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Agronomic practices and causes of decline in trifoliate yam (*Dioscorea dumentorum Kunth Pax*) production in Enugu State, Nigeria

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Trifoliate yam is a species of yam with limited documented research and information on its production and importance in spite of its high yielding quality, nutritional, medicinal and industrial uses. This study was therefore carried out to describe agronomic practices, production trend and causes of decline in trifoliate yam production in Enugu state, Nigeria. Three agricultural zones, six blocks, eighteen circles and 108 respondents purposively selected from the state constituted sample for the study. An interview schedule was used to collect data while percentage, mean score and standard deviation were used for data analysis. Findings of the study reveal that the respondents had no extension contact but sourced information on trifoliate yam from neighbours, friends or relatives (90.7%). Hence they produced trifoliate yam using indigenous methods and varieties (73.1%). Production trend shows that mean size of land allocated to trifoliate yam production was relatively steady, mean cost of input and income were increasing while mean output was decreasing within the years under consideration (before 2001 to 2014). Poor finance ($\bar{x}$=1.8) and drudgery ($\bar{x}$=1.72) were some of the causes of decline in trifoliate yam production in the area. The study recommended that more research and public enlightenment campaign on the importance of trifoliate yam should be carried out by research institutes and extension organisations respectively in order to attract interest of people in growing, consumption and industrial utilization of the crop. This will prevent the crop from going extinct but contribute to food security and sustainable development.

Key words: Agronomic practices, causes, decline, trifoliate yam.

INTRODUCTION

Trifoliate yam *(Dioscorea dumetorum)* from the family Dioscoreaceae (the Yam family) contains approximately 622 to 652 species. The type of species is *Dioscorea sativa* (Hortipedia, 2013). According to Onwueme and Sinha (1999), trifoliate yam originated from Africa. It is Found in West Africa, primarily in Eastern Nigeria. Trifoliate yam is known by various names such as three-leaved yam, bitter yam and cluster yam. It is also known as 'ji una' or 'ji ona' in Ojoto and many Igbo speaking areas in the South-Eastern Nigeria, where it is regarded

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as food for adult (Egbuonu et al., 2014).

Trifoliate yam differs from other yams by having trifoliate leaves. It also contains a bitter toxic alkaloid called dihydroscorine, which can be removed by soaking and boiling in water. Nutritionally, the tuber is superior to the commonly consumed yams (like white and yellow yams) having high protein and mineral content (Martin et al., 1983). It has a mean protein content of 9.6% (dry weight basis) compared to 8.2% for water yam (*D. alata*) and 7.0% for White yam (*D. rotundata*) (Mbome-Lape and Treche, 1994). The proteins are more balanced than those of white yam and it is rich in vitamins and minerals. Trifoliate yams are highly yielding compared to other yam species.

Bitter yam is good for diabetic patients. It can also be used as a vegetable, but not pounded into 'fufu'. Owing to its soft texture, it is favoured by old people with poor teeth. The wild forms are regarded as famine food. It is becoming a preferred yam in Cameroon. The tubers of trifoliate yam, when properly processed can be used in the production of yam flakes; instant flour for the bakery sector or starch in diverse pharmaceutical preparations (Ukpabi, 2010).

However, there is limited information on the use of flours from trifoliate yam in food industries and at household levels in Nigeria (Abiodun and Akinoso, 2014). This could probably be due to lack of information on the usefulness and importance of the flours for functional food products (Abiodun and Akinoso, 2014). Trifoliate yam is also one of the numerous tropical tubers that are yet to be exploited and is fast being driven into extinction despite being good source of phyto-proteins, carbohydrates, vitamins and minerals for human nutrition (Medova et al., 2005). A research in Enugu North Agricultural Zone of Enugu state by Iwuchukwu and Onwubuya (2012) showed that average yield (kg/ha) of *D. dumetorum* for 2006 to 2008 were 22,337, 19,563 and 17,800 kg/ha respectively These data obviously suggest decrease in *D. dumetorum* production in the area.

