BIBLIOGRAPHY

HECTOR, GAYOMBA C. APRIL 2006. Growth and Yield of Promising Potato Genotypes Grown in an Organic Farm at Sinipsip, Buguias. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study aimed to evaluate the growth and yield of different potato genotypes in an organic farm, to identify the best performing potato genotypes based on yield, to determine the profitability of the different potato genotypes and to determine which of the potato genotypes will be selected by the organic farmer.

The study revealed that 13.1.1 had the highest canopy cover, highest resistance to late blight and highest total yield. Genotype 13.1.1 also had the highest ROCE for both seed and table potato production.

Genotype 13.1.1 could be produced at Sinipsip, Buguias. Genotypes 38025.17, 676070, and 5.19.2.2 could also be produced in the area since these genotypes were selected by the farmer.

TABLE OF CONTENTS

INTRODUCTION

Potato is considered a world crop since it is produced in 130 nations. It is grown from sea level to 13,000 feet, and its edible dry matter accounts for a higher volume of the food consumed in the world than fish and meat combined (Rhaodes, 1982). Potato can also give 11,000 kg or more of tubers per hectare even in underdeveloped agricultural situations (Schultz, 1982).

In Benguet, Mountain Province, and some other areas where potatoes and other crops are grown, most of the farmers are using chemicals in farming. They use synthetic fertilizers and pesticides as a method to increase production and reduce yield loss. However, these practices resulted in persistence or resistance of some pests and diseases, soil degradation, low yield and water pollution.

To solve some of these problems and to increase profit, some farmers in Benguet are now practicing organic farming. Instead of using chemicals, farmers employ crop rotation, biological control, and others to reduce pest and disease incidence. They also practice green manuring and use compost or organic fertilizer to sustain the fertility of their soil. As a result, higher yields are produced (Lang, 2005) and higher profit is gained.

Many farmers believe that potato has a potential for sustainable, non-chemical farming since it fits well with many crop rotations, and does very well with natural fertilizers. However, growing potato organically need a potential variety which is able to produce high yield.

The objectives of the study is to:

1. evaluate the growth and yield of different potato genotypes grown in an organic farm;

2. identify the best performing potato genotypes based on yield;

3. determine the profitability of the different potato genotypes; and

4. determine which of the potato genotypes will be selected by the organic farmer.

The study was conducted in an organic farm at Sinipsip, Buguias, Benguet from November 2005 to February 2006.

REVIEW OF LITERATURE

Varietal Evaluation

To have a high yield, selecting a variety is necessary. Rasco and Amante (1994) stated that variety evaluation is a process of documenting variety traits that can be used to distinguish one variety from other varieties. Furthermore, Work and Carew (1995) cited that varietal evaluation is done to observe characters such as yield, earliness, vigor, maturity and quality.

Bautista and Mabesa (1972) suggested that a variety to be selected should be high yielding, resistant to pest and disease, early maturing, and requires less input. In addition, Cagampang and Lantican (1977) observed that the choice of variety is important. The wise use of an improved and well-selected variety may result to tremendous increase in yield.

Productivity of Organically Grown Crops

Yields in an organic farm during drought are comparable to or slightly better than in a conventional farm. Organic farming yields would vary from moderately less than to nearly comparable with conventional farming yields (Poincelot, 1986).

Organic farming produced either the same yield or lower but consume less energy. Crop yields may be 20 % lower in the organic system, but input of fertilizer and energy is reduced by 34 % to 53 % and pesticides input by 77 % (Madder and Fliebach, 2002).

Scientist and farmers agree that it is economically feasible to grow potatoes successfully and at the same time improve the land's productivity and fertility. Twenty thousand to forty thousand pounds per acre is the usual range of organic yields while conventional growers, often on muck soils, average around twenty seven thousand pounds per acre (Caldwell, 1993). Furthermore, organic potatoes can be grown on a large scale without commercial pesticides and standard fertilizers. However, yields are lower than conventionally produced potatoes.

