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Evaluating Varietal Adaptability of Four Irish Potato (*Solanum tuberosum*), with Emphasis on Growth, Yield and Disease Resistant Status in the North West Region of Cameroon

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Abstract

Irish potato (*Solanum tuberosum* L.) is amongst very important vegetable crops worldwide. It is fourth among food crops after rice, wheat and maize. Potatoes provide a cheap source of carbohydrates, vitamins (B_1 and C) and minerals. Irish potato production provides a livelihood for many farmers in Cameroon, especially in the Western Highlands. Production is limited by the scarcity of seeds of local varieties or Cameroon-improved varieties. Farmers now rely on some European imported varieties, of which adaptability studies have not been conducted. The study was designed to evaluate the adaptability of three European varieties (Safari, Panamera and Diamant) in relation to a check (Banso). A field study was conducted in Mankon, North West Region of Cameroon, from August to November in a randomised complete block design. Variety did not influence plant emergence and plant height. Imported varieties had more foliage, and this resulted in greater vigour and leaf area index. Productivity of Banso (~ 3.3 t ha^{-1}) and Panamera (3.5 t ha^{-1}) differed significantly ($P< 0.05$) from all other varieties; Safari (~ 2.8 t ha^{-1}) and Diamant (~ 2.3 t ha^{-1}). Late blight incidence was significantly higher ($P< 0.05$) in Panamera than in the other varieties. Banso and Panamera are recommended for growers in the North West Region of Cameroon.

Keywords: Banso; Irish potato; adaptability; disease resistance; yield; Cameroon.

1. Introduction

Potato (*Solanum tuberosum* L) is the fourth most important food crop in the world after rice, wheat and maize and 5th as a food and industrial crop (Kennedy et al., 2019). Its production represents half the world's annual output of roots and tubers, with a production of 383 million tonnes in 2023 (FAOSTAT, 2024; IPC, 2024). China is the highest producer of potatoes with 95.3 million tons, while Africa produces 17 million tons (Ojha et al., 2025). Other major producers are India, Russia, Ukraine and the United States. It remains an essential crop in Europe (especially northern and eastern Europe), where per capita production is still the highest in the world, but the most rapid expansion over the past few decades has occurred in Southern, Eastern Asia and Africa (Devaux et al., 2014). The demand and consumption of potatoes is soaring largely due to the adaptability of potatoes in different climates, easier cultivation practices, high yield, and nutritional value (Devaux et al., 2014; Ojha et al., 2025, Njualem 2010).

Potatoes are rich in protein, calcium and vitamin C and have especially good amino acid balance (Izmirlioglu and Demirc, 2015). A single medium-sized potato contains about half the daily adult requirement of vitamin C. Other staples, such as rice and wheat, have none. When boiled, it has more protein than maize. Potatoes are a valuable source of nutrition in many developing countries, contributing carbohydrates, vitamins and minerals to the diet of millions. Potatoes production is now a source of livelihood for many, especially smallholder farmers in developing countries, since it is a short-cycle crop and adaptable to various farming systems such as intercrop with maize, rice and some legumes (Kennedy et al., 2019; Thiela et al., 2010).

In Cameroon, potatoes are produced in the Savannah and Western highland agro-ecological zones, where growth conditions are favourable, away from the main consumption centres in cities like Yaounde, Douala, Limbe, and Buea (Njualen, 2010). The crop suffers severe post-harvest losses during transportation to the cities due to its fleshy nature. The agro-ecological zone where potato grows well is the Western highland of Cameroon, with the suitable areas being Santa, Nso, Ndu, and Dschang (Achiri et al., 2018; Fontem et al., 2004).

Despite the importance of potatoes, their production is still constrained by many factors, among which is the lack of good planting materials, leading to continuous exchange of seed amongst farmers (Fontem et al., 2004; Achiri et al., 2018). This situation is exacerbated by little or no research to develop new varieties in the country. Consequently, this has resulted in a reduction in the performance of Cameroon's improved potato varieties. Potato farmers are now importing European varieties for their seeds, with no screening programs for adaptability. Screening for adaptability, diseases resistant are highly recommended for any introduced variety (Lyon et al., 2018). This study was therefore designed to study the selection of potato genotypes for adaptability to farmers of Mankon-Bamenda, North West Region of Cameroon. The main objective of the study was to screen potato varieties for adaptability in Bamenda, North West Region of Cameroon. In order to achieve this (i) we screened four potato varieties growth, yield and disease resistant status to Mankon climatic conditions. We