Onuegbu et al. (2011) reported that so far the yam has no industrial application. Moreover, the crop is yet to attract adequate research interest in tapping the potentials and its culinary uses are relegated to the background (Degras, 1993). Consequently, yam farmers are moving into less laborious and more economical crops like garden-egg, maize, cucumber, cocoyam production among others. Very few farmers are growing bitter yam in recent times. In yam markets, little or no bitter yam is displayed or sold.

The above stated scenario necessitated the need to investigate the activities of trifoliate yam farmers with a view to ascertain the possible causes of decline in trifoliate yam production in Enugu State. Specifically, the study identified and described trifoliate yam farmers sources of information, extension contact, purpose and season of production, agronomic practices, trend in production as well as causes of decline in trifoliate yam production in the area.

METHODOLOGY

The study was carried out in Enugu state, Nigeria. Enugu State is one of the states in the Eastern part of Nigeria. Trifoliate yam farmers in the state constituted the population for the study. The multi-stage random sampling technique employed in selecting the respondents is as follows:

Stage one: From the six agricultural zones in the state, three zones namely Udi, Enugu Ezike and Nsukka, were purposely selected because of their involvement in the trifoliate yam production.
Stage two: Two blocks where trifoliate yam were mostly produced were purposively selected from each of the zones giving a total of six blocks for the study.
Stage three: From each of the selected blocks three cells or circles where trifoliate yam farmers can be mostly found were selected giving a total of eighteen cells for the study.
Stage four: from each of the circles, six trifoliate yam farmers were selected giving a total of 108 respondents for the study.

Data for the study were collected from the respondents through the use of structured interview schedule. It contained relevant questions based on each objectives of the study. Respondents were asked to indicate their number of extension contacts in the last one year and their source(s) of information on trifoliate yam production. They were also requested to indicate the agronomic practices they employed in trifoliate yam production for examples, variety grown, cropping pattern, method of land preparation, fertilizer application, weeding, harvesting and types of tool used. In order to assess the trend in production of trifoliate yam, respondents were requested to estimate the size of land they allocated to trifoliate yam production (in hectare), cost of input (in Naira), output (in kg) and income (in Naira) realized from the product before 2001, 2001 to 2007 and 2008 to 2014. Causes of decline in trifoliate yam production were captured using a modified Likert-type scale of three points as follows "to a large extent, to a little extent and to no extent", with nominal values of "2, 1 and 0" assigned to them respectively with a mean of 1. Respondents were requested to rate the extent to which they perceive possible causes provided and others they enumerated as causes of decline in trifoliate yam in the area on this scale and mean scores were computed. Variables with mean scores greater than or equal to 1.0 were regarded as major causes, while variables with mean scores less than 1.0 were regarded as minor causes of decline in trifoliate yam production. Data were analyzed with percentage, mean scores and standard deviation.

RESULTS AND DISCUSSION

Personal contact with extension agents

In the present investigation, it has been found that the majority (80.6%) of the respondents did not have any personal contact with agricultural extension agents on agricultural matters in 2013 while 14.8% had only one contact with extension agents in 2013 (Table 1). The mean number of personal contact with extension agents in 2013 was 0.25. Thus the respondent's contact with extension agent was almost inexistent. This is probably because of lack or shortage of extension staff. In line with

Table 1. Distribution of respondents according to their social characteristics.

Social characteristics	Frequency	Percentage	Mean (M)
Contact with extension agents in 2013			
None	87	80.6	
Once	16	14.8	0.25
Twice	4	3.7	
Three times	1	0.9	
Source of information on trifoliate yam *production			
Neighbours/friends/relatives	98	90.7	
Radio	23	21.3	
Extension agents	3	2.8	
Television	3	2.8	
Newspaper	2	1.9	

Source: Field survey, 2014. *Multiple responses.

this Ogbeh (2016) reported that extension workers have almost disappeared in Nigeria as the country presently has an average of one extension worker to about 3,000 farmers. This high farmer- extension ratio may make it extremely impossible for the extension workers to have the required contacts with the clients. Extension visits help to identify the needs of farmers/rural people, equip them with current innovations in agriculture and provide solutions to their problems directly or indirectly through researchers. When the visit is lacking farmers, agriculture and economy suffer.

