BINDURA UNIVERSITY OF SCIENCE EDUCATION

DEPARTMENT OF CROP SCIENCE

AN EVALUATION OF THE PERFOMANCE OF NEW IRISH POTATO (*Solanum tuberosum.L*) VARIETIES ON YIELD POTENTIAL AND VEGETATIVE GROWTH IN ZIMBABWE IN HIGHVELD (MUTARE)

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE BACHELOR OF AGRICULTURAL SCIENCE HONOURS DEGREE IN CROP SCIENCE

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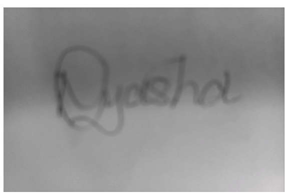
DECLARATION

I do hereby declare that this research project entitled AN EVALUATION OF THE PERFOMANCE OF NEW IRISH POTATO (*Solanum tuberosum.L*) VARIETIES ON YIELD POTENTIAL AND VEGETATIVE GROWTH IN ZIMBABWE IN HIGHVELD (MUTARE) was written by me and that it is the record of my own research work. It is neither in part nor in whole been presented for another degree elsewhere.



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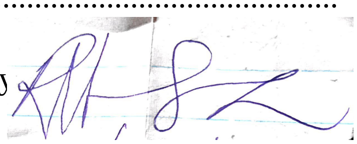

This is being submitted for the partial fulfilment of the requirements for the Bachelor of Science Honours degree in Crop Science with the approval of supervisors.

29/09/24

Signature.. Date..

Supervisor: Ms. A. Kamota

DEDICATION

I dedicate this project to my family who have been my constant source of love, support and inspiration throughout my academic journey.

ACKNOWLEDGEMENTS

Firstly, I would like to pay my gratitude to God for giving me the ability to work hard successfully. Words actually will never be enough to express all my gratefulness. Again, I would like to express my indebtedness appreciation to my academic supervisor, Ms Kamota. Her constant guidance and advice played the vital role in making the execution of this project. She always gave me her suggestions that were crucial in making this project as flawless as possible. My appreciation further goes to my family and friends (Terrence Mwavera and Rutendo.S Labana) for providing diligent support throughout my work-related learning and guidance in writing this project.

ABSTRACT

In Zimbabwe, potatoes are one of the most consistent crops in terms of market demand for both the formal and informal markets. A scientific study to evaluate the performance of new Irish potato varieties on yield potential and vegetative growth was conducted in Honde Valley at Sahumani village, Mutasa district in Manicaland province during the 2023-2024 season. The six new varieties BR11, BR12, BR13, BR15, BR16 and BR17 were grown with the addition of some locally available varieties that is, Amethyst, BP1 as well as Garnet. The experiment was laid out in a Randomized Complete Block Design with nine treatments. The trial was replicated three times and the analysis of data was done using Genstat Seventeenth Edition. Data was recorded for parameters such as tuber yield, days to 95% maturity, days to 50% flowering, number of stolons, the stem height of the potato varieties and number of leaves. The analysis of variance (ANOVA) showed that there was a significant difference ($P<0.05$) on tuber yield, height of potato varieties, days to flowering, number of leaves and days to maturity. Amethyst, BR17, Garnet, BR13, BP1, BR15 and BR16 varieties took longer days to 50% flowering respectively. BR17, BR13, BR12, BR15 and BR16 took longer days to 95% maturity. Highest tuber yielding was recorded in variety BR13, BR12 and BR16 with 60.67kgs and 56.33kgs respectively. In conclusion, the new varieties had a higher tuber yield potential with BR13, BR12 and BR16 producing the maximum tuber yielding followed by BR11, BR15, Garnet, Amethyst, BP1 and BR17. Some of the new potato varieties yielded better than the locally available potato varieties. The new varieties can therefore be released on the market to the farmers in Highveld, Mutare who are currently growing the locally available potato varieties which have been out performed. The new potato varieties can also be grown and tested for other parameters such as disease and pest resistance in other agro-ecological regions in Zimbabwe.

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CHAPTER 1: Introduction

1.0 BACKGROUND

Agriculture is a major sector of the economy with Irish potatoes being one of the most important food crops. It originated from South America and finally spread to Africa. The Irish potato is the fourth most important source of food and income in Zimbabwe which comes after maize (*Zea mays*) and wheat (*Triticum aestivum*) (Manzira, 2011). There are several varieties of potatoes available for production in Zimbabwe. Common varieties include Diamond, Jasper, BP1, Montclare, Amethyst and Garnet. Potato is a nutritious and filling food that can be stored for a longer period of time without spoiling (Adane *et al*, 2010). In addition, potatoes are also an important part of the diet in many parts of Zimbabwe by providing essential nutrients such as potassium, vitamin C and dietary fiber. Irish potatoes also has some medicinal importances which include their ability to reduce inflammation, lower blood pressure and aid in digestion.