hypothesised that the different varieties would respond differently under conditions in Mankon, Bamenda, Cameroon. The varieties used included three European potato varieties (Safari, Diamant and Panamera) and one Cameroonian variety (Banso) as experimental materials. The planting material was obtained from the Institute of Agricultural Research for Development (IRAD), Bambui, North West Region of Cameroon. These varieties are high-yielding and disease-resistant. Panamera originated from a cross conducted in 2000 at HZPC Holland B.V. in Metslawier, Netherlands, between 'Voyagers' and 'Fabula'. Panamera was selected in 2001 for its yield, internal and external quality, and resistance against diseases and pests. Diamant is a versatile, early main crop variety with good heat tolerance, a high yield and suitable for home fries. Yellow skin colour and light yellow flesh colour. The shapes of the tubers are oval, medium-sized, and produce good tuber numbers of uniform size. Dry matter content is 23%, and crisping quality is average. Cooking type is rather floury. Diamante is suitable for cultivation in most soil types but is very susceptible to common scab. Regular irrigation will ensure uniformity of growth and even yield performance, which prevents growth cracking. It is an early main crop. Safari potato variety is a potato variety with late maturity, very high yield and round oval tubers. It has a yellow skin colour and light-yellow flesh colour. It has a dry matter content of 18.8% and is resistant to cyst nematode and immune to Wart disease and slightly susceptible to leaf blight, and slightly susceptible to leaf blight. Banso is a local landrace that has been cultivated since potato cultivation in Banso.

2. Materials and Methods

2.1 Description of the Study Area

Our experimental farm was located in the St Joseph Metropolitan Compound, Big Mankon, Bamenda town. It is a city in the North West Region of Cameroon situated at latitude 5^0, 5559.99N and latitude 10^009, 60.00 S, at an altitude of 1250 above sea level. The city used to have a population of about 2.000.000 inhabitants, but has reduced in the last decade due to political instability.

Economically, agriculture occupies a great part of the population, yet there are some elementary food production and processing industries. It is an area characterised by moderate rainfall and moderate temperature between 13-28 ˚C. The area has well-drained soil, which is good for potato production. The experiment was conducted from the 10^{th} of August to the 10 of November 2021 in the North West Region, more precisely in Mankon village, Bamenda, Cameroon.

2.2 Treatments and Experimental Setup

Treatments are referred to as entities to which a factor can be attributed, so as to help report the experiment**.** This research was carried out with three exotic varieties of potato from the Netherlands, and one Cameroonian improved potato variety. They were Safari (T1), Diamant (T2), Banso (T3) and Panamera (T4). The experimental design used is the Randomize complete block design (RCBD) with three blocks. Each block consisted of four experimental units to which each treatment was assigned. Each experimental unit measured 1m×6m, giving an area of $6m^2$. The block/replicate was separated by a path of 1m. The total surface area of the experiment was (6m×19m) $=114m^2$ (Fig. 1). The plot used was cleared, grass raked out of the plot, tilled, and the stumps and shrubs uprooted using a dig axe. Using a line, the plot was demarcated, and ridges pegged out along the ropes. The ridges were arranged 100cm apart and 6m long. A path of 1m separates each block of 4 ridges. Planting was done manually on the 10th of August 2021. A sprouted seed of each variety was planted by placing the seed tuber in the furrow on the crest of the ridge. The seeds were planted 30cm between plants and 100cm between rows/ridges. The seeds were planted at a depth of 5cm, covered with soil and properly firmed with hands. The inorganic fertiliser (11-11-22) was applied at a rate of 1.2 tons/ha to all treatments at planting. The fertiliser was applied at the crest of the ridges. Small furrows were created with a stick on the crests, and the fertilizer applied therein. The fertiliser was properly mixed with hands to avoid direct contact with the potato seedlings.

2.3 Agronomic Practices

These refer to all activities carried out after the crops have emerged and ensure proper development of the crop for a good yield. Weeding was done on 7 September 2021 (28 days after planting) using hand and hoe to off-root early germination of weeds, it was done to reduce competition between the potato and weeds for available nutrients. Moulding was done on 10 of September 2021 (one month after planting) a mixture of 20-10-10 and

urea at the rate of 60kg/ha was applied using the ring method before moulding with the objectives of covering the applied fertilizer (20-10-10 and urea) from evaporation or wash by rain and also to help the root to penetrate easily into the soil to absorbed more nutrients, it also enhance support to the plants. In addition, weeds that are around the plant are completely removed.

