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Production practices of potato *(Solanum tuberosum* L.) by farmers in Mzimba District, Northern Malawi

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Potato (*Solanum tuberosum* [L.]) is one of the food and cash crops in Malawi. Almost all potato farmers in the country are smallholders with low productivity. In order to develop appropriate interventions to improve productivity, it is important to first understand farmers' characteristics and prevailing production practices. This study was therefore carried out in October 2010 in Champhira Extension Planning Area (EPA) in Mzimba District, Malawi with main objective of documenting key baseline information characterising smallholder potato growers and their production practices in the area. The survey was conducted in five randomly selected villages in Kazingilila Section in the same EPA whereby a total of 50 households (10 household from each village) were interviewed using a pre-tested questionnaire. The questionnaire was designed to gather information on social and demographic characteristics of households, farm size, knowledge and experience with potato production, soil fertility management practices, perceived market for potatoes and challenges. In addition, interviews with government extension officers residing in the area were carried out as key informants for general information about the status of potato production in the study area. Results indicate that total land holding size is between 0.65 and 1.01 ha and farmers allocate on average 0.08 ha to potato production. Results also show that farmers were growing Rosita as the only recognised and released variety in Malawi. Also, 80% of respondents were recycling their own seed with very limited knowledge of proper seed selection. On soil fertility management practices, 98% of farmers were applying chemical fertilisers mainly as 23:21:0 + 4 S and CAN or Urea. Sixty eight percent of farmers were also applying manure as a source of organic fertilizer to their crop. However, the average yield was 6 tons/ha, compare national average of 11.9 t/ha in 2008. Farmers and extension staff mentioned pests and diseases, limited access to improved varieties and clean seed, low soil fertility and limited knowledge of crop management as main constraints that affect potato production in the area. Based on these results technical issues, areas of research interventions and recommendations for improving potato production in the area have been indicated.

Key words: Potato, Malawi, soil fertility management, production constraints.

INTRODUCTION

Potato is increasingly becoming an important food and cash crop in Malawi. In 2007 Malawi was ranked the second largest potato producer in Africa with 2.85 million tonnes harvested (FAOSTAT, 2008). Potato production

also ranks fourth when compared to other major food crops produced in Malawi thus cassava, maize and sweet potato (Ministry of Agriculture and Food Security (FAOSTAT, 2008). Potato is the main cash crop and second major food crop after maize in the major growing districts of Malawi (Demo et al., 2009b), which are: Ntcheu, Dedza, Neno, Mchinji, Mzimba and Ntchisi. These are suitable areas for potato production because of their high altitude with cool climate and adequate rainfall (MoAFS, 2005).

Almost all potato growers in Malawi are small scale farmers (Demo et al., 2009a). Despite general increase in potato production in Malawi for the past years, the average productivity at national level is still very poor as compared to other countries. For instance, the national average yields for some countries such as South Africa and Egypt are 34 and 24.8 tonnes/ha respectively whereas with Malawi it is 11.9 tonnes/ha (FAOSTAT, 2008). The national average potato yield of 11.9 tons/ha is still very low against a potential of 40 tonnes/ha (Soko, 2004). The national aim is to increase production to 20 t/ha (MoAFS, 2005). Also, the current national potato production is still below market demand (Demo et al., 2009c). The quality of tubers obtained is also generally very low due to some factors such as small tuber sizes, bruises on tubers, tuber diseases and rotting (Soko, 2004; MoAFS, 2005). There are a number of constraints that negatively affect potato production in Malawi and these include lack of quality seed potato, declining soil fertility and structure due to poor management practice, diseases such as late blight, bacterial wilt and viruses, and limited knowledge of farmers, extension staff and existing research technicians on improved production (Demo et al., 2009c, 2007).

In order to improve potato productivity in Malawi, there is need to address some of these already identified constraints through research and other interventions. However, to develop appropriate interventions such as a research programme for addressing these constraints like poor soil fertility management, it is important to first understand farmer characteristics and prevailing soil fertility management practices. This is because soil fertility is one of the major factors that affect the yield and quality of the potato because the crop requires high amounts of nitrogen, phosphorus, potassium, magnesium and calcium (Adhikari and Sharma, 2004; Hossain et al., 2003; Gathungu et al., 2000). This is why a baseline survey of similar nature was conducted in Mzimba District, Malawi in 2010 in order to document key baseline information characterising potato production in the study area, with focus on soil fertility management practices. Mzimba District is one of the areas in Malawi where potatoes are important. Farmers are motivated by a steady market along the main Lilongwe - Mzuzu road.

