



Research article

Potato rot disease incidence among supermarket owners within Raymond Mhlaba local municipality of South Africa

John Meomikem Ehiobu¹, Emrobowansan Monday Idamokoro^{2,*} and Anthony Jide Afolayan¹

¹ Medicinal Plants and Economic Development Research Centre (MPED), Department of Botany, University of Fort Hare, Alice 5700, South Africa

² Agriculture and Rural Development Research Institute, University of Fort Hare, Alice 5700, South Africa

* **Correspondence:** Email: mondaidamokoro@gmail.com; Tel: +27833343640.

Abstract: This study assessed the incidence of potato rot disease in supermarkets, within Raymond Mhlaba local municipality. Sixty two structured questionnaire, were randomly administered to supermarket owners in towns that were within the study municipality. The results obtained, revealed that 40.3% of the sampled supermarkets lose between R1501-R2000 (South African rand) annually, while 24.3% of the respondents lost R500 yearly. The study further revealed that, 98.4% of the supermarket owner indicated that potato rot disease mostly occurs in summer. Conversely, 51.6% of the respondents indicated that they lost 101 kg of potatoes per annum. Furthermore, 6.5% of the supermarket owners do not have knowledge of the cause of potato rot disease. A total of 100% of the respondents indicated that they do not use artificial fungicide in the preservation of potatoes. However, 91.95% of the supermarket owner indicated their willingness to adopt the use of bio fungicides for potato preservation. Environmental factors, such as temperature, relative humidity, poor handling and poor sanitary conditions were identified as factors that could lead to potato rot disease infestation during storage.

Keywords: biofungicides; environmental factors; potato; rot disease; supermarket owners

1. Introduction

Several factors have been shown to limit the actualization of food security in many countries of the world [1]. Increasing food availability is therefore not only boosting productivity in agriculture, but it also involves reducing food losses [2,3].

Potato (*Solanum tuberosum* L.) is the fourth most important food crop in the world with an annual production of about three hundred million tonnes [4]. Out of the total world annual potato production output, half is obtained from developing countries [5]. South Africa is the fourth largest producer of potato in Africa with about 2.25 million tonnes annually [6]. It has been reported that the protein and energy value of potato is more than that of cereals [7]. Potato can be eaten in form of chips, crisp, porridge and as livestock feed [8]. Reduction of post-harvest loss help in increasing income, there by reducing poverty and subsequently increase food security by making more food available [9]. With the reduction in post-harvest losses by 50%, food availability would be increased by 20% without cultivating an additional hectare of land for increasing crop yield [10]. Potato provides more food per unit area than any other major staple crop. It is a perfect food crop and one of the few food crops that can sustain life unilaterally. Thus, it has a significant impact on providing nutrition to families and increasing household income [11]. From a nutritional point of view, all parts of potato are rich in fibre [12]. The leaves and the stems contain high minerals particularly iron and carotene, vitamin B2, vitamin C and vitamin E [13,14], reported that potato tuber is richer in protein than cassava and yam tubers.

Potato tubers are vulnerable to fungi attack which is responsible for rot disease [15–18], reported that an estimate of about 20–25% of the harvested fruit and vegetables generally, with potato inclusive, are destroyed by fungal pathogens during post-harvest handling in developed countries. Many pathogens including, *Penicillium expansum*, *Mucor piriformis* and *Alternaria sp* depreciate the quality of fruits that, leads to a reduction in the market values and unfit for human consumption. Various artificial fungicides such as Thiabendazole mixture and pencycuron were formerly used for the management of rot diseases of potato [19]. The indiscriminate usage of the fungicides has resulted to the appearance of resistant species of pathogen [20], that are harmful to humans and his environment.

The use of plant extracts for the production of fungicides has been reported to be more acceptable and eco-friendly [21]. However, not many people are aware of the use of plant extracts to preserve potatoes. Although, several studies have been reported of the incidence of potato rot disease in many countries [22], no study on the incidence of potato rot disease have been reported in Raymond Mhlaba local municipality. Therefore, this study is aimed to assess the incidence of potato rot disease in some selected supermarkets in the Raymond Mhlaba local municipality of the Eastern Cape province of South Africa.

