



Feasibility of Sack Potato Production as a New Technique used in Some Urban Parts of Zimbabwe

D.R. Masvodza^{1*} and T. W. Mapuwei²

¹Bindura University of Science Education, Biosciences Dept, P. Bag 1020, Bindura, Zimbabwe.

²Bindura University of Science Education, Mathematics and Physics Dept, P. Bag 1020, Bindura, Zimbabwe.

Authors' contributions

This work was carried out in collaboration between both authors. Authors DRM and TWM designed the study and collected data. Both authors managed the literature searches, analyses of the data and wrote the first draft of the manuscript with the discussions and conclusions. Both authors read and approved the final manuscript.

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ABSTRACT

Aims: To evaluate the feasibility of sack potato production in some parts of Zimbabwe.

Study Design: The study utilised two instruments for data collection, namely questionnaires and structured interviews.

Methodology: The first questionnaire for the producers of sack potato was distributed to fifty respondents. It enquired about personal information, inputs and adherence to best practices, technicalities, viability and sustainability of the technique. Another questionnaire reaching twenty respondents targeting consumers, was also effected focusing on product quality, acceptability and consumer perspective of sack potatoes. Data was analysed using the Statistical Package for Social Sciences (SPSS. 16).

Place and Duration of the Study: Data was collected in parts of Harare and surrounding areas for a duration of six months.

Results: Most respondents were in the age range, 25-55 years, which is the most economically

*Corresponding author: Email: rmasvodza2011@gmail.com, rmasvodza@buse.ac.zw;

active group in the farming industry in Zimbabwe. Low yields were cited by 25% of respondents as a major limitation encountered with sack potatoes. These low yields were reportedly a result of lack of technical knowledge by 16.7% of the sample as most of them were new to the field. Another 16.7% reported labour problems especially in filling the sacks while some observed land degradation, 8.3%, when soil was collected in the forests for sale to potato producers and yet some experienced water shortages, 8.3%. Other limitations identified were high soil media costs as well as lack of access to the right type of soil by 8.3% of the sample, while 8.3% reported that the bucket system of watering was strenuous. Another 8.3% especially those at early stages of planting reported that there were no problems at all with the technique.

Conclusions: Sack potato production in Zimbabwe may still require more research before full implementation. The feasibility of large scale commercial production and the optimum size of the sack or container also needs investigation so as to avoid unnecessary wastage of resources. There might be cases of misrepresentation of potential yield performance of sack potatoes in Zimbabwe.

Keywords: Solanum tuberosum; food security; solanacea family; best practices.

1. INTRODUCTION

Potato, (*Solanum tuberosum*L., Solanaceae) is a starchy, tuberous, perennial plant, being the world's fourth most important food crop, next to wheat and maize. However, the potato plant is considerably more efficient in its use of water and soil nutrients than the cereals Kipple and Ornelas [1]. Scientists in the food industry believe potatoes could become far more important in the future, as a healthy staple that helps feed the growing world population as the area under production is increasing day by day Haydar et al. [2]. The UN general assembly recognises this fact and seeks to focus world attention on the role of potato in defeating hunger and poverty Hossain, [3].

In Zimbabwe, potato is paving its way to staple production in the face of recurrent droughts. According to Dinar et al. [4], strategies to cope with climate change must take into account selection of crop species that suit prevailing climatic conditions. In other words a prudent food security strategy should examine the promotion of other carbohydrate-rich plants that compliment staple cereals. Potato has a great potential in crop diversification for both commercial and food security purposes Manzira [5].

Zimbabweans are adopting various technologies and means to place potato on the table. One of these is production in sacks. The technique involves use of sacks of roughly 120 × 60cm dimension instead of growing them in the field. Soil media is periodically topped up until a stage the plant can set tubers. Agronomic practices generally recommended for field production apply although subtle differences in requirements are continually being observed and studied. This

study explores various aspects of how the technique is being implemented in parts of Zimbabwe as a baseline study. The reasons for failure of the technique are also examined as well as the consumer perception on the product. This paper reports on the main findings, statistics, logistical problems, misconceptions as well as presents the opinion of specialists in potato production gathered through the interviews as well as opinion from consumers.

