer's indigenous knowledge on sweet potato leaf spot disease is critical, as a channel for infusion of modern techniques of integrated disease control [21] [22]. Determination of farmers' perception of plant diseases, the level of yield damage and effectiveness of locally practiced control methods, may offer long term disease management solutions [23]. However, there is knowledge gap on the strategies used by farmers in western Kenya to manage SPLS.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

A survey of sweet potato farms for SPLS occurrence was conducted in Homa bay and Kisumu counties in Western Kenya. Homa bay County covers an area of 4,267.1 $Km^2$ and is located in South western Kenya along Lake Victoria shoreline (Fig 1). The county borders Kisumu and Siaya counties to the north, Kisii and Nyamira counties to the east and Migori County to the south.

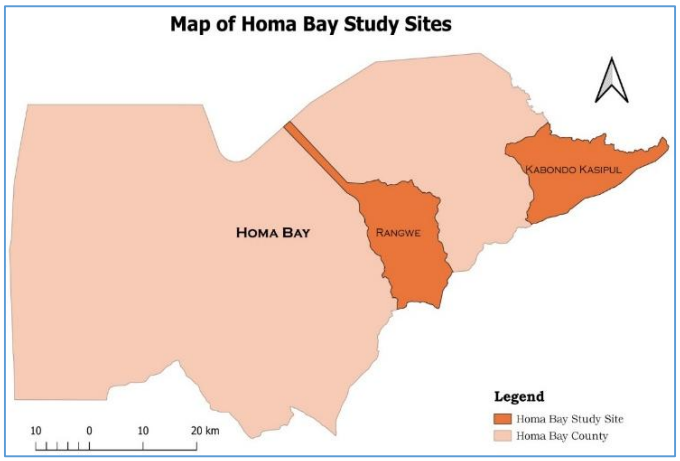


**Figure1.** *A map showing Rangwe and Kabondo-Kasipul sub-counties in Homa-bay County*

The County is divided into two agro-ecological zones: Upper and Lower Midlands. The study was specifically carried out in Kabondo-Kasipul and Rangwe Sub -counties. In Rangwe sub-county, the farms surveyed were at Kamollo, Nyakwadha, Nyawita, Asumbi, Kabor and Gem villages while in Kasipul- Kabondo, the farms surveyed were at Kakelo, Kojwach, Kokwanyo, Oriang -1, Kakngutu and Kakumu.

Kisumu County covers an area of 2085.9 $Km^2$. It neighbors Siaya County to the West, Vihiga to the North, Nandi County to the North East, Kericho County to the East, Nyamira County to the South and Homa Bay County to the South West. The county has a shoreline on Lake Victoria occupying northern, western and a part of the southern shores of the Winam Gulf. It has 7 sub counties but Kisumu East sub-county was selected as study site due to active cultivation of sweet potatoes in East and West Kajulu. The farms were at Ongadi, Obwolo, Wathorego, Oriang-2, Okok and Rapogi.

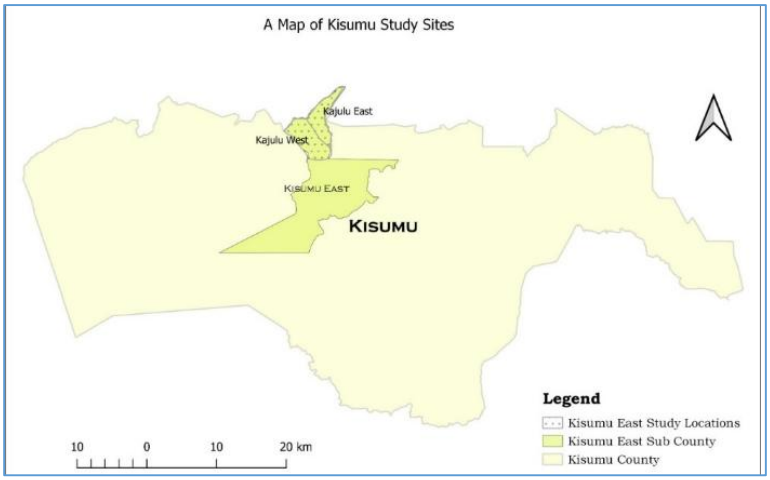


**Figure2.** *A map of sampling points in Kisumu East sub-county: East Kajulu and West Kajulu*

### 2.2 Determination of Incidence and Severity of Sweet Potato Leaf Spot

Assessment of incidence and severity of SPLS disease was conducted in farmers' fields with habitable space of diseased plants according to Sseruwagi *et al*. [24]. A multi-stage sampling technique was used to select representative villages and the farms were identified purposively based on acreage of sweet potato crop. A 4×4 m micro plot was established at each farm, along diagonal transects at equidistance of 5 m. A quadrat measuring 1 m × 1 m was randomly thrown, and disease incidence assessed diagonally by counting the number of leaves with spots, against the total number of leaves within the quadrat. The number of diseased leaves was expressed as a percentage of the total number of leaves sampled according to Mahantesh *et al.* [25] as:

$$\% \text{ Disease incidence} = \frac{\text{Number of infected potatoes}}{\text{Total no. of potatoes assessed}} x100$$

Disease severity assessment was done by visual estimation of percentage leaf area with spot on 20 randomly selected plants per quadrat using a scale of 1 – 5 (CIP, 2017)

**Table1.** *Disease rating scores used in severity test*

| Disease Rating | % of leaf area with spot | Intensity of symptoms |
|---|---|---|
| 1 | 0 | Free from disease |
| 2 | 15 | Slight symptoms |
| 3 | 16-30 | Moderate symptoms |
| 4 | 31- 45 | Slightly severe Symptoms |
| 5 | > 50 | Severe Symptoms |