Sources of information on trifoliate yam production

Table 1 reveals that majority (90.7%) of the respondents' sourced information on trifoliate yam production from their neighbours/friends/relatives while about 21% got information on trifoliate yam production from the radio. Based on finding on their extension contact, it may be said that little or no extension contact resulted to very few people receiving information from the extension worker and other good information sources that extension worker may have linked them to. Hence, these farmers relied on information from informal sources for the production of trifoliate yam. Thus reliability of information from these sources is questionable and these informants may not boast of current scientifically proven innovations on trifoliate yam that they can communicate to these farmers for improved output, productivity and income. Consequently, farmers may be demoralized to consolidate the effort or invest in trifoliate yam enterprise.

Purpose and season of production and sources of planting material

Purpose of production

According to the data obtained, it has been found that greater proportion (67.6%) of the respondents produced trifoliate yam for consumption while 52.8% produced it for commercial purposes (Table 2). Normally, farmers in rural communities of developing countries produce crops and rear animals mainly for subsistence with little of the output commercialized. In corroboration to this finding Verter and Bečvářová (2015) asserted that yams as staple food crops do not only serve as integral vehicle for food security, but also as a source of income and a further source for employer of labour in yam producing areas in Nigeria.

Season of production

Entries in Table 2 also show that majority (70.4%) of the respondents grew trifoliate yam during rainy season, 16.7% cultivated during dry season while 6.5% of the respondents grew trifoliate yam in both seasons. The finding suggests that trifoliate yam is a crop that is grown mainly during rainy season in the area. There could be scarcity of trifoliate yam during dry season which may result to high market price of this commodity during this season. Farmers can explore this opportunity by producing during dry season for higher income.

Sources of planting material (trifoliate yam seed)

Data in Table 2 also show that majority (89.8%) of the respondents obtained planting materials (trifoliate yam seeds) from their farms while 16.7% sourced their planting materials from the market. When there is no subsidy on agriculture, cost of agricultural inputs like seeds, fertilizers, pesticides are likely to be high and unaffordable for farmers especially peasant farmers. They may resort to keeping some of their previous harvest as planting materials for the next planting season. Recycling the species of trifoliate yam especially when it is not improved type may subject these farmers to

Table 2. Percentage distribution according to purpose and season of production and sources of planting material.

Purpose and season of production	Frequency	Percentage
Purpose of production*		
Consumption	73	67.6
Income	57	52.8
Hobby	1	0.9
Reduce erosion	1	0.9
Soil/nutrient conservation	1	0.9
No response	5	4.6
Season of production		
Rainy season (main)	76	70.4
Dry season (off)	18	16.7
Both main and off season	7	6.5
No response	7	6.5
Sources of planting material*		
Individual	97	89.8
Market	18	16 7
No response	7	6.5

Source: Field survey, 2014. *Multiple responses.

cultivation of low quality and poor-yielding varieties of trifoliate yam. Although the importance of seed provisioning in food security and nutrition, agricultural development and rural livelihoods, and agrobiodiversity and germplasm conservation is well accepted by policy makers, practitioners and researchers but the role of farmer seed networks is less understood (Coomes et al., 2016). The authors further stated that the networks need to be strengthened and fed by innovations from research in order to maximize the primary and secondary products as well as productivity from trifoliate yam.