2. Materials and methods

2.1. Study site

The study was conducted in Raymond Mhlaba local municipality in Amatole district of the Eastern Cape province of South Africa. The geographical location of the area lies between longitude 32°78' E and latitude 26°85' S at an altitude of 450–500 m above sea level. It is characterised by

mean annual rainfall of 480 mm with much of the rain occurring during summer. The mean annual temperature of the area is 18.7 °C. The study is relevant in this area because of high number of household potato local farmers and numerous supermarkets business men and women selling potato for financial sustenance. Figure 1, below shows the map of the study area with about 6357 square km.

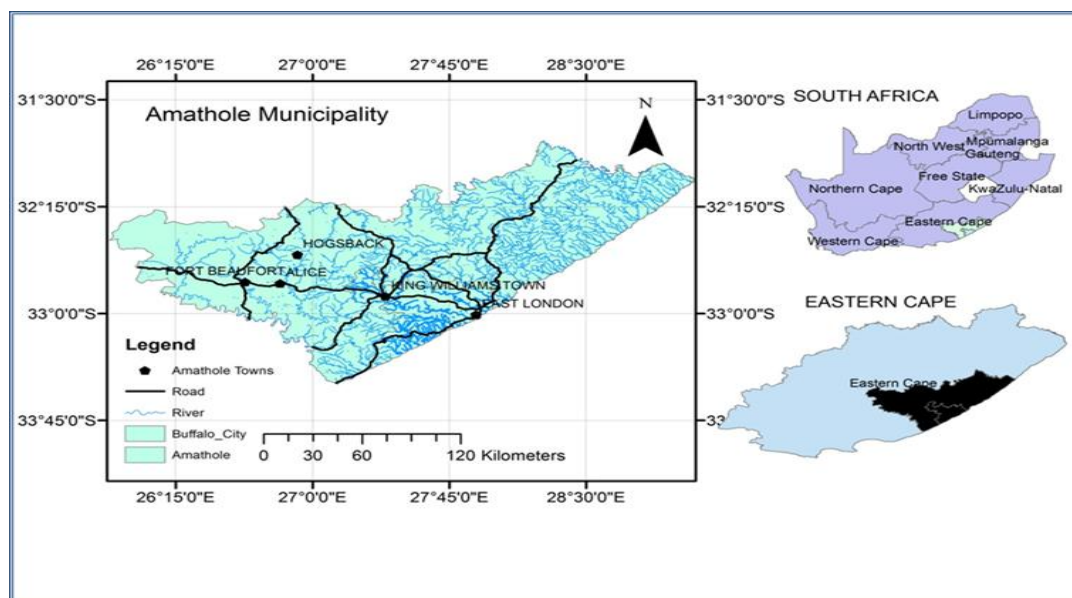


Figure 1. Map of Raymond Mhlaba local Municipality in Amathole district of Eastern Cape Province (Source: Municipalities of South Africa.).

2.2. Sampling procedure

In this study, 62 structured questionnaires were administered randomly to some selected supermarkets within the towns of Raymond Mhlaba local municipality of South Africa. The questions asked were centred on the sources of potato stock purchase, experiences in potato business, the establishment of the occurrence of the potato rot disease in the supermarkets, factors that influence the spread of the disease, the economic impact of potato rot. Conversely, question on supermarket managers' perceptions on the use of artificial fungicides in controlling potato rot disease was asked.

2.3. Data analysis

Data generated from the study were captured in Microsoft Excel spreadsheet and data analysis was done using IBM SPSS Statistic version 20.

3. Results

From the study, 40.3% of the supermarket owners had 6–10 years of experience in the business while 12.9% of the respondents had 11–15 years of experience in the business. About 33.9% of the respondents have 5 years of experience in potato business. In addition, 98.4% of the respondents,

indicated summer, as the season with most disease occurrence. The supermarket owners (88.7%) further indicated that their main source of purchase is from middlemen (Table 1).