The percent severity index was calculated as:

$$\text{Percent Disease Severity} = \frac{\text{Number of individual ratings}}{\text{Total number of leaves assessed}} x \frac{100}{\text{Maximum scale}}$$

### 2.3 Survey on Farmers' Knowledge of Sweet Potato Leaf Spot Disease

A survey was conducted by administering a structured questionnaire to sweet potato farmers in Rangwe, Kabondo-Kasipul and Kisumu-East sub counties. The questionnaire was used to interview 22 farmers per Sub County that totalled to 66 farmers based on history of sweet potato cultivation. A face-to-face interview combined with farm observations was done from May to August, 2020. Each interview lasted for about 30 minutes. Information obtained included age of crop, variety grown, tolerance/susceptibility to fungal diseases, source of vines, use of fertilizers, planting methods used, ability to differentiate diseases, most infected stage of growth, disease history and its effect on production. A pilot study was conducted in 10 farms in Kisumu East Sub County not included in the sample, a month before actual study. Minor adjustments were made on the questionnaire to enhance clarity.

### 2.4 Data Analysis

Percentage disease incidence and severity data was analysed using General Linear Model ($p < 0.05$) and significant means separated using least significant difference in Scientific Analysis System (SAS) version 9.4. Data on farmer perception of SPLS occurrence was analyzed using the Chi-Square ($\chi^2$) test of association on SAS version 9.4.

## 3. Results and Discussion

### 3.1 Incidence of Sweet Potato Leaf Spot Disease

Disease incidence significantly varied ($p < 0.05$) between the 18 villages surveyed (Table 2). The highest incidence (30.38%) was observed in Kamollo, while lowest incidence of 11% was observed at Kakelo village. Rangwe sub-county had significantly ($p < 0.05$) the highest percentage incidence of 21.35%, followed by Kisumu East sub-county at 16.9% while lowest incidence of 12.45% was observed in Kabondo- Kasipul sub-county (Fig 3). Farms within the 18 villages surveyed showed significant variation ($p < 0.05$) in SPLS severity. A severity index of 28.37% was observed at Kokwanyo village in Kabondo - Kasipul sub-county, which was significantly higher, compared to 15.27% observed in Rapogi village within Kisumu East sub-county (Table 2). Kabondo-Kasipul and Kisumu East sub-counties reported significant variation ($p < 0.05$) in severity of SPLS with values of 23.96% and 21.49% respectively (Fig. 3). However, the disease severity in Rangwe sub-county was not significantly

different ($p > 0.05$) from Kasipul Kabondo and Kisumu East sub-counties. Variation in incidence and severity of SPLS infection in the three sub counties is partly attributed to climatic and soil conditions which could have affected disease development. Cool humid weather conditions have been reported to favor leaf spot development and foliar destruction [26] [11]. Disease development could further have been affected by plant defense mechanisms, which differ by species and environmental patterns [27]. Disease incidence may have also been influenced by the specific sweet potato variety cultivated [28]. Pathogen factors such as virulence, dispersal rate, and farm practices such as sources of sweet potato vine and variety planted also influenced disease incidence and severity [29] [30], factors attributed to the variation in SPLS incidence and severity in the study area. The SPLS disease reduces yield due to effect on plant physiology. Plants' photosynthesis capacity and translocation of sugars as well as water and minerals may be hampered drastically due to killing of leaf areas [31] [11]. Infected plants experience impaired physiological activities such as increased respiration rates and reduced photosynthesis that lead to yield losses [32] [33].

**Table2**. *Incidence and severity of sweet potato leaf spot in villages in Rangwe, Kisumu East and Kabondo – Kasipul Sub Counties*

| Village | Sub-county | Incidence (%) | Severity (%) |
|---|---|---|---|
| Kamollo | Rangwe | $30.38^{a}$ | $22.10^{c}$ |
| Gem | Rangwe | $26.64^{ab}$ | $22.75^{bc}$ |
| Nyakwadha | Rangwe | $22.08^{bc}$ | $22.93^{bc}$ |
| Wathorego | Kisumu-East | $21.59^{bcd}$ | $23.02^{bc}$ |
| Nyawita | Rangwe | $20.49^{cb}$ | $20.49^{b}$ |
| Okok | Kisumu-East | $18.82^{ecd}$ | $23.94^{b}$ |
| Kabor | Rangwe | $18.77^{ecd}$ | $22.13^{c}$ |
| Oriang_2 | Kisumu East | $17.43^{edf}$ | $22.66^{bc}$ |
| Asumbi | Rangwe | $15.38^{efg}$ | $23.67^{bc}$ |
| Kakngutu | Kabondo-Kasipul | $15.22^{efg}$ | $18.12^{d}$ |
| Ongadi | Kisumu-East | $14.63^{fgh}$ | $17.42^{d}$ |
| Obwolo | Kisumu- East | $14.22^{fgh}$ | $23.51^{bc}$ |
| Rapogi | Kisumu-East | $12.97^{ghi}$ | $15.27^{e}$ |
| Kokwanyo | Kabondo-Kasipul | $12.81^{ghi}$ | $28.37^{a}$ |
| Oriang_1 | Kisumu East | $12.10^{hi}$ | $23.17^{bc}$ |
| Kakumu | Kabondo-Kasipul | $11.96^{hi}$ | $22.99^{bc}$ |
| Kojwach | Kabondo-Kasipul | $11.73^{hi}$ | $26.62^{a}$ |
| Kakelo | Kabondo-Kasipul | $11.00^{i}$ | $23.99^{b}$ |
| Mean | | 16.45 | 22.794 |
| LSD ($p<0.05$) | | 1.248 | 1.766 |
| CV (%) | | 20.261 | 20.02 |

[a]Means followed by the same letters are not significantly different ($p<0.05$).