Potatoes were well established in contemporary Zimbabwe by the early 20th century (Butterly & Shepherd, 2010). In 1911, variety trials were undertaken with recorded yields up to 11.5 tonnes/ha. Additionally, a national breeding programme, which subjected imported potatoes to heavy quarantine was instituted in 1956 and has been the only such programme that is authorized to do so. After the programme's institution the mean crop yield rose by about 9 tonnes/ ha (Masvodza, 2015). The production of potatoes in Zimbabwe is protected under the Plant Pests and Diseases (Seed Potato Protection) Regulations in Statutory instrument 679 (1982), although famers themselves bear the responsibility to safeguarding their crop from disease.

Although the government declared potatoes as a national strategic crop in 2018, some horticultural farmers are still experiencing lower yields. According to Chiwona *et al.*, (2016) limited availability of improved potato varieties adapted to local conditions is a constraint to potato production in Zimbabwe. Farmers could be relying on growing varieties that are susceptible to pest and diseases thereby leading to lower yields. Therefore, this research evaluated the performance of new potato varieties for tuber yield potential and vegetative growth in Highveld, Mutare.

1.2 PROBLEM STATEMENT

New potato varieties were released whose performance under different agro ecological zones in Zimbabwe is not yet known.

1.3 JUSTIFICATION

Yields of Irish potatoes in Zimbabwe are currently low, due to a number of factors including a lack of suitable varieties. Evaluating new Irish potato varieties, helps to identify those that are high yielding and suitable for local conditions thereby improving the profitability and productivity of potato farming

1.4 RESEARCH OBJECTIVES

1.4.1 MAIN OBJECTIVE

To evaluate the performance and yield potential of new Irish potato varieties grown in Highveld Mutare.

1.4.2 SPECIFIC OBJECTIVES

- To determine the effect of variety on vegetative growth of potatoes.
- To evaluate the effect of variety on reproductive growth of potatoes.
- To investigate the effect of variety on tuber yield of potatoes.

1.4.3 HYPOTHESIS

H_1: Variety has an effect on the vegetative growth of the potato crop.

H_1: Variety has an effect on the reproductive growth of the potato crop.

H_1: Variety has an effect on the tuber yield of the potato crop.

CHAPTER 2: Literature Review

2:1 ECONOMIC IMPORTANCES AND USES OF IRISH POTATOES IN ZIMBABWE

Zimbabwe has a well-established history of potato production. Apart from giving high returns per invested dollar to the farmer, the crop contributes significantly to the nation's food security. As such, the government declared potato as one of the strategic crops to enhance food security at household and national levels (Cromme, 2010).

In 2010, there was an imposition of a ban on table potato imports, to protect the local potato farmers from unfair competition from neighbouring countries that were flooding the local market (Neven, 2014). Since then, national potato production trends have been increasing exponentially from 52 000 tonnes in 2010 up to 475 000 tonnes produced in 2017. This increase reflects continual growth in local consumption of potatoes.

Irish potatoes provide income for smallholder farmers, who constitute a significant portion of the agricultural sector in Zimbabwe. The crop is especially important for farmers in marginal areas where other crops may not grow well. According to a study by Sakadzo *et al*, (2020), the Irish potato value chain in Zimbabwe provides employment opportunities for over 3.5 million people.

The agricultural sector contributes significantly to Zimbabwe's GDP, and Irish potatoes are part of this contribution. Although the exact figure is not readily available, it is evident that the Irish potato value chain contributes to the overall growth of the economy. In addition, Irish potatoes are not only consumed fresh but are also processed into various products such as chips, crisps, and flour (Woolfe & Poats, 1987). This processing creates an additional value chain, contributing to industrial growth and creating more employment opportunities.

Potatoes are used for several industrial purposes such as for the production of starch and alcohol. Potato starch (farina) is used in laundries and for sizing yarn in textile mills. Potatoes are also used for the production of dextrin and glucose. As a food product itself, potatoes are converted into dried products such as potato chips, sliced or shredded potatoes. Irish potatoes also contain minerals, roughages and a substance called carotenoids which promote good heart health (Temple & Burkitt, 2012).In addition, the fiber present in Irish potatoes helps in lowering cholesterol and improves the functioning of insulin in the body which helps to lower blood pressure. There are several different B group vitamins, and potatoes are a source of some of these. A medium serving of boiled potatoes (180 g) contains more than one sixth of the adult daily requirements for vitamins B1, B6 and folate. (Campos & Ortiz, 2019) These B group vitamins have many functions in the body including being essential components in the metabolism of carbohydrates to provide energy, and maintaining a healthy skin and nervous system. Vitamin B6 also aids in the production of adrenaline, a hormone that helps us respond to stress and GABA, a substance linked to relaxation (Waugh &Grant, 2018). Folate is essential for the production of red blood cells.

