International Journal of Agricultural Science, Research and Technology in Extension and Education Systems (IJASRT in EESs)
Available online on: http://ijasrt.iau-shoushtar.ac.ir
ISSN: 2251-7588 Print
ISSN: 2251-7596 Online
2022: 12(1):1-10, DOR: 20.1001.1.22517588.2022.12.1.1.0

Received: 12 May 2021
Reviewed: 01 August 2021
Revised: 23 August 2021
Accepted: 23 August 2021

Assessing the Indigenous Pest and Disease Management Methods of Sweet Potato Crop

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Keywords: Pest and Disease, Indigenous Management, Sweet potato, Nigeria

Abstract

Sweet potatoes are extremely adaptable to adverse environmental conditions and can increase food security in times of drought and famine. However, in recent times sweet potato production has been on the decline due to pest and disease infestation. The objectives of the study were to describe the socio-economic characteristics of the sweet potato farmers; identify the common field/storage pest and disease of sweet potato; investigate the indigenous measures of controlling field/storage pests and diseases among others. One hundred and twenty-two sweet potato farmers were randomly selected from two local government areas. The study shows that majority of the sweet potato farmers were male (89.3%) and married (80.4%). The major field and storage pests were armyworm (100%), grasshopper (100%), and rat (100%). Black rot (x=2.39), and bacterial wilt (x=2.35) were the major field and storage diseases of sweet potato. The major challenges faced by sweet potato farmers with use of indigenous methods were proximity to natural herbs (100%). The study concluded that the use of indigenous measures to control sweet potato pest and diseases are very effective and beneficial. Therefore, the study recommended that Extension agent should work with the farmers on how the natural herbs can be preserved within their environment.

1. Introduction

Insect pests are a major cause of crop yield losses around the world (Oerke, 2006) and an important cause of food insecurity in developing countries (Zakari, Ying & Song, 2014). Farmers make crop and pest management decisions within the realm of their production situations (Savary, mille, Rolland & lucas, 2006) and their decisions in turn shape their production situations. The management of pests has important implications for African agriculture where the majority of the community consists of smallholder farmers with low agricultural productivity (Bature, Sanni & Adebayo 2013). The attack of crops by pests can come at any point in the long chain of crop production. Pests can damage the seeds when sown, when plants are green and tender, just at the time the grains are formed or about to ripen, the harvested grain or when stored. Some pests are difficult to control with available technologies and large differences exist in the efficacy of pest control.

Nigeria is one of the largest producers of sweet potato (ipomoea batatas) in sub Saharan African with annual production estimated at 3.46 million tons per year (Omore, Fakoye, Fapojuwo, & Oyediran, 2014). Despite the use of agricultural chemicals such as pesticides and fertilizers, etc pest still constitutes major challenges for farmers and agricultural activities, which warrant looking for alternative farming systems. Although, the interdependence between the susceptibility to pest infestation and the production situation has been demonstrated before (Allinne, savary & avelino, 2016; Savary, Roberts, Esker, Willocquet & Teng, 2017), little is known about the relationship between production situations and farmer reported pest severity on common crops in Nigeria. Therefore, analysing the perceptions of farmers on pest severity within the context of their production situation can provide important new

insights in the ways to encourage ecologically based pest management attitudes and practices. The study assessed the indigenous pests and diseases management methods of sweet potato in Kwara State, Nigeria. The specific objectives of the study are to:

1. Describe the socio-economic characteristics of the sweet potato farmers;
2. identify the common field/storage pest and disease of sweet potato in the study area;
3. investigate the indigenous measures of controlling field/storage pests and diseases used by the sweet potato farmers in the study area;
4. ascertain the benefits of using indigenous method of controlling pest and disease in the study area;
5. identify the challenges to the indigenous method of controlling pest and disease in the study area;

Hypothesis of the study

Ho_1: There is no significant relationship between some selected socio-economic characteristics of the famers and management practices of pests and diseases in the study area.