2. MATERIALS AND METHODS

The study utilised two instruments for data collection, namely questionnaires and structured interviews. The first questionnaire targeting mainly the producers of sack potato was distributed to fifty respondents. Sample size was estimated to exceed the minimum recommended statistical sample size of thirty, since there are not yet official statistics with respect to the technique in the country. Agronomists, seed agents, extensionists as well as officers from the ministry of women and gender affairs assisted in identification of respondents. The questionnaire for producers enquired about four aspects namely, personal information, inputs and adherence to best practices, technicalities, viability, returns and sustainability of the technique.

Structured interviews targeting specialists in the potato industry reaching up to twelve respondents as listed in Table 1 consisting of specialists in the field of potato production e.g. agronomists, seed agents, extensionistsetc were also carried out. The structured interviews basically aimed at extracting the specialist perspective on sack potato production.

A smaller questionnaire for consumers reaching twenty respondents targeting consumers was also effected. The consumer questionnaire focused on product quality, acceptability and consumer perspective of sack potatoes. Data was collected in parts of Harare and surrounding areas.

3. RESULTS AND DISCUSSION

3.1 Producer Questionnaires

Out of fifty questionnaires two were spoilt and were not fully completed.

3.1.1 Personal information

Out of forty-eight respondents 75% were women while 17% were men and 8% were both men and women, that is, enterprises that were run by especially husband and wives teams and or cooperatives. The age group distribution of the sample is shown in Fig. 1.

Most respondents were in the age group range, 25-55years, which is the most economically active in the farming industry in Zimbabwe. The respondents reported various sources of information about production of potato in the sack namely from neighbours, relatives and friends (66.7%) women groups and awareness campaigns (8.3%), media (16.7%) and lastly some 8.3% heard from 'consultants' who came to tell them of the technique and also sell them seed, sacks and chemicals. So, 75% were trained and the rest embarked on production without receiving any training but relying on information from friends, relatives and the media. However, only 50% reported that they felt adequately empowered for the project and the other 50% felt they were not

3.1.2 Inputs and adherence to best practices

Commitment in the use of inputs namely use of certified seed, chemical sprays and fertilisers in the sample might be a sign of determination to

achieve positive results. In total production costs ranged 100us to approximately 9000usd spent by potato producers in the sample.

3.1.2.1 Seed

On the type of seed used, 66.7% used certified seed, while 16.7% used uncertified seed and 16.7% did not know the type of seed they used. The unknown seed type was either provided by a trainer and the type was not specified or was obtained from door-to-door vendors or was sourced from an open market. In terms of quantity of seed 16.7% of respondents used half a 15kg pocket or less of seed, while 58.4% used one to two 15 kg pockets. Most of those who used such small quantities were testing to see if the technique works and were hoping to use the potato for household consumption and sell the excess tubers. Two much bigger enterprises, one church and humanitarian-based planted 40pockets and the other, a family business with members who run restaurants dotted in and around Harare and were hoping to cut costs of buying potato by carrying out sack production. They planted 12 pockets.

3.1.2.2 Chemicals

Nearly ninety-two percent used chemicals and the rest produced organically. Almost the whole range of most fertilisers common and special, chemical sprays namely nematicides, fungicides, pesticides and adjuvants recommended for potato were reported as used by the respondents.

3.1.3 Technicalities and extension

Most of the respondents were invited through out-reach programs through the government ministry of women and gender affairs targeting women, youths and their empowerment. Fifty percent received some sort of training from various organisations working through the ministry for women and gender affairs,

Table 1. Respondents of structured interviews

	Name of line	Number
1	Agronomists	2
2	Chemical sales agents	3
3	Extension officers	3
4	Officers from ministry of women and gender affairs	2
5	Crop Breeder	1
6	Potato Seed Specialist	1

non-governmental organisations and individual 'consultants' in all cases for a fee ranging from 10-35usd. Ten percent were provided with production manuals, seed and some chemicals, although some were not aware what kind of seed it was.