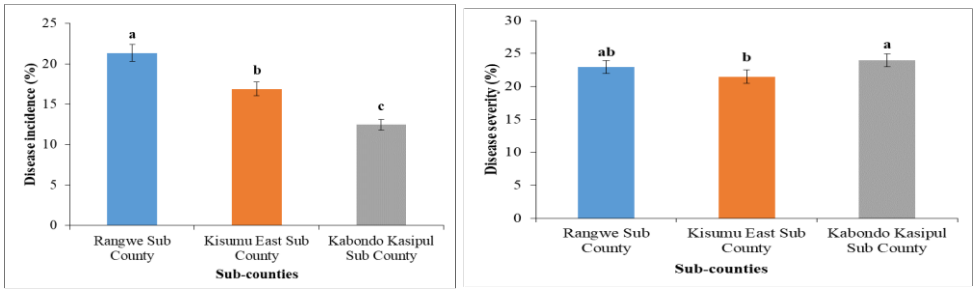


**Figure2**. *Sweet potato leaf spot incidences and severity in Rangwe, Kisumu East and Kabondo-Kasipul Sub Counties*

### 3.3 Farmers indigenous Knowledge and Practices

*3.3.1 Sweet Potato Varieties Grown*

Varieties cultivated was significantly ($p < 0.05$) different and associated with gender in Kabondo-Kasipul ($X^2 = 4.774$, $p = 0.0248$) and Kisumu East sub-counties ($X^2 = 8.294$, $p = 0.004$; Table 4). Most farmers grew Odinga variety, which is a local landrace with high tuber yields. It is preferred for

consumption due to its high dry matter content and good taste (Table 4). Variety SPK004 was also cultivated in the study area, since it is rich in beta-carotene thus improved nutritional status of the consumers [34]. Averagely, 50% of female farmers in Kabondo-Kasipul planted Odinga variety while 4.55% planted variety SPK004. Equal number of males and females (22.73%) planted both Odinga and SPK004 varieties. In Kisumu East sub-county, 86.36% of the farmers grew Odinga variety, while only 13.37% grew SPK004 variety. Data on sweet potato variety grown agrees with studies by Bashaasha *et al.* [35] and Sindi and Wambugu [36] that some varieties are preferred by the farmers. Varietal preference may be attributed to high yields, rooting quality, better growth in different types of soil and sweet potato nutrition value and taste [37] [38] [39] [40]. This implies that variety grown in an area is mainly influenced by preference of consumers and farmers.

**Table3.** *Variety of sweet potato grown during the study in Rangwe, Kisumu East and Kabondo-Kasipul Sub Counties*

| Factor | Sub-county | Farmer response | Sex of respondents | | | *Chi* Square | *p* value |
|---|---|---|---|---|---|---|---|
| | | | Male (%) | Female (%) | Total % | | |
| Variety of sweet potato grown during study. | Rangwe | SPK004 | 18.18 | 63.64 | 81.82 | 1.2731 | .2592 |
| | | Odinga | 9.09 | 9.09 | 18.18 | | |
| | Kabondo-Kasipul | SPK004 | 22.73 | 4.55 | 27.27 | 4.7743 | .0248 |
| | | Odinga | 22.73 | 50.0 | 72.73 | | |
| | Kisumu East | SPK004 | 4.55 | 8.82 | 13.37 | 8.294 | .004 |
| | | Odinga | 9.09 | 77.27 | 86.36 | | |

*3.3.2 Source of Sweet Potato Vines for Planting*

Source of sweet potato planting material in all the sub counties was not significantly ($p > 0.05$) associated with gender (**Table 5**). Majority of farmers obtained planting vines from the last season's crop, with Rangwe and Kabondo-Kasipul scoring 100% and Kisumu East 88.89% (**Table 5**). This agrees with the findings of Sseruwu *et al*. [41] and Aldow [42] that farmers prefer to obtain planting materials from last season crops. Out of 37.88% of the farmers, 25.76% reported occurrence of diseases, compared to 12.12% who did not report occurrence of sweet potato fungal leaf spot. This implies that the major source of SPLS transmission in the study area is recycling of sweet potato vines among farmers. Recycling of poor seed material facilitates diseases transmission and spread among farmers' lands [43].

**Table4:** *Sources of sweet potato planting vines used by farmers in Rangwe, Kisumu East and Kabondo-Kasipul Sub Counties*

| Factor | Farmer response | Sub-county | Response | Sex of respondents | | | *Chi* Square | *p* value |
|---|---|---|---|---|---|---|---|---|
| | | | | Male (%) | Female (%) | Total % | | |
| Where obtained the last sweet potato vine? | Friends | Rangwe | Yes | 33.33 | 50.00 | 83.33 | 1.20 | .273 |
| | | | No | 16.67 | 0.00 | 16.67 | | |
| | | Kabondo-Kasipul | Yes | 16.67 | 66.67 | 83.33 | 0.24 | .624 |
| | | | No | 0.00 | 16.67 | 16.67 | | |
| | | Kisumu East | Yes | 0.00 | 50.00 | 50.00 | 3.00 | .083 |
| | | | No | 33.33 | 16.67 | 50.00 | | |
| | Last season | Rangwe | Yes | 16.67 | 83.33 | 100.00 | 1.20 | .094 |
| | | | No | 0.00 | 0.00 | 0.00 | | |
| | | Kabondo-Kasipul | Yes | 60 | 40.00 | 100.00 | 0.84 | .63 |
| | | | No | 0.00 | 0.00 | 0.00 | | |
| | | Kisumu East | Yes | 0 | 88.89 | 88.89 | 0.92 | .071 |
| | | | No | 11.11 | 0 | 11.11 | | |
| | Friends and last season | Rangwe | Yes | 10 | 60 | 70 | 0.476 | .490 |
| | | | No | 10 | 20 | 30 | | |
| | | Kabondo-Kasipul | Yes | 50 | 33.33 | 83.33 | 1.2 | .273 |
| | | | No | 0 | 16.67 | 16.67 | | |
| | | Kisumu East | Yes | 0 | 14.29 | 14.29 | 0.194 | .659 |
| | | | No | 16.67 | 83.33 | 85.71 | | |