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2. Materials and Methods

Study area: The study was carried out in Offa and Oyun local government area, Kwara state, Nigeria. Offa and Oyun are well known for cultivation of Sweet potatoes and maize which also forms part of the favourite staple foods of it is indigenes. Offa in one of her eulogies is being address as the home of sweet potato. Offa local government Population (2006) total 88,975 while Oyun local government area has an area of 476km^2 and a population of 94,253 at 2006 census (NIPOST 2009).

Sampling Procedure and Sample Size: A two-stage sampling technique was employed. The first stage was random selection communities in Offa and Oyun local government areas based on the prevalence of sweet potato farmers. These communities are Ayaba, Lemon and Irra. The second stage was random selection of forty (40) percent of the registered sweet potato farmers in the selected communities. The total registered sweet potato farmers in Ilemona were eighty-five (85) and the forty (40) percent was thirty-four (34) farmers, the total registered sweet potato farmers in Ayaba were one hundred (100) and the forty (40) percent was forty (40) farmers, total registered sweet potato farmers in Iraa were one hundred and twenty (120) and the forty (40) percent was forty-eight (48) farmers making a sample size of 122 respondents.

Method of Data Analysis: The data was analysed by using both descriptive and inferential statistics. Descriptive statistics like the use of percentage, mean and chart were used. Pearson product moment correlation was used to test the hypothesis.

3. Results and Discussion

The result in table 1 shows that the average age for the farmers was 58.9 years. This implies that old people are the ones involved in the production of sweet potato in the study area. This finding is similar to that of Fasina (2013) who observed that the majority of the farmers in Ondo state was between the ages of 50-65. The result further shows that majority of the respondents were male (89.3%), married (80.4%), practice Islam (72.1%) and had Non-formal education (69.7%). This implies that the level of education of the farmer in the study area is low. The table shows that 78.7% of the respondents hire labor for their agricultural production. This implies that their farm size may be large. The average household size of the respondent was eleven (11) persons. This implies that the respondent had fairly large household size and may use their household member as labour. 42.6% of the respondents engaged in agricultural practice as their primary occupation. The average farming experience of the respondent was 31.8 years. It means the respondents were experienced in sweet potato cultivation. In addition, the average farm size of the farmers was eight (8) hectares. This justifies the use of hired labor during the farming activities of sweet potato. 39.3% of the respondents were on leased land and the average annual income for the study was five hundred and forty-three thousand naira (#543,000). This implies that sweet potato cultivation is a profitable business under proper management. 59.8% of the respondents generate their source of finance from their personal savings. Only 38.5% of the respondents had extension contact. This implies that many of the farmers may not have current information on sweet potato technology. This is contrary to Apata (2010) that found that farmers require innovation generated from research and development to boost their productivity.

Table 1. Distribution of the respondents by their socio-economic characteristics (n=122).

Variable	Frequency	Percentage	Average
Age (years)			
21-30	4	3.3	58.9 years
31-40	8	6.6	
41-50	19	15.6	
51-60	31	25.4	
61-70	40	32.7	
>70	20	16.4	
Gender			
Male	109	89.3	
Female	13	10.7	
Marital status			
Single	2	1.6	
Married	98	80.4	
Separated	1	0.8	
Divorced	4	3.3	
Widow	17	13.9	
Religion			
Christianity	34	27.9	
Islam	98	72.1	
Level of education			
Non formal education	85	69.7	
Primary education	19	15.6	
Secondary education	11	9.0	
Tertiary education	7	5.7	
Source of labour			
Self	1	0.8	
Family labour	25	20.5	
Hired	96	78.7	
Household size			
1-5	6	4.9	11 persons
6-10	64	52.5	
11-15	42	34.4	
16-20	10	8.2	
Primary occupation			
Farming	52	42.6	
Trading	14	11.5	
Artisan	48	39.3	
Clergy	4	3.3	
Civil servant	4	3.3	
Farming experience			
1-10	12	9.8	31.8 years
11-20	14	11.5	
21-30	36	29.5	
31-40	45	36.9	
> 40	15	12.3	
Farm size (hectares)			
1-5	24	19.6	8 hectares
6-10	84	68.9	
11-15	13	10.7	
16-20	1	0.8	
Land ownership			
Rent	12	9.8	
Inheritance	44	36.1	
Lease	48	39.3	