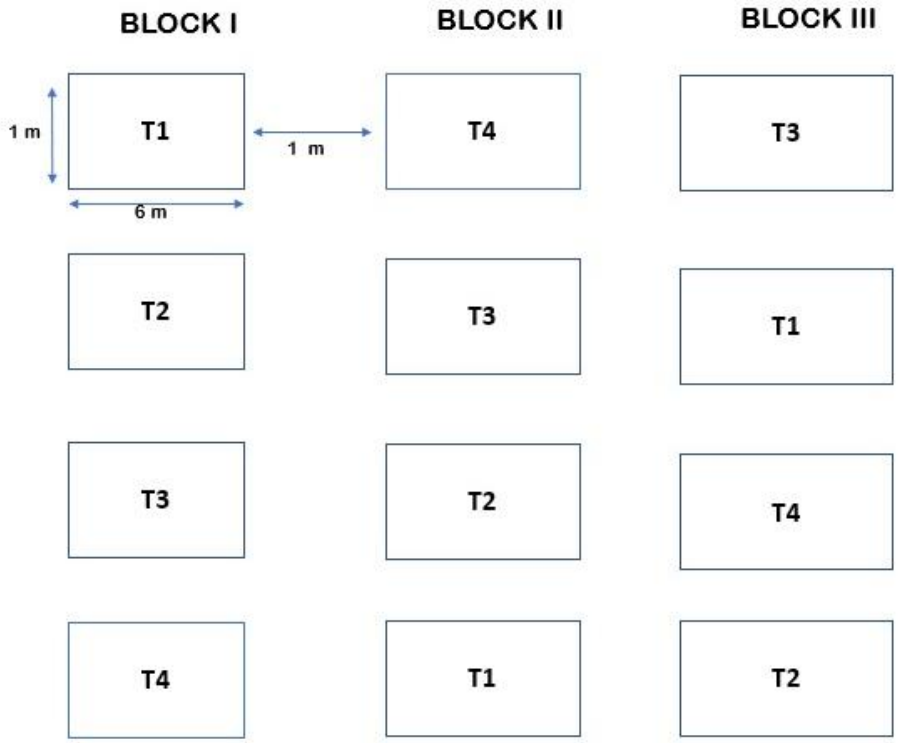

Fig. 1. Experimental layout

Diseases and pest control were done chemically using mancozebe which is a systemic and contact fungicide. It contains 120g per kilogram of cymoxanil and 600g per kilogram of mancozeb. It was applied at a dose of 50g per 15litres of water. The fungicide/bactericide used was BALEAR. It is a suspension concentrate and contains 720g/L chlorothalonil. It was applied at a dose of 60ml per 15litres of water. The herbicides and fungicides were mixed and applied together in order to save time. Virus-infected plants were removed and discarded in a pit outside the experimental plot.

2.4 Data Collection

2.4.1 Plant Emergence

Germination took place 30days after planting. Germination was very encouraging, even though not uniform. The number of plants that emerged was recorded by counts and entered per treatment.

2.4.2 Plant Height

Plant height was collected 75days after planting when the plants had started to flower. This was done using a ruler measuring from the base to the last leaf in centimetres. A sample of five plants was randomly selected and used. An average of the scores of the five plants of each treatment was calculated and recorded.

2.4.3 Leaf Area Index (LAI)

Leaf area index was taken 60days after planting. A sample of five plants was randomly selected. A ruler was used to measure the length and the width of the leaves of the five plants. An average of the total length and width scores was calculated and multiplied by a constant of 0.75 according to Jeo (2000). (L×B) 0.75.

2.4.4 Earliness

Earliness was recorded when the leaves of the potato plants turned yellowish from green, 86days after planting.

2.4.5 Plant Vigour

Plant vigour is the health status of the plants. It was recorded using a scale of 1 to 5 (Table 1). A sample of 5 plans was randomly selected and used to rate for vigour. An average of the 5 plants was calculated and entered as plant vigour for each treatment.

Table 1. Codes and description of plant vigour

Codes	Description of plant vigour
1	Very weak plants with thin stems, small leaves and pale colour
3	Intermediate or acceptable
5	Very strong plants, very thick stems and abundant foliage.

2.4.6 Late Blight Incidence (LBI)

Late blight was collected by observing and counting the number of plants showing symptoms of the disease in each treatment. The number of infected plants was counted and expressed as a percentage.