MATERIALS AND METHODS

Bio-physical and socio-economic background to study area

The baseline survey was conducted in October, 2010 during 2010/2011 growing season. The study area Mzimba District, Champhira Extension Planning Area (EPA) located at 12° 24'S and 33° 38'E and lies at altitude ranging from 1216 to 1338 m. The organisation structure of extension service in Malawi starts from national level (Ministry of Agriculture and Food Security) → Agriculture Development Division (ADD) → District Agriculture Development Office (DADO) → Extension Planning Area (EPA) → Section. The EPA is headed by an Agricultural Extension Development Coordinator (AEDC) while a Section is headed by an Agricultural Extension Development Officer (AEDO).

Champhira EPA was preferred for the study because of senior author's work experience in the area whereby poor yields and quality of potato tubers was observed. It is also one of the major potato producing areas in the district. Farmers plant the crop at least twice a year. First planting is done around November/December depending on the on-set of rains and this is referred to as a summer crop. The second planting is done around March/April in 'wetland or dambo, areas (usually the crop relies on residual moisture) and this is referred to as a winter crop.

Study design

The survey was purposively conducted in Kazingilila Section because it is the main potato production area in the EPA. From a complete list of 64 villages under Kazingilila Section, five villages namely Chang'ombe, Chinombo, Psyutu, Kasoti and Zifere Chisi were selected using a simple random sampling method. In each village, 10 households were randomly selected for the interview from a complete list of households who grew potato. The number of households sampled from five villages was 50 from a total number of 121 households. The data from the households was collected using a pre-tested structured questionnaire. A questionnaire was designed to gather information on socio and demographic characteristics of households, farm size, knowledge and experience with potato production, soil fertility management practices, perceived market for potatoes and challenges. The questionnaire was administered on a one-to-one basis such that questions were well clarified. In addition, interviews with AEDOs and AEDC residing in the area were carried out as key informants for general information about the status of potato production in the study area.

Conversion of measures and weights

Farmers were also asked to provide information on potato yields using their local units for the past three seasons. Farmers were able to recall the number of ox-carts and pails harvested per unit area of land. One ox-cart full of potato was estimated to be weighing 400 Kg while a standard pail was equivalent to 20 Kg.

Data analysis

Data collected were analysed for descriptive statistics such as means, frequencies and percentages using Statistical Package for Social Sciences (SPSS) Computer Package 16th Edition.

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Table 1. Characteristics of the respondents.

Variable	Frequency	Percent
Gender of household head		
Male	40	80
Female	10	20
Education level		
None	1	2
Primary	36	72
Secondary	13	26
Age group of household heads		
Less than 30	7	14
30 - 40	18	36
40 - 50	15	30
Over 50	10	20
Household size		
Less than 5	11	22
5 - 10	36	72
Over 10	1	2

RESULTS

Characteristics of respondents

Socio and demographic characteristics of respondents are shown in Table 1. Most of the households were male headed (80%). The majority of respondents (72%) had household size between 5 and 10 members with average of 6.5. Most of household heads (66%) were between the ages of 30 and 50 years. Moreover, most of the respondents (72%) had primary education which is an indication that most farmers had a fairly good education level to understand basic farming practices.

Potato production

General information on potato production

The study found that 60% of respondents had total land holding size between 0.65 and 1.01 ha (Table 2). However, the average land size allocated to potato production for the summer crop was about 0.11 ha with ranges from 0.04 to 0.4 ha. For the winter crop, the average land size was 0.08 ha with majority (51.4%) growing on 0.04 ha of land. Most of respondents explained that they allocated less land to potato farming because of lack of adequate potato seed and limited land near water sources for winter farming. When asked how they perceive their own trend of potato production over the years, only 27.1% of the respondents indicated that it had increased while 35.4% claimed that it had decreased and 37.5% indicated that it had remained constant. The respondents attributed the decrease to pest and diseases, poor markets, low yields, and limited access to clean seed.