Potatoes are a significant source of the mineral potassium, and also contain small amounts of magnesium and iron. Potassium has many functions in the body including muscle function and contraction, the transmission of nerve impulses, and the regulation of blood pressure. Potatoes contain amounts of potassium that match those in most fruits and vegetables per unit weight, and because potatoes are typically consumed in greater quantities, they are an important and reliable food source of this nutrient (Yildiz & Ozgen, 2021). A boiled medium portion of potatoes (180 g) also provides about one tenth of an adult's daily requirement of magnesium and iron.

Table 1: Nutritional values for different potato preparations per 100g

	Boiled potatoes, in skins	Boiled potatoes, peeled	Baked potatoes, in skin	Mashed potatoes, with milk (7g) and butter (5g)	French fries, retail from burger outlet
Energy(kcal)	66	77	85	104	280
Protein (g)	1.4	1.8	2.6	1.8	3.3
Carbohydrates (g)	15.4	17.0	17.9	15.5	34.0
Fat(g)	0.3	0.1	0.1	4.3	15.5
Fibre (g)	1.5	1.2	3.1	1.1	2.1
Potassium (mg)	460	280	547	260	650
Iron(mg)	1.6	0.4	0.9	0.4	1.0
Vitamin B1(mg)	0.13	0.18	0.11	0.16	0.08

Vitamin B6(mg)	0.33	0.33	0.23	0.30	0.36
Vitamin C(mg)	9	6	14	8	4

2.2 CONSTRAINTS TO POTATO PRODUCTION

Potato production in Zimbabwe faces several constraints that impact the overall output and quality of the crop (Gildemacher, 2012). These constraints include disease and pests, market access and post- harvest losses, research and development as well as policy environment and support services.

2.2.1 Diseases and Pests

Potato production in Zimbabwe faces significant constraints due to diseases and pests, such as late blight, bacterial wilt, and nematodes [(FAO, 2019)]. These diseases can cause substantial yield losses if not properly managed through crop rotation, resistant varieties, and fungicides. The lack of access to appropriate agricultural inputs and extension services exacerbates these issues.

2.2.2 Market Access and Post-Harvest Losses

Market access remains a constraint for potato producers in Zimbabwe due to poor infrastructure and an underdeveloped value chain (Chiwona *et al*, 2016). Limited access to storage facilities results in high post-harvest losses, estimated at approximately 30% of total production (FAO, 2019). Furthermore, price fluctuations due to seasonality and market speculation hinder smallholder farmers’ profitability.

2.2.3 Research and Development

There is a need for increased investment in research and development programs that focus on breeding disease-resistant varieties with higher yields and better nutritional quality. This will help ensure food security while promoting economic growth in the sector.

2.2.4 Policy Environment and Support Services

Inadequate support services for potato producers, including credit facilities, input subsidies, and extension services, also serve as constraints (Chiwona *et al*, 2016). A more enabling policy environment that focuses on providing these necessary services can greatly enhance potato productivity in Zimbabwe. Additionally, targeted efforts to address gender disparities within the sector will help empower female farmers who contribute significantly to potato production.

2:3 IRISH POTATO VARIETIES IN ZIMBABWE

2.3.1 BP1

A medium to early variety (14-15) weeks. It is the earliest commercial variety available on the market. Its haulms are upright with dense foliage. Tubers are white skinned and white fleshed. It is moderately tolerant to late blight. High yielding potential up to 30t/ha.

2.3.2 Amethyst

Is a late maturing variety taking (18-19) weeks with white flesh and skin. It has a good resistance to both early and late blights. High yield 35-60t/ha.

2.3.3 Diamond

Diamond variety of potatoes is a yellow-fleshed, mid- to late-season potato with a round shape and russeted skin. It has a high starch content, making it well-suited for baking, frying, and mashing. The potato also has good storage qualities and is resistant to many potato diseases.

2.3.4 Jasper

The Jasper variety of potatoes is a late-maturing variety, typically taking around 17-19 weeks to mature. It is known for its vigorous growth and is characterized by having white skin and flesh. The tubers are round and oval with shallow eyes, and the variety is known for its high yield, producing about 30 tons per hectare. Additionally, Jasper potatoes have some tolerance to blight, making them a favorable choice for cultivation in Zimbabwe.

2.3.5 Montclare

This variety, takes around 15 weeks to mature, and is known for its specific characteristics in size, skin color, and inside color.