Purchase	11	9.0	
Membership of association	7	5.7	
Annual income (#000)			
1-100	7	5.7	543,000 naira
101-200	6	4.9	
201-300	32	26.2	
> 300	77	63.2	
Source of finance			
Personal savings	73	59.8	
Loan from friends	6	4.9	
Bank	4	3.3	
Cooperative	39	32.0	
Extension contact			
Yes	47	38.5	
Extension schedule			
Fortnightly	1	0.8	
Monthly	26	21.3	
Interval of three month	20	16.4	
Total	122	100	

Source: Field survey, 2019.

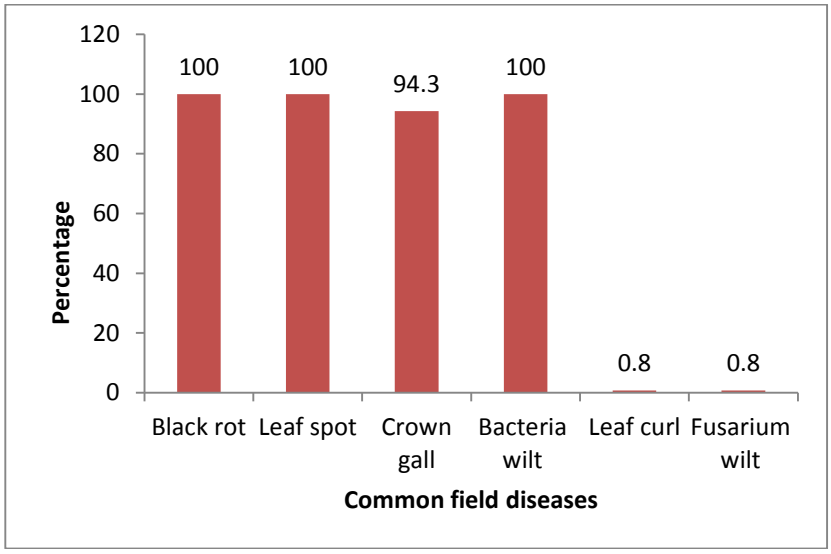
Table 2. Distribution of the respondents by the common field pests of sweet potato and the level of infestation

Field pests	Frequency	Percentage (%)	Low (%)	Moderate (%)	High (%)	Mean score	Rank
Grasshopper	122	100	-	46 (37.7)	76 (62.3)	2.62	1st
Armyworm	122	100	1 (0.8)	47 (38.5)	74 (60.7)	2.59	2nd
Rat	122	100	3 (2.5)	53 (43.4)	66 (54.1)	2.52	3rd
Aphids	119	97.5	2 (1.6)	50 (41.0)	68 (55.7)	2.51	4th
Cutworm	120	98.4	8 (6.6)	63 (51.6)	49 (40.2)	2.30	5th
Giant rat	121	99.2	18 (14.8)	59 (48.4)	45 (36.8)	2.22	6th
Squirrel	117	95.9	24 (18.9)	58 (47.5)	40 (32.8)	2.13	7th
Rabbit	122	100	26 (21.3)	57 (46.7)	39 (32.0)	2.11	8th
Grass cutters	120	98.4	23 (18.9)	58 (47.5)	39 (32.0)	2.10	9th
Sweet potato vine borer	116	95.1	9 (1.6)	73 (59.8)	33 (27.0)	2.08	10th
Butterfly	56	45.9	28 (23.0)	22 (18.0)	6 (4.9)	0.74	11th