Results also show that 74% of respondents grow the crop twice in a year while 22% grow three times in a year (Table 2) through bucket irrigation. The majority of these farmers plant their summer crop in November/December and their winter crop in March/April. However, 76% of households dry plant their summer crop in order to reduce the work load as more field crops are planted in November/December. Results also show that the farmers were growing Rosita as the only recognised and released variety in Malawi (Table 2). Farmers were also growing two cultivars known in their language as Betane and Mbeya because of their source. Betane came from neighbouring Zambia while Mbeya was brought from Tanzania through traders at their Jenda produce market. Between Betane and Mbeya, 42% of the respondents preferred Betane because they claimed it was high yielding with big tuber sizes and tolerant to diseases unlike Mbeya which was perceived to be very susceptible to diseases and pests. On frequency of seed sources, 80% of respondents were recycling their own seed.

Soil fertility management practices, yield and constraints

On soil fertility management, the majority of respondents (68%) applied manure to their potato crop especially during the winter. The majority of respondents (44%)

Table 2. General information on potato production by respondents (n = 50).

Variable	Frequency	Percent (%)
Total land holding size		
0.04 ha to 0.61 ha	8	16
0.65 ha to 1.01 ha	30	60
> 1.01 ha	12	24
Varieties grown		
Rosita alone	18	36
Rosita and Betane[1]	21	42
Rosita , Betane[1] and Mbeya[2]	7	14
Betane[1] + Mbeya[2]	2	4
Betane[1]	2	4
Favourite variety		
Rosita	26	52
Mbeya[2]	3	6
Betane[1]	21	42
Frequency of seed sources		
Own	40	80
Neighbour	8	16
Market	2	4
Number of harvests per year		
Once	1	2
Twice	37	74
3 times	11	22
4 times	1	2

Betane[1] is a cultivar sourced from Zambia; Mbeya[2] is a cultivar sourced from Tanzania.

use fresh manure from khola without composting it (Table 3). On average, farmers applied an estimated rate of 6 tonnes of manure per ha.

The results also showed that 98% of respondents were also applying chemical fertilisers. On types of inorganic fertilisers, 70% of respondents applied 23:21:0 + 4 S alone as basal dressing and applied a mixture of 23:21:0 + 4 S and CAN or Urea as top dressing (Table 3). Only 4% of respondents used Compound D (8-18-15 + 6 S) fertiliser that contained potassium. On average, potato farmers in the study area were applying three 50 kg bags of 23:21:0 + 4 S and two 50 kg bags of CAN per ha.

The average total yield for the respondents was 6 tons/ha. However, the farmers complained of small size of potato tubers they usually harvest from their fields despite the application of both manure and inorganic fertilisers. When asked how they perceive market of potato in the area, 52% of the respondents were of the opinion that market for potato was not good especially for summer crop because of poor prices.

On production constraints, both farmers and agriculture extension staff in the area indicated that the major challenges were pests (such as red spider mite, aphids and cut worms) and diseases (bacterial wilt (*Ralstonia solanacearum*) and viruses), low soil fertility, limited technical knowledge for crop management, limited access to improved varieties and clean seed, poor marketing and lack of capital for inputs. When these constraints were ranked by respondents, the problem of pests (red spider mite and cut worms) and disease (bacterial wilt) emerged to be the major problem seconded by limited access to improved varieties and clean seed. However, all respondents and extension staff admitted that smallholder farmers harvest very low yields without application of any form of fertiliser to a potato crop although low soil fertility problem was ranked third.

DISCUSSION

Table 1 show that the average household size of 6.5 persons for the study area was above the national average household size of 4.6, and literacy level of 72% was above the national average of 64% for persons aged 6 years and above (National Statistics Office, 2009). The high literacy level for farmers is considered as one of

Table 3. Prevailing soil fertility management practices among respondents (n=50).