2.4.7 Number of Tubers Per Plot

Harvesting was done when the leaves of the plant had turned from green to yellow. This was done 120 days after planting. Harvesting was done by holding the stems and lifting the plants from the soil with hands, separating the tubers from the roots and digging to remove the tubers from the soil. The number of tubers per plot was collected by counting the number of tubers from every plant harvested.

2.4.8 Weight of Tubers/plot (g)

The weight of tubers per plant was measured with the use of a spring scale. Productivity (tons/ha): The productivity was calculated by dividing the total weight of tubers from the different treatments by the total surface area and extrapolating to a hectare.

2.5 Statistical Analysis

Homogeneity of variance and normality tests were conducted using Levene's test and Kolmogorov-Smirnov in SPSS (ver 23), respectively. The data were subjected to a one-way Analysis of Variance (ANOVA) test. Where means were significantly different, they were separated using Duncan's Multiple Range Test (DMRT) *posthoc test* at alpha significance (α) level of 0.05 using SPSS (ver. 23). Where the blocking effect was not statistically significant, the ANOVA was redone with the blocking effect removed in order to increase the degree of freedom of the error term, thus increasing the reliability of the analysis (Achiri et al., 2021). Graphs were plotted using Microsoft Excel for Windows (ver. 2016).

3. Results

3.1 Plant Emergence and Plant Height

The number of Irish potato plants that emerged (%) from the different Irish potato varieties is reported in Table 2. There was no significant difference ($F = 0.799$, $df = 3, 8$, $P = 0.528$) in the number of Irish potato plants that emerged. The emergence of the Irish potato was 88.33% and 83.33% for Panamera and Diamant, respectively.

The plant height of Irish potatoes from different varieties is shown in Table 2. The plant height did not differ significantly ($F = 2.104$, $df = 3, 8$, $P = 0.178$). The highest plant height was 56.87cm from Diamant, while the smallest plant height was 45.17cm from Panamera.

Table 2. Effect different varieties on plant emergence and plant height

Potato variety	Plant emergence (%)	Plant height (cm)
Safari	76.67 ± 9.28a	49.73 ± 3.56a
Diamant	83.33 ± 6.01a	56.87± 4.10a
Banso	76.67 ± 4.41a	54.60 ± 3.34a
Panamera	88.33 ± 4.41a	45.17± 3.32a

Means in the same column with the same letter are not significantly different (DMRT, P < 0.05)

3.2 Plant Vigour of Different Irish Potato Varieties

The plant vigour of Irish potato plants from different varieties is shown in Fig. 2. The highest plant vigour (5) was recorded from Diamant and Panamera, and differed significantly (F = 5.67, df = 3, 8, *P* = 0.041) from that of Safari and Banso (3).

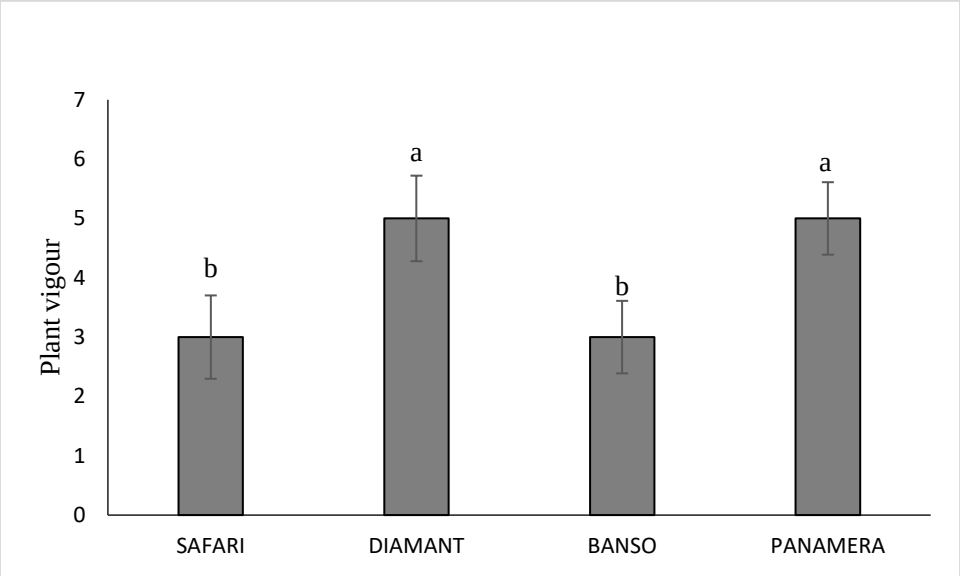

Fig. 2. Plant vigour of different potato varieties
Mean bars with the same letter are significantly different (DMRT, P< 0.05)

3.3 Leaf Area Index of different Irish Potato Varieties

The leaf area index of different Irish potato varieties is presented in Fig. 3. The LAI differed significantly (F = 8.2, df = 3, 8, *P* = 0.036). The highest LAI was recorded from Safari at 14.36, while the smallest LAI was recorded from Banso at 9.73.