Table 1. Response of supermarkets managers on years of experience, source of purchase, rot disease incidence, season of occurrences and the treatment of potato against rot diseases.

Characteristics	Response	Frequency	Percentages (%)
Years of selling potato	1–5yrs	21	33.9
	6–10yrs	25	40.3
	11–15yrs	8	12.9
	>15yrs	8	12.9
Potato rot observation in supermarkets	Yes	62	100
	No	0	0
Seasons of occurrence	Summer	61	98.4
	Winter	1	1.6
Source of purchase	Middlemen	55	88.7
	Direct from farm	7	11.3
Artificial fungicides treatment	Yes	0	0
	No	62	100

Table 2. The impact of potato rot disease in terms of weight of infection per 10 kg bag annual weight lost and annual financial lost as indicated by the respondents.

Characteristics	Response	Frequency	Percentages (%)
Weight infected per 10 kg bag of potatoes	200–400 g	3	4.8
	401–601 g	6	9.7
	601–801 g	2	3.2
	801–1001 g	51	82.3
Annual weight loss of potatoes	<10 kg	6	9.7
	10–50 kg	10	16.1
	51–100 kg	14	22.6
	>101 kg	32	51.6
Annual loss of potatoes in Rands	<R500	15	24.2
	R500–R1000	11	17.7
	R1001–R1500	11	17.7
	R1501–R2000	25	40.3

Approximately eighty two percent, (82.3%) of sampled supermarkets lose 801–1001 g, for every stock purchase, per 10 kg bag of potatoes. Ten percent (10 %) of the supermarket owners indicated that they lose 401–601 g of potatoes, while 4.8% and 3.2% of the supermarket owners lost between 200–400 g and 601–801 g respectively. Also, 51.6% of the supermarket owners indicated that they lose more than 10 kg of potato, annually. This is followed by 22.6% of the supermarket's managers/owners losing 51–100 kg of potato. Less than 10 kg and 10–50 kg of potatoes are lost by 9.7% and 16% sampled supermarkets respectively. Considering the financial loss of potatoes, 40.3% of the sampled supermarkets lose between R1501–R2000 annually, followed by 24.2% losing less

than R500. Additionally, 17.7% of the supermarket owner's loss between R500–R1000 and R1001–R1500 per annum, respectively. This is followed by 22.6% of the supermarket's managers/owners losing 51–100 kg. Less than 10 kg and 10–50 kg are lost by 9.7% and 16.1% sampled supermarkets respectively (Table 2).

From the study, about 93.5% of the surveyed supermarket owners were aware of the cause of the disease. Also, 80% of the respondents indicated long stay and poor handling as the factors that could enhance the spread of the disease. Conversely, 91.9% of the respondents were willing to adopt the use of bio fungicides for the control of potato rot disease (Table 3).

Table 3. Respondent's knowledge of potato rot disease and their willingness to adopt the use of bio fungicides to control the disease.

Characteristics	Response	Frequency	Percentage (%)
Knowledge of the cause of the disease	Yes	58	93.5
	No	4	6.5
Factors that enhance the spread of the disease	None	4	6.5
	Long stay and poor handling	50	80.6
	Poor ventilation and low humidity	8	12.9
Alternative usage of bio fungicides for the disease control	Yes	57	91.9
	No	5	8.1

4. Discussion

Fungal rot disease is a common food pathogen that affects food crops in most parts of the world [23]. Therefore, its occurrence in potato within supermarkets of Raymond Mhlaba local municipality in the Eastern Cape province of South Africa as obtained from this study shows the ubiquitous nature of the disease. The fast spread of the fungal rot disease could be linked to the wide host range of the individual disease pathogen [24]. Specific fungal pathogens such as the *Colletotrichum* species, can invade a wide range of plant species, at pre and post-harvest leading to loss in crop productivity [25]. In America, plant fungal diseases has led to annual economic loss estimate that exceeded 200 billion US dollars [26], and fungal disease commonly attacks plant during the pre and post-harvest processes [27]. The fungal rot disease incidence in supermarkets, during summer as reported by respondents, may be due to the high prevailing temperature during the summer season which may enhance the rapid growth of the pathogens, consequently causing the disease that reduces the market value of potato [28] and hence resulting to high economic loss.