Huntsinger (1995) cited that in carefully monitored fields tests in 1990, organic farming yield an average of twenty one thousand two hundred pounds of potatoes per acre (over three tested varieties) while conventional farming methods yielded thirty two thousand eight hundred pounds per acre.

<u>Effects of Organic Fertilizer on the Growth of Crops</u>

Donahue (1971) reported that organic matter supply some of the nutrients needed by the growing plants as well as hormones and antibiotics. The nutrients are released in harmony with the needs of plants. When environmental conditions are favorable, rapid growth may happen.

Pandosen (1980) found out that organic matter contains nutrients, which can be available through the work of microorganisms. The nutrients from the organic fertilizer are supplemented by inorganic fertilizer mainly nitrogen (N), phosphorous (P) and potassium (K). Once they are available, they are translocated by potassium thereby influencing the growth of plants.

MATERIALS AND METHODS

The study was conducted in a 150 m^2 area which was thoroughly prepared. The area was divided into three blocks containing ten plots measuring 1 x 5 meters each to accommodate all the ten potato genotypes (Figure 1).

The potato genotypes that were observed are the following:

GENOTYPE	ORIGIN
380251.17	CIP, Peru
384558.10	CIP, Peru
676070	CIP, Peru
Ganza	Philippines
285411.22	CIP, Peru
573275	CIP, Peru
676089	CIP, Peru
5.19.2.2	CIP, Peru
575003	CIP, Peru
13.1.1	CIP, Peru

Preparation of Planting Materials

Clean mother plants were established and cut after 12 to 14 days. The stem cuttings were then rooted in plastic trays containing sterilized black subsoil and compost. After 8-12 days, the rooted cuttings were planted in the field.

Layout and Planting

The experiment was laid out in randomized complete block design (RCBD) with three replications. The planting distance was 25 x 30 cm between hills and rows.

The Farmer and the Farm

Mr. Johnny F. Osting is organic practitioner for almost six years. He updates himself by attending seminars and trainings to gain additional knowledge and skills on organic farming. He last attended the 1st Cordillera Organic Agriculture Congress in January of 2006.

His farm which is almost flat and located on the top of a mountain is 2,350.31 meters above sea level. The crops he previously planted were carrots and raddish. The soil type of his farm is sandy loam.

His farm was conventional for almost ten years and transitioned to an organic farm four years ago.

Cultural Management Practices

Fertilizer application was done before planting. The basal fertilizer that was used is a combination of compost chicken manure, sunflower and other weeds. Botanical fungicide was used only during the occurrence of late blight.

All cultural management practices were employed uniformly to all plots as needed throughout the duration of the study.

Data Gathered

1. Temperature and relative humidity. The temperature and relative humidity of the area were taken every after two weeks using a Compact Sling Psychrometer.

2. Soil analysis. The nitrogen, phosphorous, potassium, soil pH, and organic matter content of the soil were taken before planting and after harvesting.

3. Percentage survival. This was taken one week after transplanting and computed using the formula:

$$\% \text{ Survival} = \frac{\text{Number of surviving plants}}{\text{Total number of plants planted}} \times 100$$

4. Plant height. Initial and final height was taken one week after hilling up and one week before harvest respectively.

5. Plant vigor. This was recorded at 30 and 45 days after transplanting using the rating scale of 1-5 as follows:

RATING	DESCRIPTION
5	Highly vigorous
4	Vigorous
3	Moderate vigor
2	Poor vigor
1	Very poor vigor

6. Canopy cover. It was taken 30, 45, 60 and 75 DAP by using a wooden frame 120 x 60 cm in size and have equally sized 12 x 6 cm grids.