3.4 Earliness to Maturity of Irish Potato Varieties

The earliness (percentage of plants that showed senescence at the 86th day) is shown in Fig. 4. The highest earliness percentage was observed from Diamant (100%). The value was 91.66% for Banso and Panamera.

3.5 Yield of different Irish Potato Varieties

3.5.1 Number of Plants Harvested

The number of Irish potato plants harvested is shown in Fig. 5. The number of Irish potato plants harvested differed significantly (F = 8.74, df = 3, 8, *P* = 0.021), with the highest (18) observed from Banso and the lowest (14) observed from Safari. The number of Irish potato plants harvested was 16 from Panamera and Diamant (Fig. 5).

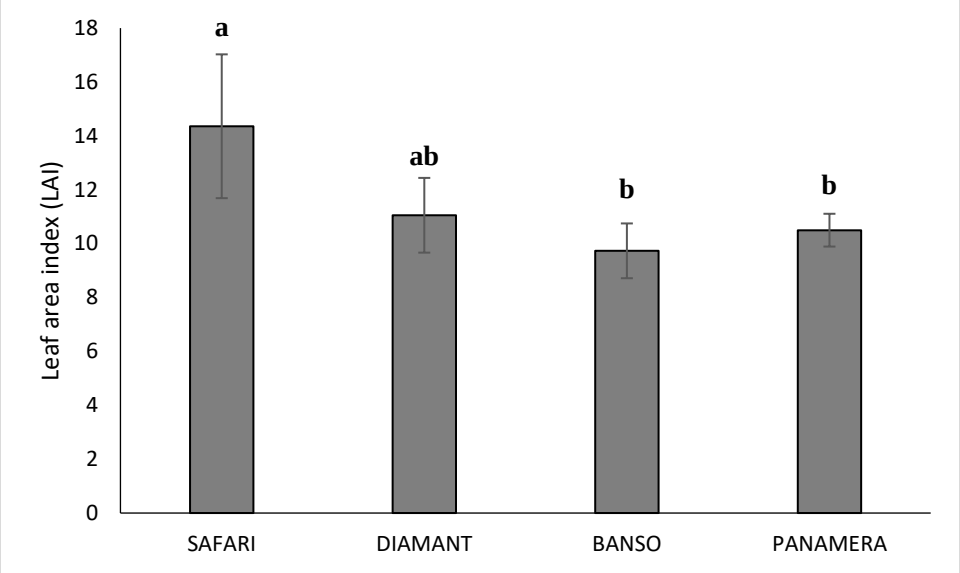

Fig. 3. Leaf area index of different Irish potato varieties
Mean bars with the same letter(s) are not significantly different (DMRT, P< 0.05)