Agronomic practices of trifoliate yam farmers

Planting operations

Methods of land clearing: Entries in Table 3 show that majority (71.3%) of the respondents used hand tools such as hoe and cutlass while 14.8% used herbicides in clearing the land before cultivation. Land clearing is an operation usually carried out before the conventional tillage in a farm land. There are several operations that are involved in land clearing depending on the type of vegetation. Soil condition, topography, the extent of clearing required and the purpose for which the clearing is done (Ugbobor, 2013) are some of the critical factors to put into consideration before clearing the land for agriculture. Also, land clearing should be done in such a way that desirable attributes of the land such as nutrient and moisture availability, erosion resistance and accessibility are not lost. Further, the findings show that agronomic activities of trifoliate yam were done manually which is typical of agriculture in developing world where manual labour is the main source of farm power and farmers produce at subsistent level because of limitations of human power.

Production site

Table 3 shows that 75% of the respondents cultivated their trifoliate yam in farms far away from the place of residence while 49.1% cultivated within their residence. Since majority of the respondents cultivated the trifoliate yam in farms far away from their residence, production cost accruing from cost of transporting farmers, trifoliate yam and other agricultural inputs to and from home, farm and even market may be high. This could lead to poor management of the farm in terms of timely and proper execution of routine activities like weeding, pests and diseases control in the farm.

Varieties of trifoliate yam grown

Entries in Table 3 also show that majority (73.1%) of the respondents cultivated indigenous variety of trifoliate yam while 19.4% cultivated both indigenous and improved variety of trifoliate yam. Indigenous variety grown by these respondents may have some inherent good characteristics but cannot equate the improved type that can be said to be epitome of good qualities for trifoliate yam. Consequently, researchers, policy makers, and foundations are working hard to improve the seed provisioning to farmers in developing countries in order to

Table 3. Distribution of respondents according to their planting operations.

Planting operations	Frequency	Percentage
Method of land clearing used		
Manual	77	71.3
chemical (herbicide)	16	14.8
None	13	12.0
Chemical (herbicide) and manual	2	1.9
Site of production of trifoliate yam*		
Farm away from residence	81	75
Within the residence	53	49.1
No response	6	8.46
Garden	1	1.41
Varieties grown		
Indigenous	79	73.1
Both indigenous and improved	21	19.4
No response	5	4.6
Improved	1	0.9
***Planting/cropping system**		
Trifoliate yam grown in a mixture with other crops	94	87.0
Trifoliate yam grown as a sole or only crop in the farm	12	13.4
No response	4	4.4
Staking		
No	4	3.7
Yes	104	96.3

Source: Field survey, 2014. *Multiple responses.

increase agricultural productivity, nutrition and rural well-being (Coomes et al., 2016). The Alliance for a Green Revolution in Africa (AGRA) has also placed particular emphasis on strengthening the seed sector and promoting the commercialization, distribution and adoption of improved crop varieties (AGRA, 2013). Many development donors have also projects, aimed at improving farmers access to adapted and certified seed, as well as supporting the informal seed sector (FANRPAN, 2010; Gill et al., 2013). Trifoliate yam farmers are likely to tell success stories about their enterprises if they benefit from these activities or programmes by way of growing improved trifoliate yam seed varieties.

Planting/cropping system

Data in Table 3 show that majority (87%) of the respondents practiced mixed cropping while13.2% grew trifoliate yam as a sole crop in the farm. Mixed/multiple cropping involves growing two or more crops on the same piece of land and at the same time. When the right crop combination is made, it leads to an improvement in the fertility of the soil and increase in crop yield because the products and waste from one crop help in the growth of the other crop and vice-versa. Most importantly, farmers especially small scale farmers resort to multiple cropping in order to guard against crop failure in such a manner that when a crop fails another one may not fail.