Source: Field survey, 2019. *Multiple responses

Table 2 shows that all (100%) the respondent attest to the infestation of Armyworm, Grasshopper, Rat and Rabbit. Also 98.4% of the respondent said Cutworm and Grass cutters have infested their sweet potato cultivation. Sweet potato vine borer, Aphids, Squirrel and Rat are also major field pest of sweet potato. The study of Goergen, Kumar, Sankung, Togola & Tamo (2016), Cock, Beseh, Buddie, Cafá & Crozier (2017) reported the outbreaks of the Fall Armyworm in Africa. Table 2 also shows the severity of the infestation of field pest of sweet potato in a study area. The result shows overwhelmingly positive responses on the level of infestation of field pests. Grasshopper was ranked 1st ($\bar{x}$ =2.62). The Armyworm was ranked 2nd ($\bar{x}$=2.59) and Rat was ranked 3rd ($\bar{x}$= 2.52). However, Vine borer and Butterfly were ranked 10th and 11th respectively ($\bar{x}$=2.08 and 0.74).This shows that butterfly was not a major challenge

to the sweet potato farmers. This finding can be supported with the result obtained from Clark, Ferrin, Smith & Holmes (2013) that highlighted the negative effect of aphis gossypii, stating that they are capable of transmitting viruses.



Source: field survey, 2019.

Figure 1. Distribution of the respondents by the common field diseases of sweet potato

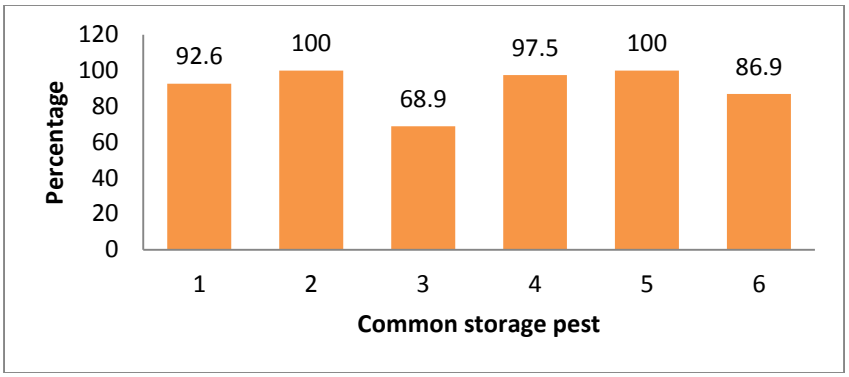
Table 3. Distribution of the respondents by the level of infestation of common field diseases

Field diseases	Low (%)	Moderate (%)	High (%)	Mean score	Rank
Black rot	6 (4.9)	63 (51.6)	53 (43.5)	2.39	1st
Bacteria wilt	10 (8.2)	59 (48.3)	53 (43.5)	2.35	2nd
Leaf spot	12 (9.8)	57 (46.7)	53 (43.5)	2.34	3rd
Crown gall	12 (9.8)	53 (43.5)	50 (41.0)	2.20	4th
Leaf curl	-	1 (0.8)	-	0.02	5th
Fusarium wilt	-	1 (0.8)	-	0.02	5th

Source: Field survey, 2019.

Figure 1 shows the infestation of field disease in the study area in a bar chart. Black rot, Leaf spot and Bacteria wilt had 100% while Crown gall had 94.3%. The result can be supported with the finding of Pulawska (2010) who found out that crown gall is one of most important diseases caused by these bacteria and is responsible for extensive economic losses to nursery productions of fruit trees, roses and grapevines in many countries. Table 3 indicates the level of infection of the common field diseases of sweet potato cultivation in the study area. Black rot, Bacteria wilt and Leaf spot were ranked 1st 2nd and 3rd with the mean scores of 2.39, 2.3 and 2.34 respectively. This shows that Black rot, Leaf rot and Crown gall pose a threat to the cultivation of sweet potato in the study area.