*3.3.3 Sweet Potato Farming System*

The system of farming (subsistence or commercial) was significantly ($p < 0.05$) associated with gender in Kabondo-Kasipul sub-county ($X^2 = 10.476$, $p = 0.0017$) where 63.64% of farmers grew sweet potatoes for commercial purposes (Table 6). This agrees with Ezin *et al.* [44] that sweet potato is grown mainly for the fresh market, since tubers are sold in the surrounding markets for income. Most male farmers (45.45%) planted sweet potatoes for commercial purposes, while the females (36.36%) grew the crop for subsistence. A higher commercial value of the crop amongst the males may be attributed to higher responsibilities and increased market demands, resulting in more marketability. According to Low [45], the increasing role of sweet potato as a cash crop attracts participation of males in its production. Additionally, a lower commercial farming by women may generally be attributed to land ownership, since women own less land of lower agricultural quality. Bach and Andersen [46], reported that women in Africa only own one per cent of the land and they have to contend with limited access to financial and technical resources.

**Table5.** *Farming systems practiced by sweet potato farmers in Rangwe, Kisumu East and Kabondo-Kasipul Sub Counties*

| Factor | Sub-county | Farmer response | Sex of respondents | | | *Chi* Square | *p* value |
|---|---|---|---|---|---|---|---|
| | | | Male (%) | Female (%) | Total (%) | | |
| Scale of farming practiced by farmer | Rangwe | Subsistence | 18.18 | 54.55 | 72.73 | 0.153 | .6958 |
| | | Commercial | 9.09 | 18.18 | 27.27 | | |
| | Kabondo-Kasipul | Subsistence | 0.00 | 36.36 | 36.36 | 10.476 | .0017 |
| | | Commercial | 45.45 | 18.18 | 63.64 | | |
| | Kisumu East | Subsistence | 4.55 | 77.27 | 81.82 | 5.4893 | .0727 |
| | | Commercial | 9.09 | 9.09 | 18.18 | | |

*3.3.4 Sweet Potato Planting Method*

The planting method used by farmers was significantly ($p < 0.05$) associated with gender in Kabondo-Kasipul sub-county ($X^2 = 4.455$, $p = 0.0348$) where 54.55% of farmers used ridges to plant the sweet potatoes while 45.45% used mounds. Most males (18.18%) used mounds while most females (31.82%) planted using ridges (Table 7). In Rangwe, and Kisumu east majority of the farmers used mounds as compared to use of ridges. The findings agree with earlier reports that both mounds and ridges are used to plant sweet potatoes in the region [47]. According to Dhliwayo and Chiunzi [48], farmers believe that use of ridges increases sweet potato yields. Preference of planting method may be attributed to terrain or flood issues. According to Gomes [48], ridges may be helpful in farms prone to water logging.

**Table6.** *Planting method used to cultivate sweet potatoes in Rangwe, Kisumu East and Kabondo-Kasipul Sub Counties*

| Factor | Sub-county | Farmer response | Sex of respondents | | | *Chi* Square | *p* value |
|---|---|---|---|---|---|---|---|
| | | | Male (%) | Female (%) | Total % | | |
| Planting method used | Rangwe | Ridge | 4.55 | 18.18 | 22.73 | 0.1725 | .6779 |
| | | Mound | 22.73 | 54.55 | 77.27 | | |
| | Kabondo-Kasipul | Ridge | 13.64 | 31.82 | 54.55 | 4.455 | 0.0348 |
| | | Mound | 18.18 | 22.73 | 45.45 | | |
| | Kisumu East | Ridge | 4.55 | 22.73 | 27.27 | 0.0643 | .7998 |
| | | Mound | 9.09 | 63.64 | 72.73 | | |

*3.3.5 Fertilizer Use in Sweet Potato Production*

The use of fertilizers in sweet potato farming was significantly ($p < 0.05$) associated with gender in Kabondo-Kasipul sub county ($X^2 = 1.691$, $p = .01935$) where more females (18.18%) used fertilizers than males (4.55%). Only 27.73% of farmers used fertilizers in sweet potato production (**Table 8**). Most farmers did not use fertilizers in the region but they reported use of manure. However, soil nutrition changes caused by appropriate fertilization leads to an overall improvement in crop productivity since continuous cultivation depletes soil organic matter hence the need for fertilization during sweet potato production [49]. Growth and yield of sweet potato is affected by plant population and nutrient supply, and low yields could be attributed to poor soil nutrients. Organic and inorganic fertilizers are thus used

to improve the yield and growth rate of sweet potato. Dapaah *et al.* [50] reported that application of nitrogen, phosphorus and potassium fertilizers influenced growth and yield of sweet potato. Potassium and nitrogen promote high yields since Potassium increases water uptake, efficient use of nitrogen, translocation of assimilates, photosynthesis, drought and disease resistance. Potassium also enhances sweet potato tuber taste, shape, size, colour and texture [51].