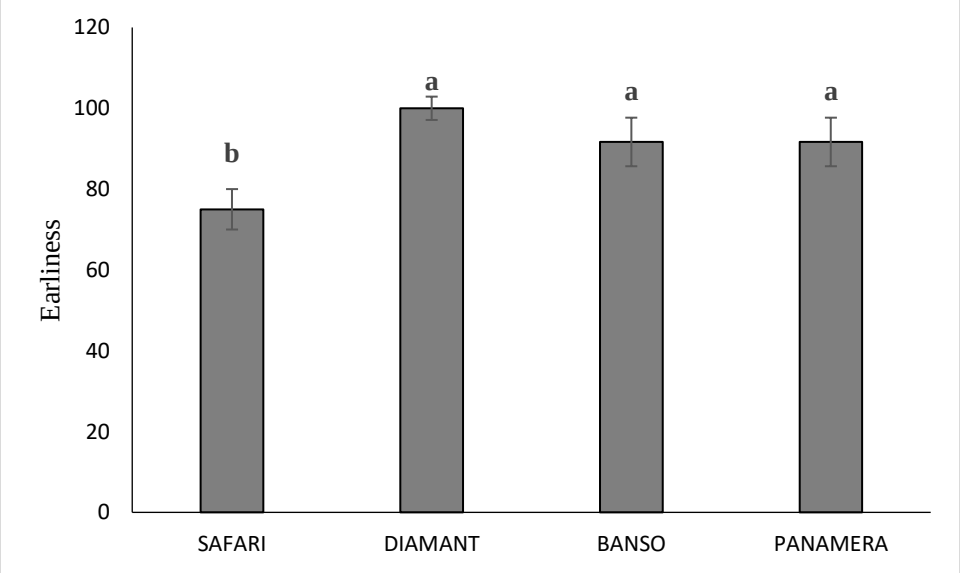

Fig. 4. Earliness (%) of Irish potato varieties
Mean bars with the same letter(s) are not significantly different (DMRT, P< 0.05)

3.5.2 Weight of Harvested Tuber Per Plot of Different Varieties of Irish Potato

The average weight of Irish potatoes harvested per plot was recorded and reported in Figure 6. There was a statistically significant difference (F = 7.95, df = 3, 8, *P* = 0.045) in the number. The highest weight of Irish potato per plot was observed from Panamera and Banso at 2.11kg and 1.91kg, respectively. Diamant recorded the smallest weight of tubers per plot at 1.35kg per plot (Fig. 6).

3.5.3 Productivity of Some Irish Potato Varieties

Productivity was estimated as the production per hectare. There was a significant difference (F = 7.95, df = 3, 8, *P* = 0.045). The highest productivity was observed from Panamera and Banso at 3.5 t ha^{-1} and 3.3 t ha^{-1}, respectively (Fig. 7). The smallest productivity was observed from Diamant at 2.3 t ha^{-1}.

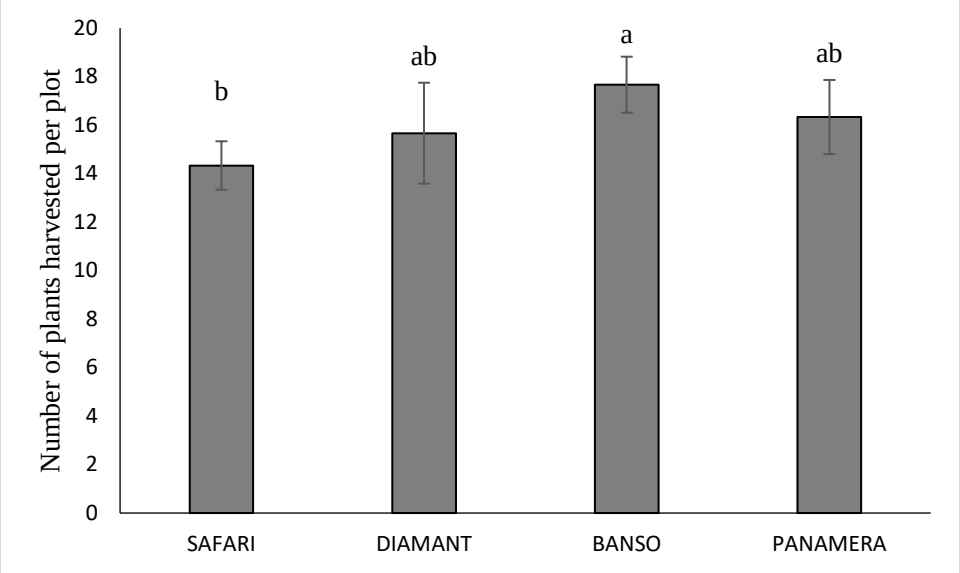

Fig. 5. Number of Irish potato plants harvested per plot of different Irish potato varieties
Mean bars with the same letter(s) are not significantly different (DMRT, P< 0.05)