Figure 2 shows the storage pests that infest sweet potato in the study area. Sweet potato weevil and Rat were ranked first with percentage of 100%. The study of Johnson & Gurr (2016) and Fite, Getu & Sori (2014) found that Sweet potato Weevil (*Cylas puncticollis* Boheman) ranks the number one constraint for sweet potato production. Moreover, this report corroborates the findings of Seow-Mun & Min-Yang (2015) that found out that sweet potato weevil (*Cylas* spp.) is the main pest of sweet potato that is found in all sweet potato growing regions causing serious damage in the plantation. Table 4 shows that sweet potato weevils have the highest level of infestation and ranked 1st.



Keys: 1. Mite, 2. Sweet potato weevils, 3. Clearing moth, 4. Cutworm, 5. Rat, 6. Maggot, 7.Bug
Figure 2: Distribution of the respondents showing the storage pests of sweet potato
Source: Field survey, 2019.

Table 4. Distribution of the respondents by the level of infestation of storage pests of sweet potato

Pest	Low (%)	Moderate (%)	High (%)	Mean score	Rank
Sweet potato weevils	1 (0.8)	49 (40.2)	72 (59.0)	2.58	1st
Rat	1 (0.8)	49 (40.2)	72 (59.0)	2.58	1st
Maggot	5 (4.1)	34 (27.9)	67 (54.9)	2.25	3rd
Cutworm	17 (13.9)	65 (53.3)	37 (30.3)	2.12	4th
Mite	11 (9.0)	60 (49.2)	42 (34.3)	2.10	5th
Clearing moth	19 (15.6)	42 (34.4)	26 (21.3)	1.48	6th
Bug	7 (5.1)	17 (13.9)	36 (29.5)	1.22	7th

Source: Field survey, 2019.

Table 5. Distribution of the respondents by the storage diseases of sweet potato and level of infestation

Diseases	Frequency	Percentage (%)	Low (%)	Moderate (%)	High (%)	Mean score	Rank
Black rot	120	98.4	3 (2.5)	55 (45.1)	62 (50.8)	2.45	1st
Scab	122	100	5 (4.1)	70 (57.4)	47 (38.5)	2.34	2nd
Fusarium surface rot	122	100	10 (8.2)	62 (50.8)	50 (41.0)	2.33	3rd
Scurf	122	100	14 (11.5)	63 (51.6)	45 (36.9)	2.25	4th
Mold	1	0.8	-	1 (0.8)	-	0.02	5th

Source: Field survey, 2019. *Multiple responses.

Table 5 presented the storage diseases of sweet potato in the study area. All the respondent have had the occurrence of Scurf, Scab, Fusarium, surface rot, Black rot on their farm during the cultivation of sweet potato. However, Black rot was ranked 1st ($\bar{x}$=2.45).The findings can be supported with the report of Muramoto et al. (2012) that found out that Black rot is one of the most significant diseases of sweet potato. Scab was ranked 2nd ($\bar{x}$=2.34) and Fusarium surface rot was ranked 3rd ($\bar{x}$ =2.33).

Table 6: Distribution of the respondents by the indigenous measures of controlling the infestation of common field pest

Control measures	Frequency	Percentage (%)	Never (%)	Seldomly (%)	Always (%)	Mean score	Rank
Setting traps	122	100	-	41 (33.6)	81 (66.4)	2.66	1st
Use of scare crow	121	99.2	1 (0.8)	43 (35.2)	78 (64.0)	2.62	2nd
Neem leaves mixed cow dung	111	91.0	11 (9.0)	49 (40.1)	62 (50.9)	2.33	3rd
Lemon grass soak in water	100	82.0	22 (18.0)	40 (32.8)	60 (49.2)	2.13	4th
Neem leaves mixed with chilli peppe	88	72.1	34 (27.9	49 (40.1)	39 (32.0)	1.76	5th
Use of butterfly net	12	9.8	10 (90.2	9 (7.4)	3 (2.5)	0.17	6th

Source: Field survey, 2019. *Multiple responses.