2.3.6 Garnet

The Garnet variety of potatoes is a late maturing variety which takes about 17-19 weeks. It produces up to 25t/ha.

2.4 CLIMATIC AND SOIL REQUIREMENTS FOR POTATO PRODUCTION.

Potatoes are grown in areas where temperatures do not exceed 32°C. This is because temperatures above 32°C may results in poor yields. Irish potatoes are susceptible to frost. The optimal temperatures for potato production are between 15- 20°C (Haverkort, 2012). Potato can grow on a wide range of soils. The best soils are medium textured loamy soils with good drainage and high organic matter content. The ideal soil should be fine, loose and without compacted layers that hinder root penetration. Clods and stones reduce root contact with the soil and result in the production of deformed tubers. Heavy clays and some micaceous soils can become hard when dry and produce misshapen tubers (Panda, 2012). Soils must be well drained for summer crop production. Well aerated soils ensure sufficient oxygen for root, stolen and tuber growth. The optimum pH for potato production is 5.0- 5.5, though the plant can tolerate pH 4.3.

2.4.1 Fertilizer Application

Potatoes are gross feeders of all nutrients within a relatively short period of time. All phosphate and potash must be applied at planting. Phosphate increases yield by increasing the number of medium sized tubers while potash increases the number of large tubers. Half to two third of the nitrogen should be applied at planting and the remainder at 2-3 weeks after emergence (Panda, 2012). The fertilizer must be banded slightly below and at the side of the seed to avoid contact with the seed.

2.4.2 Potato growth stages

Potatoes are a staple crop that is grown all over the world. They are rich in nutrients such as vitamins, minerals, and carbohydrates, making them an important part of many people’s diets (Cavendish, 2011). Understanding the different stages of potato growth is important for farmers and gardeners alike to ensure a successful harvest.

The first stage of potato growth begins with planting. This is usually done at a time in the season that the soil has warmed up and the danger of frost has passed. Potatoes are typically planted from seed potato tubers, which are tubers that have been allowed to sprout (Navarre & Pavek, 2014). This seed potato is planted in rows in fine tilth soil, and then covered with a layer of soil. Once the seed potatoes are planted, they begin to germinate. This is the second stage of potato growth. The sprouts emerge from the soil and begin to grow towards the surface. As they grow, the sprouts become thicker and stronger, and begins to develop leaves. During this stage, it is important to keep the soil moist but not muddy to help the potatoes grow.

The third stage of potato growth is the vegetative growth stage. During this stage, the potato plant focuses on growing leaves and stems. The leaves become larger and more numerous, and the stems become thicker and stronger (Davies & Geneve, 2002). As the plant grows, it begins to produce more and more foliage, which helps it to absorb sunlight and produce energy through photosynthesis.

According to Grewal & Marwaha (1996), the fourth stage of potato growth is the flowering stage. This is when the potato plant begins to produce flowers, which can be white, pink, red, or blue depending on the variety. The flowers are not necessary for potato production, but they do indicate that the plant is healthy and growing well.

The fifth stage of potato growth is the tuber formation stage. This is when the plant begins to produce the tubers, or potatoes, that we eat. As the plant continues to grow, it begins to produce small, white tubers underground. These tubers grow larger and more numerous as the plant continues to mature. During this stage, it is important to keep the soil moist to help the potatoes grow (Davies & Geneve 2002). The final stage of potato growth is the maturation stage. This is when the potatoes are fully mature and ready to be harvested. Mature potatoes have a thick, firm skin and are generally larger than immature potatoes. Once the potatoes have reached this stage, they can be harvested and stored for later use.

2.4.3 Potato Propagation

Potatoes are primarily propagated through vegetative methods, using tubers as seed pieces. This method ensures a uniform crop and allows for the maintenance of desirable traits. The tubers, which contain nodes or eyes are cut into seed pieces and allowed to suberize or cure before planting (Stark & Love 2003). The physiological age of the seed also plays a role in the growth and yield of the new crop. Old seed emerges rapidly, produces more stems and smaller tubers, and matures earlier, while new seed emerges more slowly, produces fewer stems and larger tubers, and matures later(Mosley *et al*, 2000).Vegetative propagation has advantages such as genetic purity and high yields but also disadvantages like disease spread and the requirement for significant storage space.

Alternatively, potatoes can be propagated through sexual or botanical seed. These seeds are produced from the fruit of potato plants and contain approximately 300 seeds per fruit. Each seed develops into a plant with unique characteristics due to the random distribution of chromosomes during pollination. While this method is useful for crop improvement in breeding programs, it offers little value to growers due to the genotypic variation that results in non-uniform crops (Hoopes *&* Plaisted, 1997).