**Table7.** *Use of fertilizers by sweet potato farmers in Rangwe, Kisumu East and Kabondo-Kasipul Sub Counties*

| Factor | Sub-county | Farmer response | Sex of respondents | | | *Chi* Square | *p* value |
|---|---|---|---|---|---|---|---|
| | | | Male (%) | Female (%) | Total % | | |
| Do you use fertilizer for growing potatoes? | Rangwe | Yes | 0 | 27 | 27 | 3.0938 | .60786 |
| | | No | 27.27 | 45.45 | 72.73 | | |
| | Kabondo-Kasipul | Yes | 4.55 | 18.18 | 27.73 | 1.691 | .01935 |
| | | No | 40.91 | 36.36 | 77.27 | | |
| | Kisumu East | Yes | 0 | 13.64 | 13.64 | 0.5485 | .4589 |
| | | No | 13.64 | 72.73 | 86.36 | | |

### *3.3.6 Frequency of Growing Sweet Potatoes*

Production of sweet potatoes continuously in the same farm was not significantly associated with gender in the sub counties ($p > 0.05$; Table 9). However, more females grew sweet potatoes continuously than males, with the highest females at 50% in Kisumu East sub-county (Table 9). Continuous cultivation of sweet potato in the same farm may be attributed to the fact that it is a food security, drought and pest tolerant crop that can be produced all year round. Thus, sweet potato ensures continuous food supply where other crops are faced with risk of failing [52].

**Table8.** *Frequency of growing sweet potato continuously in Rangwe, Kisumu East and Kabondo-Kasipul Sub Counties*

| Factor | Sub-county | Farmer response | Sex of respondents | | | *Chi* Square | *p* value |
|---|---|---|---|---|---|---|---|
| | | | Male (%) | Female (%) | Total % | | |
| Do you grow sweet potatoes continuously? | Rangwe | Yes | 9.09 | 40.91 | 50.00 | 0.6351 | .3384 |
| | | No | 18.18 | 31.82 | 50.00 | | |
| | Kabondo-Kasipul | Yes | 13.64 | 36.36 | 50.00 | 2.9333 | .868 |
| | | No | 31.82 | 18.18 | 50.00 | | |
| | Kisumu East | Yes | 4.55 | 50.0 | 54.55 | 0.6304 | .4272 |
| | | No | 9.09 | 36.36 | 45.45 | | |

### *3.3.7 Sweet Potato Leaf Spot Disease Occurrence*

The relationship between SPLS occurrence and region surveyed was not significant ($p>0.05$). However, in Kabondo-Kasipul sub-county 30% of respondents reported occurrence of SPLS compared to 3% who did not report disease cases. These findings are supported by those of Sseruwu *et al.* [41] who reported variation of farmers response on occurrence of SPLS in different areas. Factors such are varied environmental factors and farming practices may be atributed to these differences. The SPLS disease occurrence was not significantly ($p > 0.05$) associated with the sub counties (Table 10). However, in Kabondo-Kasipul and Rangwe sub counties farmers reported presence of diseases in their sweet potato farms at 90.91% and 81.82% respectively. Low disease occurrence of 22.73% was reported in Kisumu-East sub-county. Most females reported disease occurrence in Rangwe sub-county at 63.64% while the male farmers in Kisumu-East sub-county reported no disease occurrence. Equal number of male and female farmers (45.45%) in Kabondo-Kasipul sub-county reported disease occurrence.

**Table9.** *SPLS disease occurrence in sweet potato farms in Rangwe, Kisumu East and Kabondo-Kasipul Sub Counties*

| Factor | Sub-county | Farmer response | Sex of respondents | | | *Chi* Square | *p* value |
|---|---|---|---|---|---|---|---|
| | | | Male (%) | Female (%) | Total % | | |
| Have you experienced | Rangwe | Yes | 18.18 | 63.64 | 81.82 | 1.2731 | 0.2592 |
| | | No | 9.09 | 9.09 | 18.18 | | |
| | | Yes | 45.45 | 45.45 | 90.91 | 1.8333 | 0.1757 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SPLS disease in your farm? | Kabondo-Kasipul | No | 0.00 | 9.00 | 9.09 | | |
| | Kisumu East | Yes | 0.00 | 22.73 | 22.73 | 1.0217 | 0.3121 |
| | | No | 13.62 | 63.64 | 77.27 | | |

*3.3.8 Identification of Diseases*

Ability to differentiate between diseases in the farms was insignificant in the three sub counties ($p>0.05$). However, sweet potato farmers in Kabondo-Kasipul and Kisumu-East sub counties were able to differentiate the diseases in their farms at 90.91% each, while 72.73% of sweet potato farmers in Rangwe sub-county were not able to differentiate the sweet potato diseases on their farms (Table 11). Most female farmers in Kisumu-East sub county were able to differentiate the sweet potato diseases at (77.27%) as compared to females in Kabondo-Kasipul at 45.45%, while in Rangwe 54.55% of female farmers reported inability to differentiate sweet potato diseases occurring in their farms. In overall, female farmers were able to differentiate the sweet potato diseases except in Kabondo-Kasipul where 40.91% of male farmers were able to differentiate the sweet potato diseases. These findings agrees with those of Echodu *et al.* [9] which observed that farmers were able to recognize disease signs and symptoms in sweet potatoes though most of them could not tell the causative agent correctly. We observed that higher percentage (72.73) of farmers in Rangwe were not able to identify sweet potato diseases. For effective disease management, there is need to educate sweet potato farmers in Rangwe sub county on how to identify diseases.