Table 6 shows the indigenous control measures used by the respondents in controlling the infestation of common field pest in the study area. The result shows that all the respondent (100%) use traps, 99.2% of the farmers use scare crow, 91.0% of the respondent use Neem leaves mixed with chill pepper,82.0% of the respondent use lemon grass soak in water and 72.1% of the respondents use Neem leaves mixed with cow dung. However, only a few of the respondents (9.8%) uses butterfly net. The findings are in line with FOODSTART (2017) that highlighted the benefits of using plant extract as natural and homemade pesticides. Setting of traps was ranked 1st ($\overline{x}$ =2.66), scare crow was ranked 2nd ($\overline{x}$=2.66) and Neem leaves mixed with cow dung was ranked 3rd ($\overline{x}$=2.33). The findings is in line with Naniwadekar & Jadhav (2011) that found out that Neem tree is one of the most versatile medicinal plants having a wide spectrum of biological activities.

Table 7. Distribution of the respondents by the level of usage of indigenous measures of controlling the infection of storage pest

Control measure	Frequency	Percentage	Never (%)	Seldomly (%)	Always (%)	Mean score	Rank
Setting of traps	122	100		41 (33.6)	81 (66.4)	2.66	1st
Application of ordinary ash	122	100	-	53 (43.4)	69 (56.6)	2.57	2nd
Neem leaves mixed cow urine	116	95.1	6 (5.0)	58 (47.5)	58 (47.5)	2.38	3rd
Use of Neem leaves or seed with chilli	84	68.9	38 (31.2)	52 (42.6)	32 (26.2)	2.07	4th
Cow dung mixed with ash	99	81.1	23 (18.9)	46 (37.7)	53 (43.4)	2.06	5th
Neem leaves with tobacco and red pepper	58	47.5	64 (52.5)	48 (39.3)	10 (8.2)	1.03	6th

Source: Field survey, 2019. *Multiple responses.

Table 7 presents the indigenous measures of controlling the infestation of storage pest in the study area. All (100%) the respondents use setting of traps and the application of ordinary ash in controlling the infestation of storage pest in the study area. Furthermore, majority of farmers use Neem leaves mixed with cow urine (95.9%) to control storage pests. However, on the level of usage of indigenous control measure of storage pest, setting of traps was ranked 1st ($\overline{x}$=2.66) , Application of ordinary ash was ranked 2nd ($\overline{x}$=2.57), Neem leaves mixed cow urine was ranked 3rd ($\overline{x}$=2.38). Pant, Dubey & Patanjali (2016) found out that Neem has beneficial properties to crop because it is biodegradable and leave no harmful residues. Besides, it is non-phytotoxic and more selective toward the target pest.

Table 8. Distribution of the respondents by the benefits of using indigenous method in controlling pests and diseases of sweet potatoes

Benefit	Strongly disagreed (%)	Disagreed (%)	Undecided (%)	Agreed (%)	Strongly agreed (%)	Mean score	Remark
The nutrition content is not affected	-	-	-	3 (2.5)	119 (97.5)	4.98	Beneficial
Shape of the tuber is not affected	-	-	-	5 (4.1)	117 (95.9)	4.96	Beneficial
It does not decolorized the tuber	1 (0.8)	-	-	3 (2.5)	118 (96.7)	4.94	Beneficial
Increases shelf-life	-	-	1 (0.8)	6 (4.9)	115 (94.3)	4.93	Beneficial
Improve the taste of the tuber	3 (2.5)	2 (1.6)	5 (4.1)	8 (6.6)	104 (85.2)	4.72	Beneficial
The cost implication is bearable	-	-	13 (10.7)	4 (3.3)	105 (86.0)	4.72	Beneficial

Source: Field survey, 2019. Bench mark: 3.00, mean score ≥3.0 is beneficial and mean score < 3.0 is not beneficial.