Variable	Frequency	Percent (%)
Use of manure		
Do not apply any type of manure	16	32
Apply fresh manure from khola	22	44
Apply pit manure (compost)	12	24
Type of fertilisers applied		
Basal dressing		
23:21:0 + 4S alone	35	70
23:21:0 + 4S and CAN	6	14
23:21:0 + 4S and Urea	7	10
D Compound alone	1	2
D Compound + Urea or CAN	1	2
Top dressing		
CAN alone	5	10
Urea alone	4	8
23:21:0 + 4 S and Urea or CAN	31	62
D compound + Urea or CAN	2	4
Do not top dress	8	16

variables that positively affect adoption of agricultural technologies (Doss, 2003). Due to this high literacy level, improved potato production methods can be extended to the farmers through reading materials such as pamphlets, leaflets and other aids (Demo et al., 2008). Also, the study recorded a higher % of men (80 %) engaged in potato production. This reflects that potato production is taken as a business enterprise, as men tend engage in income generating activities to fend for the family. This result is consistent with the findings of Takane (2008) who reported that compared to female-headed households, male headed households had higher own-farm income, land holding size, years of education, maize productivity, fertilizer use growing more tobacco, a leadig cash crop in Malawi.

Table 2 indicate that smallholder farmers were growing Rosita as the only recognised and released variety in Malawi. The smallholder farmers in the study area had very limited access to improved varieties such as Violet, Lady Rosetta, among others (MoAFS, 2005). However, both smallholder farmers and government extension staff claimed that Rosita variety was tolerant to most pests and diseases that affect the crop in the area. Their perception about Rosita variety being tolerant to some diseases agrees with what Tusiime et al. (1996) observed in Uganda during their screening of several potato genotypes for resistance to bacterial wilt (*Ralstonia solanacearum*) disease and Rosita was among the five genotypes that maintained high level of resistance to the disease for three seasons. Similarly, Demo et al. (2008) reported that potato farmers in Dedza and Ntcheu perceived that Rosita variety was resistant to late blight disease caused by *Phytophthora Infestans*. However, farmers in the study area claimed that the performance of Rosita variety has declined over years and that it was becoming more susceptive to pests and diseases. This could be attributed to limited access to clean seed as farmers recycle their own seed with limited technical knowledge of positive and negative seed selection technology. The recycling of own seed without proper selection and isolation encourages build up of diseases.

Table 3 indicate the majority of farmers were applying both manure and chemical fertilisers to the crop. This was an encouraging practice because increase of the nutrients in the soil can increase plant uptake and encourage potato haulm growth which increases both the photosynthetic and assimilation rates that lead to increase in total yield and yield components (Latif et al, 2011; Hossain et al., 2003, Gathunga et al., 2000). Manure application is widely recommended in potato production (MoAFS, 2005; Rolo, 2001). Information on the rates applied was not obtained; however, based on the potato yields in the area, the amounts are likely to be inadequate. However, use of suitable and recommended chemical fertilisers such as compound D (8-18-15 + 6 S) that contain potassium is very limited and only 2% of respondents were using this type of fertiliser (Table 3). The results found in this study are similar to those reported by Demo et al. (2008) who found out that, out of 81 potato farmers interviewed in Dedza and Ntcheu, over 90% of farmers were applying 23:21:0 + 4 S and CAN. Lack of K application in potatoes could also be part of the problems responsible for the current low yields and poor quality of potatoes in the study area. This is because potassium is the nutrient taken up by the tubers in the greatest amount; usually one and half times as much as

N, four or five times as much as P and appreciable amounts of calcium, magnesium and sulphur (Perrenoud, 1983; Rolo, 2001). Satyanarayana and Arora (1985) also reported that insufficient K results in reduced potato yield and smaller-sized tubers while Latif et al. (2011) reported that application of right amount of K per ha improves potato yields and tuber size. Potassium K is important in photosynthesis, increasing enzyme activity; improving synthesis of proteins, carbohydrates and fats, translocation of assimilates from leaves to tubers, ability to resist pests and diseases (Latif et al., 2011).

CONCLUSION AND RECOMMENDATIONS

The findings have shown that potato farmers in the study area have limited access to improved varieties and clean seed. The majority of farmers were applying both manure and chemical fertilisers to the crop but continue getting poor yields and quality. Thus is also need for a research programme to focus and demonstrate on soil fertility management. Most of the seed planted was recycled hence a need for a introducing a seed system that promotes access to clean seed. There is also need for general promotion of good agricultural practices for potato such as positive/negative seed selection, application of recommended chemical fertilisers, integrated pest and disease management.

Conflict of Interest

The authors have not declared any conflict of interest.

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