Various limitations were encountered and it seems 25% experienced much lower yields than expected. These low yields were reportedly a result of lack of technical knowhow and extension services by 16.7% of the sample.

Some reported labour problems especially in filling the sacks, 16.7%, while some observed land degradation when soil was collected in the forests for sale to potato producers, 8.3%, and yet some experienced water availability problems, 8.3%. Other limitations identified were high cost of buying the right soil, 8.3% and the strain associated with the bucket system of watering, 8.3%. There were some, 8.3% who reported no problems at all associated with the technique commonly those who were at early stages of production (Fig. 2).

The age groups and frequencies (%) in the sample

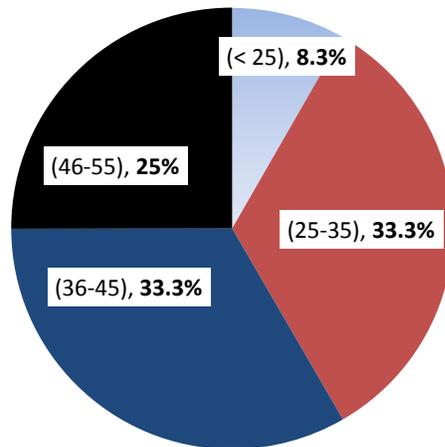
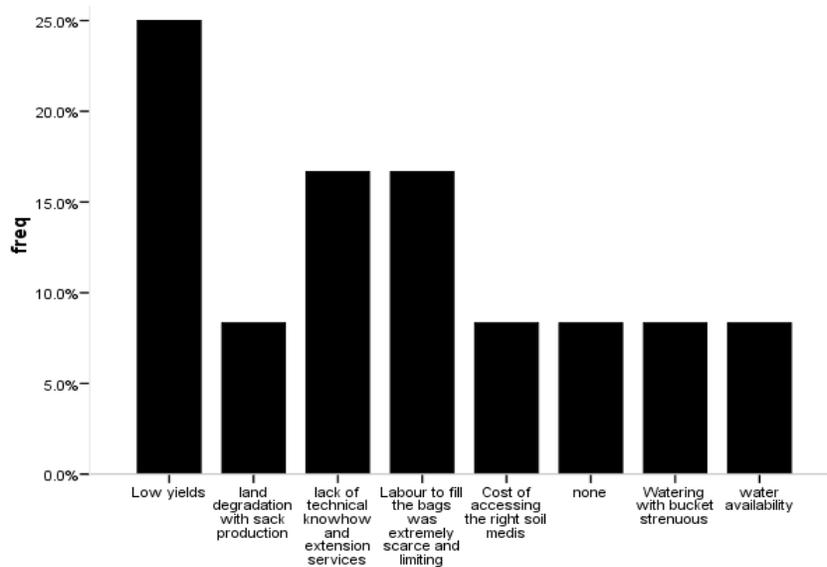


Fig. 1. Age group proportions in the sample



What are the major limitations you faced with sack potato production

Fig. 2. Graph showing reasons for limitations faced with sack potato

One of the two big enterprises in the study, which was humanitarian and church-based making an effort to feed poor members of the church raised over 10 000 sacks in a single season staggered at three time points in the season. This particular enterprise had been producing field potato and was attracted to the yields that were reported with sack potato production, however with disappointment. The other big enterprise involved two women a mother and daughters with restaurants raising over a thousand sacks aiming to cut the cost of buying potato by producing sack potato. Both enterprises cited lack of technical knowhow and extension as reasons for their failure.

3.1.4 Profitability, returns and sustainability

Ninety-two percent of the respondents were first timers while just over eight percent had produced in the field. This outcome was a surprise because the technique has been in circulation for around five years. This might be a sign that those who try it were not repeating it the next season. In the study, 83.3% mentioned that they were not going to repeat production in the following seasons due to various difficulties encountered mainly low yields and returns. Around 75% found the technique not profitable while 25% did not know yet as they had not yet harvested, although some were hopeful. Those who wanted to repeat they either thought they could adopt and adhere to best practices and try again or seek extension services.