Staking

Entries in Table 3 show that majority (96.3%) of the respondents staked trifoliate yam while the remaining 3.7% did not stake their trifoliate yam. Staking is a laborious activity in yam production. It is believed that staked yams grow better than those that are not staked. Staking provides each plant the ability to grow without bending to the point where it breaks the plant and stops growth. Having plant grown upward after it is staked allows the plant to get the necessary sunlight it needs to continue the growth and can be used as a method to keep the aisles of each row of plants clear and decent (County and Henson, 2013) . Unfortunately, stakes are costly and not easy to be found nowadays. They consequently, constitute major cost of trifoliate yam production in areas where they are used thereby increasing drudgery and draining income accruable from the enterprise.

Types and time of fertilizer application

Entries in Table 4 reveal that 58.3% of the respondents

Table 4. Distribution of the respondents according to their fertilizer application, weed management practices and method/s of harvesting.

Fertilizer and weed management	Frequency	Percentage	Mean (M)
Type of fertilizer used			
Organic	63	58.3	
Both organic and inorganic	34	31.5	
Inorganic	3	2.8	
None	8	7.4	
Period of fertilizer application			
No response	8	7.41	
Before planting	56	51.9	
After planting	5	4.6	
Before and after planting	36	33.3	
After germination	3	2.8	
Methods of weed control employed*			
Hand tools	83	76.9	
None	11	10.2	
Hand picking	13	12.0	
Chemical method	6	5.6	
Hand tools and hand picking	2	1.6	
Number of weeding done per growing period			
Twice	51	47.2	
Three times	25	23.2	
None	21	19.4	2
Once	7	6.5	
Four times	4	3.7	
Harvesting			
Manual	104	96.3	
No response	4	3.7	

Source: Field survey, 2014. *Multiple responses.

used organic fertilizer in trifoliate yam production while 31.5% used both organic and inorganic fertilizers. More than half of the respondents grew the trifoliate yam organically, which is ideal, given the associated problems of inorganic fertilizer like environmental pollution and health hazards. However, worldwide experiences in agricultural development have provided much evidence that inorganic fertilizer application is the most efficient measure for sustainably increasing crop production and ensuring food security while sustained yield growth will almost be impossible without inorganic fertilizer supply (Wang et al., 2012). Given the positive features of these types of fertilizer, farmers should strike a balance in using them so as to get maximum benefits from both and without any harm from any of them.

The fertilizer that was applied to trifoliate yam was before cultivation (after land clearing) (51.9%) while 33.3% applied it before and after planting. This shows that although majority of the respondents applied fertilizer for trifoliate yam production, greater proportion of them applied it once before the crop was planted. From the foregoing, it can be inferred that fertilizer use appeared to be currently common in Nigeria and not as low as conventional wisdom suggests (Liverpool-Tassie et al., 2015; Sheaham and Barrett, 2014) but the rate of fertilizer use among Nigerian farmers may be considerably low probably due to scarcity and expensive nature of the products (both organic and inorganic fertilizers) in recent time.

Method and frequency of weed control

Table 4 also reveals that majority (76.9%) of the respondents used hand tools in controlling weed while10.2% picked the weeds in their farm. Also, 47.2% of these farmers weeded their trifoliate yam farms twice while 23.2% weeded three times in a growing season. Average number of weeding per growing season was two, suggesting that production of trifoliate yam is relatively labour intensive. Similarly, manual methods of controlling weeds by majority of the farmers are stressful but purposeful with precision and may not lead to acid concentration on the farm/production site as in the case

Table 5. Production trend of trifoliate yam.

Production trend	Before 2001 Mean (M)	2001 - 2007 Mean (M)	2008 - 2014 Mean (M)
Size of land allocated to trifoliate yam (in hectares)	0.21	0.22	0.21
Cost of production (₦)	650.47	1,777.78	2,756.48
Quantity of trifoliate yam produced (kg)	634.95	456.44	445.23
Income from trifoliate yam (₦)	3,611.11	6,004.63	8,208.33

Source: Field survey, 2014.

of chemical like herbicide used in controlling weeds. According to Stachler (2012), cultural and mechanical weed control practices must be utilized in conjunction with herbicides, otherwise herbicide-resistant biotypes will increase. Cultural practices are those practices that maximize crop growth (biomass production) such as proper fertilization, narrow row spacing, high crop stand densities, and many others. According to the author, mechanical weed control must be used wisely to effectively control weeds and reduce soil erosion.