Tissue culture is another propagation method that permits rapid production of identical plantlets from disease-free stock. This technique involves growing plantlets in test tubes on nutrient media and cutting them into nodal sections for propagation (Mills, 2001). Meristems found at the apical meristem of potato stems allow each cutting to become a new plant. Tissue culture is advantageous for maintaining disease-free seed stock that can be stored in vitro.

CHAPTER 3

3.0 Materials and Methods

3.1 Experimental Site

The research was carried out in Honde Valley at Sahumani village at Mutasa district, in Manicaland province. This region lies in the east of the country. It has a latitude of 18.4967778°S and a longitude of 32.8532000°E with an altitude of 900m above sea level. The area falls under natural region 1 which receives more than 1000mm of rain per annually. From late October to around the end of April, the weather is hot and humid. Temperatures may rise up to 28 ˚C and this is the period where most of the rainfall is received. The experiment was carried out in December 2023 to April 2024. The research was carried out in an area with sandy loam soils which are ideal for potato production.

3.2 Experimental Design and Treatments

The trial was laid out in a Randomized Complete Block Design. It was a one factor trial, with the factor being variety. There were nine treatments, the six new varieties namely, BR11, BR12, BR13, BR15, BR16, BR17 and the varieties currently grown in Zimbabwe namely Amethyst, Garnet and BP1. The trial was replicated three times. The blocking factor was slope. Each variety was planted in plots measuring 5m x 5m with the plant spacing of 90cm interrow and 30cm inrow.

3.3 Agronomic Practices

3.3.1 Land preparation

Land preparation was done using an ox-drawn plough. This enabled the breaking up of hard top layer of soil and mixing it with softer subsoil preparing for planting. After that, soil clods were manually broken using hoes and thereafter, ridges were made throughout the field using hoes where the treatments were planted.

3.3.2 Planting

Planting was done on the 15th of December 2023. Sprouted tubers were then planted using hands with an interrow spacing of 90cm and an in row spacing of 30cm. Tubers were then covered with soil.

3.3.3 Fertilizer application

Potatoes are gross feeders of all nutrients within a relatively short period of time. Compound D was applied at planting as a basal dressing at 1300kg/ha. The fertilizer was covered with soil to prevent rotting of tubers. Top dressing of ammonium nitrate was applied at 350kg/ha.

3.3.4 Ridging

It is the process of adding soil to the potato plant in order to cover up the lower stems. Ridging was done to protect the tubers from greening, late blight and potato tuber moth. It was done using a hand hoe.

3.3.5 Irrigation

Irrigation has a special significance in the potato production as the plant has shallow and sparse root system. Water was applied to potato crops to improve quality and yield. Stolon formation, tuber initiation and tuber development are the most sensitive growth stages to deficient irrigation. Therefore, water was applied artificially using sprinkler system and irrigation was stopped 10days before harvesting in order to allow for the firming of the tubers. 45-50mm were being irrigated using sprinklers per each week.

3.3.6 Crop protection

Weeds can cause significant yield loss. Therefore, weeds were controlled manually twice per week using hoes. Cutworms were controlled using Lambda at a rate of 500ml/ ha. Burrowing nematodes (*Radopholus similis*) were controlled using curaterr, nemacur and fenamiphos 40 EC during planting.

3.3.7 Harvesting

The time of harvest is very important in potato. Harvesting was done when all the vines had died. Tubers were harvested manually by digging them up using a hand hoe. All the exposed tubers were then collected into a basket according to their plots.

3.4 Data Collection

3.4.1 Stem height of the potato plant (cm).

The height of different varieties of potatoes was measured from the soil surface to the top most growth point of the plants using a tape measure from week 3 up to week 18.

3.4.2 Number of leaves

Leaves were counted on 10 plants selected in each plot. Number of leaves of the selected plants were taken at weekly intervals from week 3 up to week 18.

3.4.3 Number of stolons

Stolons were counted manually on 10 plants selected in each plot. Number of stolons of the selected plants were counted and the average of those plants was recorded from week 3 up to week 6.

3.4.4 Days to 50% Flowering

Days to flowering was recorded when 50% of the plant population in each plot produced flowers.

3.4.5 Days to 95% Maturity

The physiological maturity of the potato was characterized by the wilting of haulms. The number of days to maturity were recorded from the day of planting to the day when 95% of the leaves had dried.

3.4.6 Tuber yield

The yield of Irish potatoes was measured by weighing the mass of tuber yield from each plot using an electronic scale. Tuber yield was recorded in kilograms per hectare.

3.5 Data analysis

Data was analysed using Genstat Seventeenth Edition, using a least significance difference (L.S.D) of $P<0.05$ to separate the means where there were significant differences.