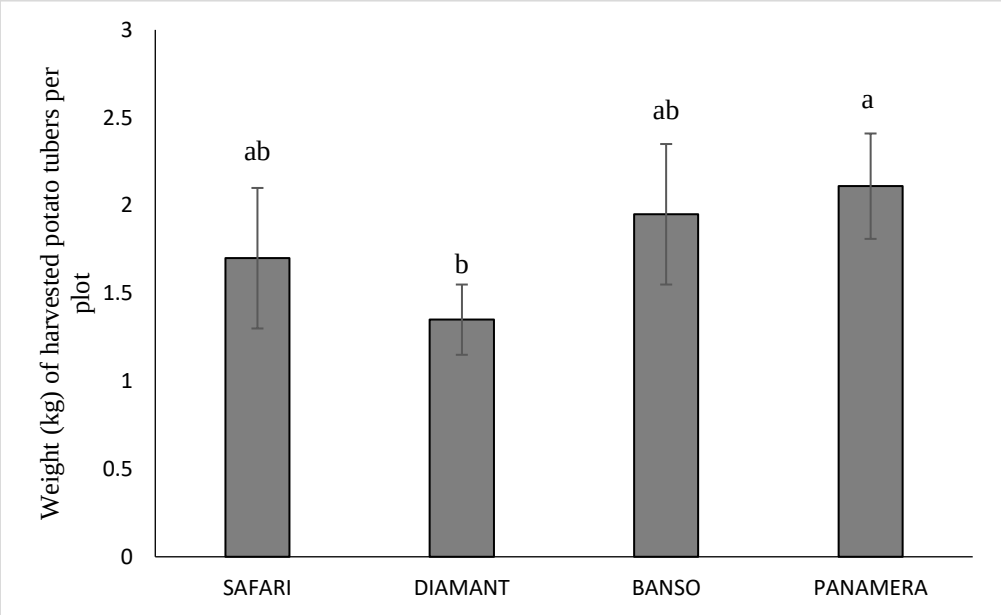

Fig. 6. Weight (kg) of harvested potato tubers of different Irish potato varieties per plot
Mean bars with the same letter(s) are not significantly different (DMRT, P< 0.05)

3.6 Disease Incidences and Number of Rotten Tubers

The percentage of late blight incidence is reported in Table 3. The highest late blight incidence was recorded from Panamera (15.10%), and it differed significantly from the others (F = 1.02, df = 3, 8, *P*< 0.044). The late blight incidence for Safari, Diamant and Banso were 13.31%, 13.33% and 13.43%, respectively (Table 3).

The number of rotten potato tubers is recorded in Table 3. There was a significant difference (F = 3.08, df = 3, 8 and *P*< 0.048) in the number of rotten Irish potatoes at harvest. The highest number of rotten Irish potatoes recorded was 19 and 18 from Diamant and Safari, respectively. Banso and Panamela had the smallest number of rotten potatoes at 12 and 15, respectively.

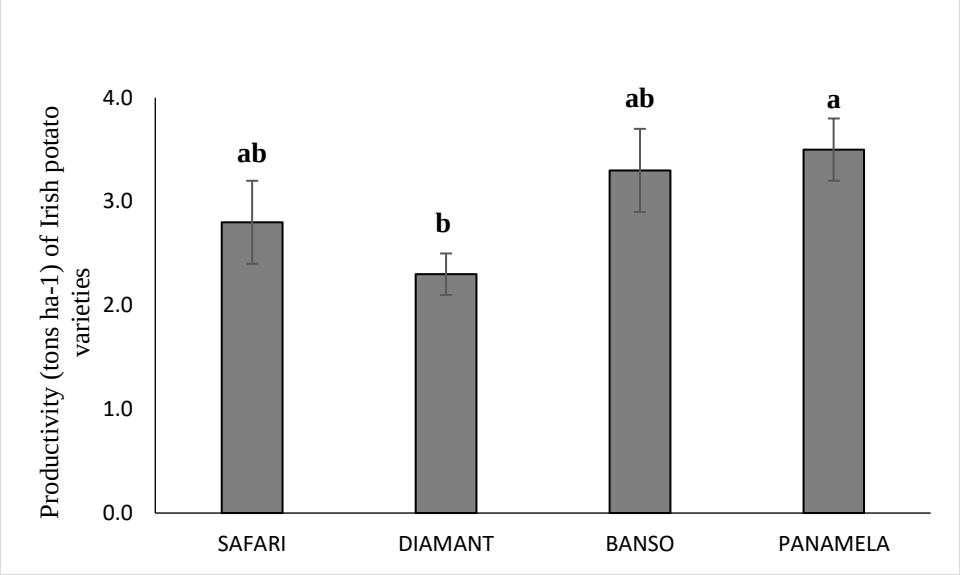

Fig. 7. Productivity (ton ha-1) of Irish potato varieties
Mean bars with the same letter(s) are not significantly different (DMRT, P< 0.05)

Table 3. Late blight incidence and number of rotten potato tubers from different Irish potato varieties

Potato variety	Late blight incidence (%)	Number of rotten tubers
Safari	13.31± 1.7b	18± 2.3b
Diamant	13.33± 1.2b	19± 3.7b
Banso	13.43± 1.1b	12± 2.7a
Panamera	15.10± 1.3a	15± 4.1ab

Means in the same column with the same letter(s) are not significantly different (DMRT, P< 0.05)

4. Discussion

Shortage of good planting material is a perennial problem for many countries, especially in the developed world. (Demo et al., 2001). There is a paucity of knowledge of the varieties being cultivated across many sub-Saharan African (SSA) countries. Significant efforts have been made in developing varieties with yield and market attributes that will ensure adoption and cultivation by farmers across large socio-economic environments. The potential for increasing potato production from adoptable varieties and improving agronomic practices is a quest for many governments and researchers in SSA (Achiri et al., 2020).