7. Leaf miner incidence. The appearance of insects was observed at 30, 45, 60, and 75 DAP using the following scale (CIP, 2000):

RATING	DESCRIPTION	REMARKS
1	Less infested (1-20 %)	Resistant
2	Infested (20-40 %)	Moderately resistance
3	Moderate infested (41-60 %)	Intermediate
4	Severely infested (61-80 %)	Moderately susceptible
5	Most serious	Susceptible

8. Late blight incidence. Observation was done at 45, 60 and 75 DAP using the following scale (Henfling 1982):

BLIGHT	CIP SCALE*	DESCRIPTION OF CORRESPONDING SYMPTOMS
0	1	No blight can be observed.
0.1-1.0	1	Very few plants are affected with lesions.
1.1-2.0	2	Not more than two lesions per 10 m of row (+/=30 plants).
3.1-10. 0	3	Up to 3 small lesions per plant or 1 lesion per 2 leaflet attacked.
10.1-24.0	4	Most plants are visibly attacked by late blight, 1 in 3 leaflets infected but few multiple infection per leaflet.
25.0-29.0	5	Newly every leaflet have lesions, multiple infection per leaflet is common, fields or plot looks green but plants in plot are infected.
50.0-74.0	6	All plants have blight and half area is infected, plots look green, freckled and brown blight is very obvious.
75.0-90.0	7	As previous, but three quarters of each plant blighted. Lower branches may be overwhelming killed off, and the only green leaves if any are at the top of the plants. Shade of the plant maybe more spindly due to extensive foliage loss. Plots look either brown or green.

91.0-97.0	8	Some leaves and most stems are green. Plots look brown with some green patches.
98.0-99.9	9	Few green leaves, almost all that remain are those with blight lesions. Many stem lesion, plot looks brown. All leaves and stem are dead.
100	9	All leaves and stem are dead.

*Description: 1-Highly resistant; 2-3 Resistant; 4-5 Moderately resistant; 6- Moderately susceptible; 8-9 Susceptible.

9. Weight of marketable tubers per 5 m^2 (g). All tubers with marketable quality were weighed at harvest.

10. Weight of non-marketable tubers per 5 m^2 (g). Tubers which were less than 11 g, cracked, deformed, rotten, and damaged by pest were weighed at harvest.

11. Total yield per 5 m^2 (g). This was taken by adding the weight of non-marketable and marketable tubers.

12. Selection of the farmer. The potato genotypes which were selected by the organic farmer and his reasons for selection were noted.

13. Return on cash expense (ROCE) per 5 m^2. This was computed using the formula:

$$ROCE = \frac{\text{Net Return}}{\text{Expense}} \times 100$$

14. Dry matter content (%). Dry matter content of potato tubers was taken using the following formula:

$$\%\ \text{Dry Matter} = 100\ \% - \%\ \text{Moisture content}$$

Where:

$$\%\ \text{Moisture content} = \frac{\text{Fresh weight} - \text{Oven dry weight}}{\text{Fresh weight}} \times 100$$

Data Analysis

All quantitative data was analyzed using Analysis of Variance (ANOVA) of the randomized complete block design (RCBD) with three replications. The significance of differences among the treatment means will be tested using Duncan's Multiple Range Test (DMRT).

Figure 1. Overview of the experiment 35 days after planting

RESULTS AND DISCUSSION

Temperature and Relative Humidity

Table 1 shows the temperature and relative humidity during the growth and development of the plants. The lowest temperature was found in the 2nd week of February whereas, the highest was during the 4th week of December.

Relative humidity (%) was found to be highest during the 2nd week of February and lowest in the 3rd week of January. The location was observed to be always cloudy and windy which might be due to the high elevation of the farm.

These conditions were observed to adversely affect the performance of the crop during its production.

Table 1. Temperature and relative humidity in the farm from planting until harvesting of potatoes

	TEMPERATURE (°C)	RELATIVE HUMIDITY (%)
November 2005		
4th week	13.8	95
December 2005		
2nd week	13.3	94
4th week	15.0	90
January 2006		
2nd week	13.3	94
4th week	13.5	72
February 2006		
2nd week	9.5	100

Soil Analysis

The soil analysis before planting and after harvesting is shown in Table 2. The soil pH, organic matter, nitrogen and potassium increased after harvest. This may be indirectly due to the low temperature of the soil. Low soil temperature causes crop roots to be stunted, stubby and have few branches, thus reducing the ability of the roots to absorb water and nutrients (Kohnke, 1968). Hence, the fertilizer applied before planting was probably not absorbed by the potato plants.