CHAPTER 4: Results

4.1 Effect of variety on stem height.

Table 2: Variety on stem height

Variety	Stem height (cm) 3WAP	Stem height (cm) 9WAP	Stem height (cm) 12WAP
BR17	8.833[a]	25.27[a]	40.97[a]
BR12	8.733[a]	24.63[ab]	36.77[ab]
BR15	8.600[a]	24.53[ab]	36.17[b]
BR13	8,300[ab]	23.87[abc]	35.70[b]
Garnet	7.700[b]	23.77[bc]	35.13[bc]
BR11	7.700[b]	23.43[bc]	33.40[bc]
Amethyst	7.600[bc]	22.70[c]	33.23[bc]
BP1	7.567[bc]	21.07[d]	32.53[bc]
BR16	6.867[c]	20.13[d]	31.17[c]
CV%	5.9	3.6	7.2
L.S.D	0.8188	1.461	4.360
S.E.D	0.3862	0.689	2.057
P. Value	0.001	<.001	0.009

*Means followed by the same letters are not significantly different

Variety had an effect (P<0.05) on the stem height at 3WAP, 9WAP and 12WAP. Highest stem height was recorded from BR17 which was statistically similar to BR12, BR15 and BR13 at 3WAP and 9WAP. Amethyst, BP1 and BR16 had the shortest stem height at 3WAP with no statistical difference between them. Shortest stem height was observed from BP1 and BR16 at 9WAP recording (21.07cm) and (20.13cm) with no significant difference between them. BR17 and BR12 varieties had the highest stem height at 12WAP with no statistical difference between them.

4.2 Effect of variety on the number of leaves.

Table 3: Effect of variety on the number of leaves

Variety	Number of leaves (12WAP)
BR15	16.33[a]
BR16	15.67[a]
BR11	15.33[ab]
Garnet	15.00[ab]
BR12	14.67[abc]
BR17	14.33[abc]
BP1	13.00[bc]
BR13	13.00[bc]
Amethyst	12.67[c]
CV%	9.4
L.S.D	2.344
S.E.D	1.106
P. Value	0.039

*Means followed by the same letters are not significantly different

Different varieties of Irish potatoes had an effect (P<0.05) on the number of leaves at 12WAP. BR15, BR16, BR11, Garnet, BR12 and BR17 had the highest number of leaves at 12 WAP with no statistical difference between them. BP1, BR13 and Amethyst had the lowest number of leaves with no significant difference between them.

4.3 Effect of variety on the number of stolons

There was no significant difference (P>0.05) on the means of variety BP1, BR11, BR16, BR15, BR12, Garnet, BR17, Amethyst and BR13 at 3WAP and 6WAP.

4.4 Effect of variety on the number of days to flowering

Table 4: Effect of variety on the number of days to flowering

Variety	Days to 50% flowering
Amethyst	44.00[a]
BR17	43.33[ab]
Garnet	42.00[abc]
BR13	42.00[abc]
BP1	41.67[abc]
BR15	41.00[abc]
BR16	40.23[abc]
BR12	39.33[bc]
BR11	38.67[c]
CV%	12.9
L.S.D	4.243
S.E.D	2.002
P. Value	<.001

*Means followed by the same letters are not significantly different

Variety had an effect (P<0.05) on days to flowering. Amethyst, BR17, Garnet, BR13, BP1, BR15 and BR16 had the highest number of days to flowering with no significant difference between them. BR12 and BR11 had the least number of days to flowering with no statistical difference between them.

4.5 Effect of variety on days to 95% maturity

Table 5: Effect of variety on days to 95% maturity

Variety	Days to 95% maturity
BR17	131.0^{a}
BR13	130.7^{a}
BR12	130.0^{a}
BR15	126.7^{a}
BR16	123.7^{ab}
Amethyst	115.0^{b}
BR11	95.7^{c}
Garnet	94.3^{c}
BP1	91.7^{c}
CV%	4.9
L.S.D	9.69
S.E.D	4.57
P. Value	<0.01

*Means followed by the same letters are not significantly different.

Variety had an effect ($P<0.05$) on the number of days to maturity. BR12, BR13, BR15, BR16 and BR17 had the highest number of days to maturity with no significant difference between them. BR11, Garnet and BP1 had the least number of days to maturity with no statistical difference between them.

4.6 Effect of variety on the tuber yield of potato

Table 6: Effect of variety on tuber yield of potato

Variety	Tuber yield(Kgs)

BR16	60.67[a]
BR13	60.67[a]
BR12	56.33[a]
BR11	47.33[b]
BR15	31.67[c]
Garnet	23.67[d]
BP1	21.00[d]
Amethyst	20.67[d]
BR17	18.33[d]
CV%	11.6
L.S.D	7.604
S.E.D	3.587
P. Value	<.001

*Means followed by the same letters are not significantly different.