**Table10.** *Identification of sweet potato diseases by farmers in Rangwe, Kisumu East and Kabondo-Kasipul Sub Counties*

| Factor | Sub-county | Farmer response | Sex of respondents | | | *Chi* Square | *p* value |
|---|---|---|---|---|---|---|---|
| | | | Male (%) | Female (%) | Total % | | |
| Are you able to differentiate the diseases in your farm? | Rangwe | Yes | 9.09 | 18.18 | 27.27 | 0.1528 | .6959 |
| | | No | 4.55 | 54.55 | 72.73 | | |
| | Kabondo-Kasipul | Yes | 40.91 | 45.45 | 90.91 | 0.2058 | .6500 |
| | | No | 0.00 | 13.64 | 9.09 | | |
| | Kisumu East | Yes | 13.64 | 77.27 | 90.91 | 0.3474 | .5556 |
| | | No | 0.00 | 9.09 | 9.09 | | |

*3.3.9 Sweet Potato Leaf Spot Disease History*

In Rangwe sub county, there was significant ($p < 0.05$) association between gender of farmers and SPLS disease history perception ($X^2 = 10.116$, $p = 0.0064$). About 13.64% of male farmers reported that it was an old disease while 22.73% of female farmers reported that it was a new disease. However, 63.64% of farmers in the sub county did not know the history of the disease. In overall, it was considered an unknown disease in Kabondo-Kasipul and Kisumu- East sub counties at 68.18% and 86.36% respectively (Table 12). Use of uncertified sweet potato planting vines may be attributed for the new cases reported by the farmers in this study particularly where the planting materials are shared from farms with old cases of the disease. Local inoculum has been reported facilitate spread of sweet potato diseases [53]. Adequate disease management approaches such as introduction of clean planting materials and farmers' education is necessary in the area to eradicate SPLS cases.

**Table11.** *History of SPLS disease in farmers' fields in Rangwe, Kisumu East and Kabondo-Kasipul Sub Counties*

| Factor | Sub-county | Farmer response | Sex of respondents | | | *Chi* Square | *p* value |
|---|---|---|---|---|---|---|---|
| | | | Male (%) | Female (%) | Total % | | |
| How long has your sweet potato suffered from the disease? | Rangwe | New | 0 | 22.73 | 22.73 | 10.1161 | .0064 |
| | | Old | 13.64 | 0 | 13.64 | | |
| | | Don't know | 13.64 | 50.0 | 63.64 | | |
| | Kasipul-Kabondo | New | 9.09 | 13.64 | 22.73 | 0.0856 | .09581 |
| | | Old | 4.55 | 4.55 | 9.09 | | |
| | | Don't know | 31.82 | 36.35 | 68.18 | | |
| | Kisumu East | New | 4.55 | 4.55 | 9.09 | 2.5596 | .2781 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Old | 0 | 4.55 | 4.55 | | |
| | | Don't know | 9.09 | 77.27 | 86.36 | | |

## 4. Conclusion and Recommendation

The incidence and severity of SPLS was varied between studied villages and sub counties due to variation in climatic, soil conditions and farming practices. Varieties SPK004 and Odinga were the most popular, since the former is orange fleshed and rich in beta-carotene, while the latter is high yielding with tasty tubers. Sweet potato vines were mostly recycled from the last season crop and from friends. More females grew sweet potatoes continuously in all the three sub counties, since it is considered a food security crop, tolerant to pests and diseases thus can be produced all year round. Male farmers grew sweet potatoes for commercial purposes, while female farmers practiced subsistence farming. The planting method involved both mounds and ridges, while fertilizer use was minimum by the females. Most farmers reported occurrence of sweet potato diseases in their farms, however, the females were able to differentiate sweet potato diseases as compared to the males. In overall, sweet potato leaf spot disease was considered an unknown disease in the study area, however farmers reported reduced yields that may be attributed to leaf pots observed in most farms surveyed. Farmers' education on sweet potato diseases such as SPLS is recommended to enhance disease management and boost yield.

## References


[1] H. Kim, C. Lee, S. Kim, C. Ji, S. Kim, J. Kim, S. Kim and S. Kwak, "Current status on global sweetpotato cultivation and its prior tasks of mass production," *Journal of Plant Biotechnology*, vol. 45, p. 190–195, 2018.

[2] S. Neela and S. W. Fanta, "Review on nutritional composition of orange-fleshed sweet potato and its role in management of vitamin A deficiency," *Food Science and Nutrition*, vol. 7, no. 6, p. 1920–1945, 2019.

[3] M. Shahbandeh, "Global sweet potato production by country 2019," 2021.

[4] G. Abong', V. Ndanyi, A. Kaaya, S. Shibairo, O. M. P. Lamuka, N. Odongo, E. Wanjekeche, J. Mulindwa and P. Sopade, "Current Research in Nutrition and Food Science," *Current Research in Nutrition and Food Science*, vol. 4, no. 3, pp. 162-181, 2016.

[5] farmlink_kenya, 2017. [Online]. Available: http://www.farmlinkkenya.com/sweet-potato-farming/. [Accessed 26 02 2020].

[6] F. Makini, L. Mose, G. Kamau, B. Salasya, W. Mulinge, J. Ongala, M. Makelo and F. A. Oluwole, Innovation Opportunities in Sweet Potato production in Kenya, Accra Ghana: Forum for Agricultural Research in Africa (FARA) , 2018.

[7] infonet-biovision, "Sweet potato," 2020. [Online]. Available: https://infonet-biovision.org/PlantHealth/Crops/Sweet-potato. [Accessed 26 02 2020].

[8] K. B. Musembi, M. S. Githiri, C. G. C. Yencho and J. Sibiya, "Combining ability and heterosis for yield and drought tolerance traits under managed drought stress in sweet potato," *Euphytica*, vol. 201, no. 3, p. 423–44, 2015.

[9] R. Echodu, H. Edema, G. Wokorach, C. Zawedde, G. Otim, N. Luambano, A. Miinda and T. Asiimwe, "Farmers' practices and their knowledge of biotic constraints to sweetpotato production in East Africa," Physiological and Molecular Plant Pathology, vol. 105, pp. 3-16, 2019.

[10] A.-L. Chai, G.-F. Du, Y.-X. Shi, X.-W. Xie and B.-J. Li, "Leaf Spot on Sweet Potato (Ipomoea batatas) Caused byStemphylium solani, a New Disease in China," Journal of Phytopathology, vol. 163, p. 1046–1049, 2015.