Method/s of harvesting

Majority (96.3%) of the respondents harvested their produce manually (Table 4). This may be because the farmers did not have access to basic farm equipment and implements such as the harvesters that will ease harvesting operations probably due to lack of fund or other constraints

Production trend of Trifoliate yam (*Dioscorea dumentorum*)

Entries in Table 5 reveal production trend of trifoliate yam. The table shows that a mean of 0.21 hectares of land was allocated to the production of trifoliate yam before 2001 while 0.22 and 0.21 ha were allocated to it in 2001-2007 and 2008 - 2014 respectively by the respondents. The table further reveals that the mean cost of production of trifoliate yam before 2001 was ₦650.47 whereas ₦1.777.78 and 2,756.48 were spent between 2001-2007 and 2008 – 2014, respectively on trifoliate yam production by the respondents.

Table 5 also shows that the respondents produced about 634.95 kg of trifoliate yam before 2001 while 456.44 and 445.23 kg of trifoliate yam were produced between 2001 - 2007 and 2008 - 2014 respectively. The mean income earned by the respondents from trifoliate yam production before 2001 was ₦3,611.11 while ₦6,004.63 and 8,208.33 were earned by the respondents in 2001-2008 and 2007 – 2014, respectively (Table 5).

These findings show that the mean cost of input used for growing this species of yam has been increasing before 2014. The mean size of land allocated to its' production may be said to be relatively steady from 2001 to 2014. It further shows that the quantity of trifoliate yam produced before 2001 and 2014 has been decreasing whereas the income generated/earned from trifoliate yam over the years has been increasing tremendously. This increase in income irrespective of decrease in output may be as a result of increase in price of the commodity as a result of its scarcity which may be termed inflation. This condition is not ideal because actually farmers are investing more and harvesting less. Factors that directly/positively affect farm level technical efficiency and yam output like farmers' education, family labour, extension contact and experience of farmers as enumerated by Etim et al. (2013) need to be investigated and enhanced to maximum level in order to maximize trifoliate yam output and yield. If not, when this negative trend continues there may be money to buy trifoliate yam but no trifoliate yam to be bought. This may further lead to species extinction and aggravation of food insecurity.

Causes of decline in trifoliate yam production

The major causes of decline in trifoliate yam production as shown in Table 6 are lack/poor finance (M=1.8); drudgery associated with trifoliate yam production (M=1.72) and lack of awareness of the nutritional, economic and health values of trifoliate yam (M=1.71). Likewise Verter and Bečvářová (2015), identified lack of finance, inadequate farm inputs, storage facilities and high cost of labour as primary constraints to yam production in Nigeria. Other major causes include lack of interest on the part of the youths in agricultural production (M=1.55); lack of good agricultural education (M=1.48); change in taste by the younger generation in terms of food/trifoliate yam production (M=1.46); destruction caused by stray animals (M=1.44); problems of basic social amenities (M=1.44); unpredictable climate (M=1.37); notion/belief that trifoliate yam can kill or cause madness when consumed (M=1.33); poor tools and farm machines (M=1.29); poor transport system (M=1.27); insufficient land for large scale production (M=1.19); lack of agricultural inputs (M=1.19); land degradation/infertile land/soil (M=1.16); lack/poor storage and processing

Table 6. Mean distribution of respondents according to perceived causes of decline in trifoliate yam production.