Phosphorous content of the soil on the other hand decreased from 360 ppm to 315 ppm. This might be the only element absorbed by the plant at its early stage of growth.

Plant Survival

Percent survival of the different genotypes was taken at 30 days after planting (Table 3). No significant differences was observed among the genotypes. However, 380251.17 had the highest percentage survival despite the strong wind and rain.

Table 2. Soil analysis before planting and after harvesting

SOIL PROPERTY	BEFORE PLANTING	AFTER HARVESTING
PH	6.23	6.47
Organic matter (%)	7.00	10.00
Nitrogen (%)	0.35	0.50
Phosphorous (ppm)	360	315
Potassium (ppm)	136	572

Table 3. Plant survival of the different potato genotypes at 30 days after planting

GENOTYPE	PLANT SURVIVAL (%)
380251.17	98
384558.10	73
676070	93
Ganza	84
285411.22	79
573275	67
676089	89
5.19.2.2	90
575003	95
13.1.1	85
CV (%)	13.57

Plant Height

Significant differences were observed in the plant height of the different potato genotypes at 35 and 83 days after planting (Table 4). Initially, genotype 13.1.1 and 5.19.2.2 were the tallest while 384558.10 was the shortest but after 83 DAP 5.19.2.2 remained to be the tallest while 285411.22 turned out to be the shortest.

The differences of height among the genotypes could be attributed to their genotypic characteristics.

Table 4. Plant height of the different potato genotypes at 35 and 83 days after planting

GENOTYPE	HEIGHT (cm)	
	35 DAP	83 DAP
380251.17	8.1[e]	23.3[ab]
384558.10	4.5[f]	14.2[bc]
676070	8.3[de]	20.1[ab]
Ganza	8.7[cd]	15.5[bc]
285411.22	10.9[b]	6.7[c]
573275	9.1[c]	19.5[b]
676089	10.4[b]	23.3[ab]
5.19.2.2	11.3[a]	31.9[a]
575003	9.0[c]	21.5[ab]
13.1.1	11.4[a]	24.2[ab]
CV (%)	3.72	31.38

Means with the same letter are not significantly different by DMRT (P>0.05).

Plant Vigor

Table 5 shows that plant vigor of different genotypes at 30 and 45 days after planting. Statistical differences were observed among the genotypes at 45 DAP but not at 30 DAP. Genotypes 368025.17, 5.19.2.2 and 13.1.1 were found to be highly vigorous while the other genotypes were either moderately vigorous or vigorous.

It was observed that at 45 DAP, genotype 380251.17 and 13.1.1 turned highly vigorous even after they were rated as only vigorous and moderately vigorous at 30 DAP. This occurrence might be due to the rejuvenation of the plants. Some of the plants from these genotypes were observed to have produced new shoots.

There was a decrease in vigor in the remaining genotypes which could be due to late blight infection.

Table 5. Plant vigor of the different potato genotypes at 30 and 45 days after planting

GENOTYPE	PLANT VIGOR	
	30 DAP	45 DAP
380251.17	4	5[a]
384558.10	4	3[c]
676070	3	3[c]
Ganza	5	3[c]
285411.22	4	3[c]
573275	4	4[b]
676089	4	4[b]
5.19.2.2	5	5[a]
575003	3	3[c]
13.1.1	3	5[a]
CV (%)	24.91	13.21

Means with the same letter are not significantly different by DMRT (P>0.05).

Canopy Cover

Table 6 shows the canopy cover of the plants at 30, 45, 60 and 75 days after planting. Significant differences were observed among the genotypes except at 45 DAP. Genotype 13.1.1 consistently had the highest canopy cover until 75 DAP while 384558.10 had the lowest. The differences in canopy cover might be attributed to the earliness or lateness of tuber formation of the different genotypes. It was found that genotypes which tuberize later develop more canopies of longer duration than genotypes twhich tuberize earlier (Cardesa *et al*., 2001).