In this study, some imported varieties (Safari, Diamant, and Panamera) and a local variety (Banso) were evaluated for growth, yield, pest and disease susceptibility characters.

The analysis revealed that plant emergence and plant height did not vary across potato varieties. Plant emergence could be described as ‘good’ since the value was greater than 75.0% for all varieties.

Like plant emergence, plant height was not statistically different for the different potato varieties. Even though no significant difference was observed for plant height, the local varieties (Banso) had the highest plant height. The results revealed that the local varieties grew taller than the imported varieties.

The local variety, Banso and the imported variety had lower plant vigour compared to the imported varieties Diamant and Panamera. It was observed that the imported varieties put up a lot of foliage, which could explain the high plant vigour.

Similarly, the leaf area index for the different imported varieties was greater than that of the local variety, Banso. The LAI was highest for Safari and Diamant. This supports the observation that the imported varieties had a lot of foliage.

The variability observed in the present study is in accordance with that of Zerihun (2016), who reported substantial variability in growth parameters from different potato varieties. According to Eaton et al. (2017), the variabilities observed in the growth parameters may be caused by plant genetics and the quality of the planting material. Thus, the results in the present study are expected, as genotypes normally differ in their phenotypes, such as growth parameters. In addition, the interaction between the genotype and the environment can greatly influence the phenotype of the plants (Habtamu et al., 2016).

Generally, it can be said that the local varieties had a higher performance on growth parameters compared to the imported varieties.

The earliness also varied across varieties. The earliness of Banso, Diamant and Panamera was greater than 90.0%making them 'early maturing' (Mihovilovich et al., 2014). Safari potato variety with 75.0% can be classified as 'medium early maturing' varieties (Kolech et al., 2017; Tessema et al., 2020).

The results of the number of plants per plot harvested differed across varieties. Banso recorded the highest number of plants harvested. The imported varieties had lower numbers of plants harvested per plot. This trend was observed for the weight of tubers per plot and productivity. Banso and Panamera produced the highest weight and the highest productivity. The productivity was about 3.5 and 3.3 tonsha^{-1} for Panamera and Banso, respectively. The other imported varieties had low productivity, with Safari producing 2.8 tons/ha. Variations in yield and yield-related parameters from different potato varieties have been reported elsewhere (Seifu and Betewulign, 2017). According to Habtamu et al. (2016), the productivity of potatoes is highly influenced by genotype and environment. The imported varieties may have had low productivity because they were not cultivated in their environment of origin, that is, where they are better adapted (Masarirambi et al., 2012). Banso appears to be well-suited for the Cameroonian condition. Bansowas the best performing variety in terms of tuber number and productivity in a six-potato varietal trial conducted in the monomodal rainforest of Buea, Cameroon (Kerla, 2018).

Late blight incidence also differed across potato varieties. The highest late blight incidence was observed in Panamera. This could be due to the fact that these imported varieties have not fully adapted to this new environment. Habtamu et al. (2016) posit that the environment is one critical factor which determine the phenotypic performance of potato. The number of rotten tubers per potato variety was generally low for all varieties; nevertheless, lowest for the local variety Banso.

5. Conclusion

The result of this study reveals variations in the response of different Irish potato varieties in terms of growth, yield and disease parameters. The study provides valuable information for growers and breeders in determining the suitability of growing these varieties in the Western highlands of Cameroon. The search for adaptable varieties that are tolerant to pests and diseases, and high yielding remain a major quest for all.

Consequently, Banso and Panamera varieties are highly recommended for growers in the western highland regions of Cameroon. Banso is a local variety that is already well-adapted to the western highland conditions. Panamera demonstrated some degree of adaptability because its productivity was as high as that of Banso, even though it showed some disease susceptibility.

It is also recommended that further research be conducted on these varieties, paying attention to themes such as agronomic practices and environmental adaptability.

Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Competing Interests

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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