Variety had an effect ($P<0.05$) on their tuber yield. BR16, BR13 and BR12 had the highest tuber yielding and there was no significant difference between them. Lowest tuber yield was recorded from BR17 which was statistically similar to BP1, Garnet and Amethyst respectfully.

CHAPTER 5: Discussion of Results

5.1 Effect of variety on stem height of the potato crop

The stem serves as the main structural support for the potato plant, allowing it to stand upright and bear the weight of leaves, flowers and tubers. Additionally, the stem acts as a conduit for transporting water, nutrients and assimilates between different parts of the plants. According to my results on stem height, BR17, BR15, BR13 and BR12 had the highest stem height compared to other varieties at 3WAP and 12WAP. This may be due to the plant genetic characteristics and the quality of plant materials that is, some varieties naturally exhibit taller stem heights compared to others. The increased height observed at this stage can be attributed to the plant's efforts to capture more sunlight for photosynthesis, which is crucial for producing energy and nutrients needed for growth (Touria, 2017). These results are similar to those reported by Banjade *et al*, 2019.

5.2 Effect of variety on number of leaves

Different potato varieties exhibit varying characteristics, including leaf development patterns which can impact the total leaf count. Highest number of leaves in potatoes is essential for maximizing photosynthesis, carbohydrate production and ultimately ensuring healthy tuber development while maintaining a balance between foliage and tubers. The highest number of leaves produced in variety BR15, BR11, Garnet, BR12, BR17 and BR16 at 12WAP may be due to the availability of nutrients like nitrogen, potassium and micronutrients in the soil that are crucial for promoting leaf development in potato plants. In addition, a balanced supply of nutrients supports photosynthesis and overall plant health, leading to increased leaf production (Breto *et al*, 2013)

5.3 Effect of variety on number of stolons

There was no significant difference ($P>0.05$) in all the potato varieties in the number of stolons at 3WAP and 6 WAP as shown in chapter 4. Stolons are specialized stems that grow horizontally along the soil surface and give rise to new plants. Difference in the number of stolons maybe due to factors such as moisture levels in some plots in the experiment which can all affect stolon development in potato plants. Practices such as fertilization regimes, and irrigation management can influence the formation and growth of stolons in Irish potatoes (Lobell & Burke, 2009).

5.4 Effect of variety on days to 50% flowering

In potatoes, the variety planted can significantly impact the number of days it takes for the plants to flower. Amethyst, BR17, Garnet, BR13, BP1, BR15 and BR16 had the highest number of days to flowering while some varieties took the lowest number of days to flower. The differences in flowering dates among the varieties could be due to varying responses to day lengths, with some varieties being classified as short-day plants and others as long-day plants. Late flowering varieties require a longer vegetative phase before entering the reproductive stage and this extended growth period can contribute to higher yields. Varieties that flower early may have a shorter vegetative growth period, potentially affecting tuber formation and size. This considerable differences between varieties with respect to days to 50% flowering was also reported by Arega *et al*, (2007)

5.5 Effect of variety on days to 95% maturity

BR17, BR13, BR12, BR15 and BR16 took longer days to reach the 95% maturity stage while BR11, Garnet and BP1 took the lowest number of days to reach maturity. The difference in the number of days to maturity in all potato varieties can be influenced by climatic conditions (Cantrell, 2016). A prolonged growing season required by some varieties may results in a longer tuber bulking stage of plant's development. BR17 is a long season variety which had lower tuber yield because of the occurrence of some pests and diseases in some plots in the experiment.

5.6 Effect of variety on tuber yield

The highest tuber yield was recorded from BR13 which was statistically similar to BR16 and BR12. This might be due to its highest number of tubers per plant which is in line with the report of (Struik & Wiersema, 1999), where the highest tuber yield was observed in potato cultivar having higher tuber number. Garnet, Amethyst, BP1 and BR17 had the lowest tuber yielding. The poor performance could have been due to the presents of diseases and pests such as cutworms in some plots in the experiment.

CHAPTER 6: Conclusion and Recommendations

6:1 Conclusion

The study measured six parameters to evaluate the performance of new Irish potato varieties for yield potential and vegetative growth in Zimbabwe in Highveld (Mutare). According to the results of this study, variety had an effect on the vegetative growth (stem height, number of leaves and number of stolons. This is because of the genetic characteristics of the potato plant as well as the availability of nutrients such as nitrogen, potassium and micronutrients in the soil that promotes the growth of potato leaves, stem height and stolons. Variety had an effect on the reproductive stage (number of days to flowering and days to maturity). This can be due to the length of the growing season, with some varieties maturing and flowering early or late. In addition, variety had an effect on the tuber yield because of the number of tubers per plant and the presents of burrowing nematodes in some plots that hinder the growth of the crop resulting in lower yields. Local varieties which are BP1, Garnet and Amethyst had lower tuber yields as compared to the new varieties. Therefore, the researcher finds out that BR13, BR12 and BR16 varieties performed very well resulting in high tuber yielding among the local varieties.