Causes of decline in trifoliate yam production	Mean (M)	Std. deviation
Problems of good storage and processing facilities	1.06*	0.62
Poor extension activities	1.01*	0.74
Poor marketing system	1.01*	0.79
Pest and diseases attack	0.78	0.69
Unpredictable climate	1.37*	0.65
Lack of agricultural inputs (e.g fertilizer)	1.19*	0.83
Insufficient land for large scale production	1.20*	0.78
Lack of seed yam	0.72	0.67
High cost of seed yam	0.69	0.72
Drudgery associated with trifoliate yam production	1.72*	0.56
Problems of land tenure system	1.04*	0.85
Problems of basic social amenities	1.44*	0.71
Poor financing	1.80*	0.45
Poor transport system	1.27*	0.68
Lack of good agricultural education	1.48*	0.63
Poor tools and farm machines	1.29*	0.74
Unstable policies and programs of government	0.92	0.83
Erosion	0.84	0.74
Land degradation/infertile land/soil	1.16*	0.76
Cultural barriers associated with trifoliate yam	0.32	0.53
Lack of awareness about the nutritional, economic and health values of trifoliate yam among farmers and consumers	1.71*	0.47
Change in taste by the younger generation in terms of food/trifoliate yam consumption	1.46*	0.70
Lack of interest on the part of the youths in agricultural production	1.55*	0.54
Quest for ‘white collar’ jobs	0.98	0.83
Notion/belief that trifoliate yam kills or can cause madness when consumed.	1.33*	0.74
Destruction caused by stray animals	1.44*	0.66

Source: Field survey, 2014. *Causes of decline.

facilities (M=1.06); problems of land tenure system (M=1.04); poor extension activities (M=1.01) and poor marketing system (M=1.0). It is a known fact that developing countries are faced with numerous problems such as land tenure, lack of credit/finance, poor extension education and contact, lack/poor infrastructural facilities among others which militate against the development of agriculture. Adebowale et al. (2013) also observed that despite the nutritional advantages of trifoliate yam, it is highly underutilized in Nigeria mainly due to tuber hardening which begins a few hours after harvest thus becoming hardened and hard to chew even after long hours of cooking, making their consumption almost impossible.

Minor causes of decline in trifoliate yam production as shown in Table 6 include quest for ‘white- collar jobs’ (M=0.98); unstable agricultural policies and programs of government (M=0.92); erosion (M=0.84); high cost of seed yam (M=0.69) among others. Thus there are agreements in the responses of these respondents on the causes of decline in trifoliate yam production as can be proved by the standard deviation of less than one in all the variables in the table. This signifies relevance of the data for policy. In view of the constraints/causes of decline, there is an urgent need for the Nigerian government to provide conducive environment by subsidising farm inputs and providing affordable loans to the smallholder yam farmers for sustainable production (Verter and Bečvářová, 2015).

Conclusion

It can be deduced from the study that trifoliate yam farmers had no agricultural extension contact but relied on informal sources for information. The farmers produced trifoliate yam during rainy season for consumption using traditional agronomic practices/methods. Moreover, poor finance, drudgery, lack of awareness of the nutritional, economic and health values of trifoliate yam were the major causes of decreased trifoliate yam production.

Recommendations

1. Government should encourage and sponsor more research on trifoliate yam especially in area of inventing improved varieties. These varieties and other necessary agro-inputs should be made available to trifoliate yam farmers as incentives or subsidies in order to consolidate their interests and boost the production of trifoliate yam.
2. Agricultural extension agencies should carry out adequate periodic public enlightenment campaigns on the nutritional, economic as well as health benefits of trifoliate yam. This will arouse the interest of farmers and consumers of trifoliate yam and may lead to commensurate and constant demand of this product thereby motivating farmers to produce more for consumption and income. In these ways this yam species will not get extinct but contribute towards food security and agricultural /economic growth and development.
3. Infrastructural facilities (good roads, market and agricultural machines) as well as incentives and subsidies (like loan, seed yam, fertilizer, agrochemical) should be provided to farmers by the government through extension information and activities. This is to ensure that these provisions are equitably distributed among the target beneficiaries and ultimately motivate, boost and consolidate the efforts of these farmers in trifoliate yam production and agriculture.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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