3.1.5 Recommended best practices

In this study, a literature search was carried out for recommended best practices for potato production in containers. In general and from observations from literature, regarding the size of container or sack, it seems the ones used locally are much larger than the ones encountered in literature Unwins, [6]; Royal Horticultural Society, [7]; Kenosha potato, [8]). In the same vein nowhere in literature has large scale commercial sack potato production been reported. Sack potato is only reported for home-garden scale production for household use. In actual fact, the technique is not optimised for large-scale production. These incorrect recommendations are resulting in huge losses for aspiring producers some of whom have been encountered in this study. Some ideal practices extracted from literature are listed below.

3.1.5.1 Variety selection

Almost any potato variety will set tubers, but not all varieties will “bulk” or mature the tuber to proper size (Kenosha Potato, 2014) [7]. Only purchase of certified seed is recommended for all potato production enterprises. It is recommended that planting whole tubers be done rather than cut them to pieces as a cut piece is much more likely to dehydrate and develop disease Kenosha Potato, [8]; Potatoes Production Guidelines South Africa, [9].

3.1.5.2 Soil media and moisture balance

It is generally difficult to keep the soil well hydrated, but not water logged in sack production. Watering needs to be adjusted to plant growth stages. Compost and/or a mix of light filling materials is recommended Kenosha Potato, [8]; FAO, [10].

3.1.5.3 Soil temperatures

Very much like tomato, potato vines prefer warm soil temperatures. The soil in the bags is exposed to greater temperature swings between sunny days and freezing nights which will significantly lengthen the growth cycle. Typical garden soil will “bake” into a solid rock inside the bag and prevent tuber bulking (FAO, 2014) [10].

3.1.5.4 Harvest timing

Best results for tuber storage are obtained by waiting until the vines have dried out completely and the skins have hardened to prevent damage during harvest and storage operations (Potatoes Production Guidelines South Africa, [9].

3.2 Interviews

Various facts and problems were raised from interviews of specialists, the major one being that farmers were obtaining lower yields than expected and various reasons for this were examined.

3.2.1 Lower than expected yields

It was reported that the much advertised yields ranging 10-15kg per single sack, that is up to a full pocket in yield per sack were not being achieved much to the concern of producers. Some were not getting any reward from their farming efforts. The reasons were grouped and found to do with mainly lack of extension and

technical knowledge, inputs and seed issues, soil and media issues, dishonest brokers etc. The problems also resulted in poor product quality and environmental problems.

3.2.1.1 *Inputs and seed issues*

It was observed from interviews that, although it is recommended in general that certified seed should be used for potato production, it seems seed used by some for sack production was from random sources not specific, as also shown even by the statistics. This may be contributing to the low yields they were experiencing. Some seed was supplied by the 'trainers' and was not of a known source to the farmer, and yet some farmers were obtaining the right seed and fertilisers but incorrect chemical combinations. All these problems arose because of poor extension services and technical knowledge, although they received assurance for sure success from the media and advertisements.

3.2.1.2 *Soil media issues*

It was reported from interviews that there was no recommended texture and type of suitable soil for the technique of sack potato production and there was lack of reliable source of the right soil media. When the soil media type is not specified and a farmer uses any soil type they ended up getting disappointing results from their farming efforts. Sometimes, it was reported that, for instance some soils were hardening if they were too clayey resulting in lack of percolation to downward soil layers. This affected the roots and yield set. In other instances when the soil media was too loose, all the nutrients were leached to the bottom of the sack. In such cases, it seemed the crop was not responding to fertiliser application. As a solution there was need for guidance to the right soil media type and correct irrigation practices for sack production. The nematode problem was also often reported to be overlooked.

Soil media type and irrigation scheduling for production in containers are still under research from literature reports Kenosha Potato, [8]. It was observed that those who had a history and experience of growing potato for example in the field almost got the water balance right as they were aware of varying requirements at different growth stages. The new comers were observed to almost always apply too much water just because they were advised to apply an average of 5l per day. This resulted in watery tubers of an

unpleasant quality, to an extent that some consumers thought sack potatoes typically are watery.