[11] E. Ilondu, "Etiology and assessment of leaf spot disease of sweet potato (Ipomoea batatas (L.) Lam) in selected farms in Delta State, Nigeria," Agriculture and Biology Journal of North America, vol. 4, no. 4, pp. 476-484, 2013.

[12] C. Ekhuemelo and C. N. Mariagoretti, "Pathogenicity of fungi associated with leaf spot disease of sweet potato (Ipomea batatas L. (Lam) in Makurdi, Benue State, Nigeria," GSC Biological and Pharmaceutical Sciences, vol. 11, no. 02, p. 250–256, 2020.

A. K. Tugume, S. B. Mukasa and J. P. T. Valkonen, "Mixed Infections of Four Viruses, the Incidence and Phylogenetic Relationships of Sweet Potato Chlorotic Fleck Virus (Betaflexiviridae) Isolates in Wild Species and Sweetpotatoes in Uganda and Evidence of Distinct Isolates in East Africa," PLoS ONE, vol. 11, no. 12, p. e0167769, 2016.

[13] G. Wokorach, H. Edema, D. Muhanguzi and R. Echodu, "Prevalence of sweetpotato viruses in Acholi sub-region, northern Uganda," Current Plant Biology, vol. 17, pp. 42-47, 2019.

[14] D. H. Buko, A. Gedebo, C. Spetz and A. K. Hvoslef-Eide, "An update of sweet potato viral disease incidence and spread in Ethiopia," African Journals of Agricultural Research, vol. 16, no. 8, pp. 1116-1126, 2020.

[15] J. Onditi, M. Nyongesa and R. van der Vlugt, "Prevalence, distribution and control of six major potato viruses in Kenya.," Tropical plant pathology, 2020.

[16] T. J. Anginyah, "Reaction Of Ipomoea batatas (L) Lam Lines To Alternaria Leaf And Stem Blight And Effects Of Soil Ph On Disease Severity," Msc_ Thesis, University of Nairobi, 2000.

A. Alajo, "Distribution and characterization of sweet potato alternaria blight isolates in Uganda.," Thesis - Makerere University, 2009.

[17] S. S. Maharachchikumbura, S. P. Wu, K. D. Hyde, A. M. Al-Sadi and Z. Y. Liu, " First report of sweet potato leaf spot caused by Neopestalotiopsis ellipsospora in Guizhou Province, China," Journal of Plant Pathology, vol. 98, no. 3, p. 686, 2016.

[18] L. Ochieng, S. Githiri, A. B. Nyende and L. Murungi, "A Survey of farmers' perceptions and management strategies of the sweet potato weevil in Homa Bay County, Kenya," African Journal of Food, Agriculture, Nutrition and Development, vol. 17, pp. 12157-12178, 2017.

[19] P. Nyeko, G. Edwards-Jones, R. Day and T. Raussen, " Farmers' knowledge and perceptions of pests in agroforestry with particular reference to Alnus species in Kabale district, Uganda," Crop Protection, vol. 21, no. 10, pp. 929-941, 2002.

[20] M. Krauss, A. Berner, D. Burger, A. Wiemken, N. U. and M. P., "Reduced tillage in temperate organic farming: Implications for crop management and forage production," Soil Use Management, vol. 26, pp. 12-20, 2010.

[21] P. Schreinemachers, S. Balasubramaniam, N. M. B. Cuong, V. Ha, L. Kenyon, S. Praneetvatakul, A. Sirijinda, N. T. Le, R. Srinivasan and M.-H. Wu, "Farmers' perceptions and management of plant viruses in vegetables and legumes in tropical and subtropical Asia," Crop Protection, vol. 75, p. 115e123116, 2015.

[22] P. Sseruwagi, W. Sserubombwe, J. Legg, J. Ndunguru and J. Thresh, "Methods of surveying the incidence and severity of cassava mosaic disease and whitefly vector populations on cassava in Africa: a review. Virus Res 100:129–142," Virus Research, vol. 100, p. 129–142, 2004.

[23] S. Mahantesh, C. Karegowda, S. Kavitha, T. Kavita and N. Punith, "In vitro evaluation of fungicides, bio agents and natural plant extracts against early blight caused by A. solani," International Journal of Chemical Studies, vol. 5, no. 5, pp. 1346-1350, 2017.

[24] O. A. A. N. Arene, "Sweet potato diseases in Nigeria," PANS, vol. 24, no. 3, pp. 294 - 305, 1978.

[25] S. Kandolo, A. Thompson, F. Callitz, S. Laurie, M. Truter and T. Aelin, "Field tolerance of selected varieties to fungicide efficacy against Alternaria blight of sweet potato," African Crop Science Journal, vol. 24, no. 3, pp. 331 - 339, 2016.

A. Thompson, C. Narayanin and M. M. Smith, "A disease survey of Fusarium wilt and Alternaria blight on sweet potato in South Africa," Crop Protection, vol. 30, no. 11, pp. 1409-1413, 2011.

[26] M. Osiru, E. Adipala, O. Olanya, B. Lemaga and R. Kapinga, "Occurrence and Distribution of Alternaria Leaf Petiole and Stem Blight on Sweetpotato in Uganda," Plant Pathology Journal, vol. 7, pp. 112-119, 2007.

[27] G. Sseruwu, P. Shanahan, R. Melis and G. Ssemakula, "Genetic analysis of resistance to Alternaria leaf petiole and stem blight of sweetpotato in Uganda," Euphytica, vol. 3, pp. 393-404, 2016.

[28] D. W. Parry, Plant pathology in Agriculture, New York: Cambridge University Press, 1990, p. 384.

[29] K. Bilgrami and H. Dube, A textbook ofmodern plant pathology, New Delhi: Vikas Publishing House, PVT Ltd, 1976, p. 344.