6:2 Recommendations

According to this research study, it is therefore recommended that other horticultural farmers out there should opt for BR13, BR12 and BR16 cultivars of potatoes as they produce maximum tuber yield capacity as compared to the locally available varieties.

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APPENDICES

Appendix 1: Effect of variety on the number of days to flowering

Variate: D_to_flowering_4

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	132.519	66.259	11.03	
Block.*Units* stratum					
Treatment	8	302.296	37.787	6.29	<.001
Residual	16	96.148	6.009		
Total	26	530.963			

Appendix 2: Effect of variety on the number of days to maturity.

Variate: D_to_maturity_18

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	232.30	116.15	3.70	
Block.*Units* stratum					
Treatment	8	6844.52	855.56	27.29	<.001
Residual	16	501.70	31.36		
Total	26	7578.52			

Appendix 3: Effect of variety on stem height

Variate: height_3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	2.5267	1.2633	5.65	
Block.*Units* stratum					
Treatment	8	10.4800	1.3100	5.85	0.001
Residual	16	3.5800	0.2238		
Total	26	16.5867			

Variate: height_6

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	2.721	1.360	1.24	
Block.*Units* stratum					
Treatment	8	15.470	1.934	1.76	0.160
Residual	16	17.599	1.100		
Total	26	35.790			

Variate: height_9

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.

Block stratum	2	0.6067	0.3033	0.43	
Block.*Units* stratum					
Treatment	8	69.2667	8.6583	12.14	<.001
Residual	16	11.4067	0.7129		
Total	26	81.2800			

Variate: height_12

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	52.092	26.046	4.11	
Block.*Units* stratum					
Treatment	8	201.152	25.144	3.96	0.009
Residual	16	101.515	6.345		
Total	26	354.759			

Variate: height_15

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	11.93	5.97	0.11	
Block.*Units* stratum					
Treatment	8	169.01	21.13	0.40	0.902
Residual	16	834.83	52.18		
Total	26	1015.78			

Variate: height_18

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	96.74	48.37	0.95	
Block.*Units* stratum					
Treatment	8	185.97	23.25	0.46	0.868
Residual	16	813.93	50.87		
Total	26	1096.64			

Appendix 4: Effect of variety on the number of leaves

Variate: number_of_leaves_3

Source of variation	d. f.	s. s.	m. s.	v.r.	F pr.
Block stratum	2	0.5185	0.2593	0.41	
Block.*Units* stratum					
Treatment	8	5.1852	0.6481	1.02	0.459
Residual	16	10.1481	0.6343		
Total	26	15.8519			

Variate: number_of_leaves_6

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	0.222	0.111	0.08	

Block.*Units* stratum

Treatment	8	4.667	0.583	0.44	0.878
Residual	16	21.111		1.319	
Total	26	26.000			

Variate: number_of_leaves_9

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	0.519	0.259	0.11	
Block.*Units* stratum					
Treatment	8	23.407		2.926	1.30	0.313
Residual	16	36.148		2.259	
Total	26	60.074			

Variate: number_of_leaves_12

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	4.667	2.333	1.27	
Block.*Units* stratum					
Treatment	8	40.667		5.083	2.77	0.039
Residual	16	29.333		1.833	
Total	26	74.667			

Variate: number_of_leaves_15

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	1.556	0.778	0.35	
Block.*Units* stratum					
Treatment	8	42.667	5.333	2.39	0.066
Residual	16	35.778	2.236		
Total	26	80.000			

Variate: number_of_leaves_18

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	1.185	0.593	0.33	
Block.*Units* stratum					
Treatment	8	23.407	2.926	1.62	0.194
Residual	16	28.815	1.801		
Total	26	53.407			

Variate: stolons_3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	2.741	1.370	0.77	
Block.*Units* stratum					
Treatment	8	12.741	1.593	0.89	0.545

Residual	16	28.593	1.787		
Total	26	44.074			

Variate: stolons_6

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	0.889	0.444	0.19	
Block.*Units* stratum					
Treatment	8	14.667	1.833	0.79	0.619
Residual	16	37.111	2.319		
Total	26	52.667			

Appendix 5: Effect of variety on tuber yield

Variate: tuber yield

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	12.52	6.26	0.32	
Block.*Units* stratum					
Treatment	8	8016.74	1002.09	51.92	<.001
Residual	16	308.81	19.30		
Total	26	8338.07			