Table 8 shows the benefits attributed to the use of indigenous method in controlling pests and diseases of sweet potato in the study area. The respondents attest to the fact that the nutritional content of the sweet potato is not altered, the shape of the tuber is not negatively affected, the colour of the tuber does not change, increases shelf life of the tuber, improves the taste of the tuber and the cost implication is bearable. This implies that indigenous control measures of pests and disease does not have negative effect on the production of sweet potato unlike use of chemical. Inappropriate and frequent usage of chemicals has ripple effect on both human health and the environment at large. Report from Mihale et al (2009) supports the finding which states that subsistence farmers in the tropics use traditional methods to preserve their stored agricultural products. Moreover, Agbo, Nta & Ajaba (2019) found out that farmers will not depend on external input for agriculture when they make use of their own neem-based products and will be able to reduce cost of production.

Table 9. Distribution of the respondents by the challenges to the use of indigenous methods of controlling pest and disease of sweet potato

Challenges	Frequency	Percentage (%)	Not severe (%)	Severe (%)	Very severe (%)	Mean score	Remark
It requires more labour than other methods	120	98.4	7 (5.7)	65 (53.3)	49 (40.2)	3.33	Constraint
Proximity to natural herbs	122	100	6 (4.9)	68 (55.7)	48 (39.3)	3.33	Constraint
Weather does not favour the methods sometimes	109	89.3	6 (4.9)	59 (48.4)	44 (36.1)	3.10	Constraint
It consumes time than other methods	99	81.1	6 (4.9)	54 (44.3)	41 (33.6)	2.94	Constraint
It consumes energy than other methods	75	61.5	5 (4.1)	43 (35.2)	30 (24.6)	2.73	Constraint
It has slow action on the pest and disease	47	38.5	4 (3.3)	32 (26.2)	15 (12.3)	1.93	Not constraint

Source: Field survey, 2019. * Multiple responses. Cut-off point is 2, < 2 is not constraint, ≥ 2 is a constraint.

Table 9 shows the challenges to the use of indigenous methods in controlling pests and diseases of sweet potato in the study area. Majority of the respondents reported that the distance to acquire the natural herbs is far (100%), method is labour intensive (98.4%), weather does not favour the use of the indigenous methods (89.3). This implies that the use of indigenous control have been limited with the challenges identified.

Table 10. PPMC showing Relationship between the socio-economic characteristics and the benefit of indigenous method in controlling pests and diseases of sweet potato

Variables	p-value	r-value	Remark
Age	0.039	0.178	Significant
Gender	0.201	0.103	Not significant
Marital status	0.198	0.182	Not significant
Religion	0.401	0.276	Not significant
Level of education	0.041	0.189	Significant
Faming experience	0.043	0.028	Significant
Farm size	0.028	0.269	Significant
Source of finance	0.078	0.304	Not significant
Extension contact	0.036	0.020	Significant

Source: Field Survey, 2019. *Significant at p 0.05

Table 11 shows the relationship between the socio-economic characteristics of the respondents and the benefits of using indigenous method in controlling pests and diseases in the study area. Age, level of education, farming experience, farm size, and extension contact were significantly relevant to the benefits of using indigenous measures. This implies that the older the age of the respondents the more the benefit gained from the use of indigenous methods. Also, level of education is significant. This finding is in line with (Ani, 2007) that says there is a positive correlation

between education and human survival. The larger the farm size, the more the farming experience and high number of contact of extension agents with the respondents, the better the benefit gained from the use of indigenous control measure of pests and diseases.

4. Conclusion and Recommendation

The study concludes that the use of indigenous measures to control sweet potato pest and diseases is very effective and beneficial in the study area. However, the major challenge faced by the farmers in the use of the indigenous method is the unavailability of natural herbs among others. Based on the findings of this study, the following recommendations were made:

1. Farmers should organize a social group that will enable them have opportunities to teach one another on the usage of indigenous measures of controlling sweet potato pest and disease
2. More extension information should be given on indigenous management practices by extension agents
3. Extension agent should work with the farmers on how the natural herbs could be cultivated and preserved in the environment.
4. Government, NGO and research institute can work out indigenous measures can be standardized.

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