The growing concern and scepticism around food safety by consumers is a factor responsible for the complete rejection of using artificial fungicide for pre-sale potato treatment in supermarkets. Thus, supermarket owners acknowledge the alternative method of using extracts from botanicals. The use of extracts from plants has been reported to be effective against organic pathogens including fungi [29] for the control of fungi rot disease. Several studies have reported the approach of exploiting phytochemicals in controlling fungal disease infection [30–32]. In the same vein [33], reported the antifungal activity of *Garcinia indica* leaf extracts, *Curcuma aromatic* rhizome extracts,

Glycyrrhiza gahlliae root extracts, *Nyctanthes arbour-tristis* leaf extracts and seeds of *Vernonia anthelmintica* on three fungi pathogens of *Botrytis cinerea*, *Rhizopus stolonifer* and *Colletotrichum coccodes*. Also Likewise, the scientific documentation of the use of *Azadirachta indica*, *Zingiber officinales*, *Curcuma longa*, *Ocimum santum*, *Terminalia chebula* and *Catharanthus roseus* extracts for the control of fungicide-resistant pathogens have been well reported [34–37]. In another development, the leaf extracts of *Melianthus comosus*, a South African grown weed, was reported to have higher antifungal activity than six commercial artificial fungicides against some known fungal plant pathogens [38]. The validation and further research development of these antifungal activities of plants extracts, can reduce the burden of high cost and food toxicity bore by low income farmers, supermarket owners and consumers.

Environmental factors such as temperature, relative humidity, workers poor handling techniques and poor sanitary condition were identified as the factors that increase the rate of the disease infection of potatoes in supermarkets. Specific measures could be put in place by the supermarket owners to regulate the effect of high temperature that is commonly experienced during summer season to help reduce spoilage caused by potato rot disease. Consequently, high relative humidity usually experienced during storage could be reduced by supermarket owners by improving the ventilation of their supermarkets. In addition, the sanitary condition and the poor workers handling techniques of potatoes can also be improved by training of workers on standard measures required for handling potato tubers. The relevance of potato as a staple food has been globally acknowledged, but the spoilage occurrence during post-harvest transit, cleaning and packaging in supermarkets has to be closely monitored and brought under control so as to minimise loss, thus, increasing productivity that will creates stable price control for the benefit of the farmers, business men and women buying and selling potato as well as the consumers.

The present result from our study reveals that about 22.6% of supermarket owners lose over 95 kg of potatoes to fungal rot disease. This is in line with [39] who reported that post-harvest loses of food crops in developing countries can range from 15–50%. In addition, [40] in their study, reported that about 75% of the total post-harvest loses occur at the farm and about 25% at the market. Post-harvest loss generally reduces farmers' income [41].

Climate change has also been reported to increase pest infestation and the incidence of several fungal diseases in potato tubers in Africa [42,43]. According to [44], global warming has also led to great loss of global arable land, fit for potato cultivation, due to saline soil pollution. On the basis of these factors, concerns of the possible feature, fungal pandemic occurrence have been raised [45]. The relevance of potato in solving global food crisis by alleviating food security can be achieved, only if, food losses incurred at postharvest generally and in the supermarkets specifically, can be minimized.

5. Conclusions

The present study revealed that potato rot disease is prevalent in supermarkets within Raymond Mhlaba local municipality of Eastern Cape province in South Africa. Likewise, supermarket owners incurs financial losses, annually due to the disease infestation at the supermarkets within the municipality. Environmental factors such as, temperature, relative humidity, poor workers handling techniques and poor sanitary condition of supermarkets influence the spread of the disease. The supermarket owners in the study area also expressed their willingness to adopt the use of bio fungicides to control potato rot disease if available to them.

Conflict of interest

The authors declare no conflict of interest.

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