It is a possibility that sack potatoes may require small water quantities applied at a time typical of drip irrigation. Such research should have been carried out before dissemination or at least it should have been indicated that sack production is still under research.

3.2.1.3 *Lack of extension and technical knowledge*

Lack of knowledge and technical support was reported as the main cause of poor performance by potato specialists. Solid and basic knowledge of potato production would have been of great value. Those who were obtaining above average yields were observed to receive continued support throughout the production phases e.g. some continued to consult reputable chemical sales agents. Even though they were not obtaining the maximum pocket and a half but at least they could obtain yields that were comparable to field-based production. From the producer questionnaire responses, some farmers were embarking on potato production without any training received. In future it is important to strengthen extension networks for better results.

3.2.1.4 *A long growth cycle for sack potato resulting in a poor product*

The agronomists and especially seed sales agents noted that a lot of farmers who ordered varieties with a three-month growth cycle, complained that they ended up waiting for up to six months to realise a normal harvest and yield. This might be due low temperatures experienced in sacks as compared to field-produced potato which experienced ground heat which biologically helps the maturation process. They also reported that inexperienced farmers who tried to harvest at the recommended three months, faced storage difficulties as the tubers could not store for long, thus downgrading market value resulting in more losses. Consumers received such product with apprehension.

3.2.1.5 *Dishonest brokers and unscrupulous players*

Some trainers provided all the required inputs, bags, fertilisers, chemicals for a lump sum of money, which would have been convenient if

they followed up to offer support on how to apply their packages. For example a lot of them acquired the necessary chemicals but failed to carry out correct chemical calibrations for smaller plots with disastrous results. It seems that the technique has become brisk business for some brokers as chemical prices are deliberately hiked or some unknown or untested chemicals are being sold to unsuspecting farmers. Some trainers might have inflated the expected yields just to attract customers thus was tening disappointment by producers.

3.2.1.6 Environmental issues

Some specialists reported that due to lack of free space, some sites used by farmers received a lot of shading from trees resulting in tall and highly vegetative plants which delay or do not set yield or reduce quality. Environmental degradation caused by sourcing soil randomly in the environment was also of concern.

3.3 Consumer Questionnaires

3.3.1 Quality, acceptability and consumer perspective of the sack potato

It seems consumers believe sack potato tubers typically have too much water, are white fleshed, and are of poor quality that can be easily damaged. Some describe a mushy or spongy taste typical of diseased tubers. Some go to the extent of concluding they are GMOs and harmful to the body. Yet with thorough research and extension the technique can be optimised to achieve the best tuber quality. The whitish colour might have been due to bad harvest timing as some varieties according to (IBPGR, 1977), may develop a secondary flesh colour after they mature, which is different from the one in immature tubers. Bad harvest timing might interrupt secondary flesh colour development.

Because of low temperatures it is learnt that maturation can be delayed to twice the length of lifecycle in the field incurring more production costs. The best season of production in Zimbabwe when enough heat units are available to allow varieties to mature in their normal time still has to be researched upon. The watery taste likewise, might be because of incorrect irrigation routines or bad harvest timing. Some reported that they could not store sack potato for more than a week without them going bad and it might still be because of bad production practices.

4. CONCLUSION

Sack potato production in Zimbabwe may still require more research before full implementation otherwise it may cause disillusionment among would-be farmers, in terms of the right soil media, irrigation cycles and water requirements, the potential yield levels and whether they exceed that of field-produced potatoes. The feasibility of large scale commercial production and the optimum size of sack or container also need investigation so as to avoid unnecessary wastage of resources.

There may be cases of misrepresentation of yield performances of sack potato production in Zimbabwe. Best practices for general potato production needs to be disseminated to would-be farmers to empower them to make their own judgements for critical activities like harvest timing, watering regimes, chemical calibration for application rates on a small-scale basis. Lastly the technique may be beneficial for household food security if more research work is carried out.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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