[30] C. A. Amienyo and A. Ataga, "Survey of fungi assocated with diseased sweet potato (Ipomoea batatas (L) Lam) leaves in some farms in Rivers State, Nigeria," Nigeria Journal of Botany, vol. 21, no. 2, p. 336 – 341, 2008.

[31] T. Keith, E. Rwiza, A. Nyango, R. Amuor, K. Ngendello and D. Jolliffe, " The use of sensory evolution and consumer preference for the selection of sweetpotato cultivars in East Africa," Journal of the Science of Food and Agriculture , vol. 84, no. 8, pp. 791-799, 2004.

[32] B. Bashaasha, R. Mwanga and C. O. E. P. p'Obwoya, "Sweetpotato in the Farming and Food Systems of Uganda: A Farm Survey Report," International Potato Center (CIP), Kampala, Uganda, 1995 a.

[33] K. Sindi and S. Wambugu, "Going to scale with sweet potato vines," International Potato Center, Nairobi, 2012.

[34] S. Ngailo, H. A Shimelis, J. Sibiya and K. Mtunda, "Assessment of sweetpotato farming systems, production constraints and breeding priorities in eastern Tanzania," South African Journal of Plant and Soil, vol. 33, no. 2, pp. 105-112, 2016.

[35] R. Kapinga, S. Jeremiah, E. Rwiza and D. Rees, "Farmer criteria for selection of sweetpotato varieties," in Sweetpotato post-harvest assessment: experiences from East Africa, Rees D; van Oirschot, Q; Kapinga, R ed., Chatham: Natural Resources Institute, 2003, p. 9–22.

[36] M. Domola, "Survey and characterisation of sweet potato viruses in South Africa. M Inst Agrar (Plant Protection)," Thesis, University of Pretoria, South Africa, 2003.

[37] B. Zawedde, C. Harris, A. Alajo, J. Hancock and R. Grumet, "Factors influencing diversity of farmers' varieties of sweetpotato in Uganda: implications for conservation," Economic Botany , vol. 68, p. 337–349, 2014.

[38] G. Sseruwu, P. Shanahan, R. Melis and G. Ssemakula, "Farmers awareness and perceptions of alternaria leaf petiole and stem blight and their preferred sweetpotato traits in Uganda," Journal of Plant Breeding and Genetics, vol. 03, no. 02, pp. 25-37, 2015.

[39] M. Aldow, "Factors affecting sweet potato production in crop–livestock farming systems in Ethiopia," Master of Science in Agroecology, Norwagian University of Life Science, 2017.

[40] W. Mbewe, A. Mtonga, M. Chiipanthenga, K. Masamba, G. Chitedze, P. Pamkomera, E. Gondwe, O. Mwenye and F. Chipungu, "Incidence and distribution of Sweetpotato viruses and their implication on sweetpotato seed system in Malawi," Journal of Plant Pathology volume , vol. 103, p. 961–968, 2021.

[41] V. Ezin, F. Quenum and R. Bodjrenou, "Assessment of production and marketing constraints and value chain of sweet potato in the municipalities of Dangbo and Bonou," Agric & Food Secur, vol. 7, no. 15, 2018.

[42] J. Low, "The changing role of sweet potato in South Nyanza, Kenya," in Adapting social science to the changing focus of international agricultural research, S. Ehui, J. Lynam and I. Okike, Eds., Nairobi, International Livestock Research Institute, 2004, p. 95–118.

[43] C. F. Bach and P. Pinstrup-Andersen, "Agriculture, growth and employment in Africa>, Civil Society input to the Africa Commission on Effective Development Cooperation with Africa," 2008.

[44] C. Parwada, C. T. Gadzirayi and A. B. Sithole, "Effect of ridge height and planting orientation on Ipomea batatas (sweet potato) production," Journal of Agricultural Biotechnology and Sustainable Development, vol. 3, no. 4, pp. 72-76, 2011.

[45] G. Gomes, Sweet Potato Growth Characteristics, First Edition ed., 1999.

[46] M. Mcharo and P. Ndolo, "Root-yield performance of pre-release sweet potato genotypes in Kenya," J. Appl. Biosci., vol. 65 , p. 4914 4921, 2013.

[47] H. Dapaah, S. Ennin, O. Safo-Kantanka, V. Anchirinah, M. Buri, A. Dankyi and J. Otoo, Sweetpotato Production Guide: a resource and reference manual., Kumasi, Ghana: IFAD/MOFA Root and Tuber Improvement Programme (RTIP) Publication. RTIP, MOFA, 2004, p. 17.

[48] M. Nedunchezhiyan, G. Byju, R. Ray, M. Nedunchezhiyan, G. Byju, R. Ray, R. Magarey, T. Sutton and C. Thayer, "A simple generic infection model for foliar fungal plant pathogens," Phytopathology, vol. 95, p. 92–100, 2005.

[49] C. Wambui, "Kenyan farmers find sweet spot with nutritious, drought-hardy crop," 2020.

[50] V. Aritua, J. P. Legg, N. E. J. M. Smit and R. W. Gibsonc, "Effect of local inoculum on the spread of sweet potatovirus disease: limited infection of susceptible cultivarsfollowing widespread cultivation of a resistant sweetpotato cultivar," Plant Pathology, vol. 48, p. 655–661, 1999.

[51] P. Dhliwayo and P. .. Chiunzi, A Guide to profitable sweet potato production, Harare: Biotechnology Trust of Zimbabwe, 2004, pp. 3-9.

**Citation:** *Adera A. Norah, et.al., (2021). "Sweet Potato Leaf Spot Diseases and Farmer's Indigenous Knowledge in Parts of Western Kenya", International Journal of Research Studies in Agricultural Sciences (IJRSAS), 7(10), pp. 16-26 DOI: http://dx.doi.org/10.20431/2454-6224.0710003*