Furthermore, an increasing trend of canopy cover can be observed from genotypes 13.1.1, 5.19.2.2, and 676089, which could be an indication of their resistance to late blight infection. The rest of the genotypes had decreased canopy cover except for

Table 6. Canopy cover of the ten different potato genotypes at 30, 45, 60 and 75 days after planting

GENOTYPE	CANOPY COVER			
	30 DAP	45 DAP	60 DAP	75 DAP
380251.17	14[a]	18	19[b]	18[bc]
384558.10	5[c]	7	6[d]	4[e]
676070	10[abc]	12	15[bc]	15[bcd]
Ganza	11[ab]	11	12[bcd]	8[cd]
285411.22	8[bc]	8	5[d]	2[e]
573275	9[abc]	10	10[cd]	5[e]
676089	9[abc]	13	15[bc]	17[bcd]
5.19.2.2	10[abc]	12	18[b]	20[b]
575003	6[bc]	8	10[cd]	10[cde]
13.1.1	10[abc]	16	27[a]	36[a]
CV (%)	29.38	31.57	28.70	21.37

Means with the same letter are not significantly different by DMRT (P>0.05).

676070 and 575003 which maintained the same canopy cover at 60 and 75 DAP. The decrease in canopy might in turn be an indication of susceptibility to late blight injection.

Leaf Miner Incidence

Leaf miner incidence was absent among the genotypes which might be due to the low temperature and high relative humidity in the farm.

Late Blight Incidence

Table 7 shows significant differences on the resistance of the ten potato genotypes to late blight at 45, 60 and 75 days after planting. Initially at 45 DAP, most of the potato genotypes were rated resistant to moderately resistant except for 285411.22 which was moderately susceptible to late blight. At 75 DAP, 13.1.1, 676089 and 5.19.2.2 remained resistant while the rest of the genotypes were either moderately resistant or susceptible to the disease.

The resistance of the genotypes were also observed to decrease at 45 to 75 DAP except for 13.1.1. Furthermore, genotypes 676089 and 575003 remained resistant and moderately resistant at 75 DAP which might be due to the botanical fungicide (Virtuoso) sprayed at 55 DAP.

Table 7. Late blight incidence of the ten different potato genotypes at 45, 60 and 75 days after planting

GENOTYPE	LATE BLIGHT INCIDENCE DAYS AFTER PLANTING		
	45	60	75
380251.17	2^{d}	3^{c}	4^{bcd}
384558.10	3^{cd}	4^{bc}	5^{bc}
676070	3^{cd}	3^{c}	4^{bcd}
Ganza	5^{ab}	5^{b}	6^{b}
285411.22	6^{a}	7^{a}	8^{a}
573275	4^{bc}	3^{c}	5^{bc}
676089	3^{cd}	3^{c}	3^{cd}
5.19.2.2	3^{cd}	3^{c}	4^{bcd}
575003	3^{cd}	4^{bc}	4^{bcd}
13.1.1	2^{d}	3^{c}	2^{d}
CV (%)	24.74	26.75	26.22

Means with the same letter are not significantly different by DMRT (P>0.05).

Scale and description: 1–Highly resistant; 2-3–Resistant; 4-5–Moderately resistance; 6-7–Moderately susceptible, 8-9–Susceptible.

Marketable, Non-marketable and Total Yield of Potato Tubers

Significant differences can be observed in the marketable, non-marketable and total yield of tubers of the ten different potato genotypes (Table 8). Genotype 13.1.1 produced the highest marketable and non-marketable tubers while 384558.10 produced the lowest marketable and non-marketable tubers. Moreover, it follows that 13.1.1 produced the highest weight of total yield and 384558.10 produced the lowest total yield. Fig. 2 shows the harvested tubers from the different genotypes.

The genotype with the highest yield (13.1.1) was also found to be the most resistant to late blight infection and had the highest canopy cover.

Table 8. Marketable, non-marketable and total yield of potato tubers

GENOTYPE	YIELD (g)/5 m^2		
	MARKETABLE	NON-MARKETABLE	TOTAL
380251.17	$1,580^{b}$	77^{ab}	$1,657^{b}$
384558.10	228^{e}	15^{c}	243^{f}
676070	607^{de}	46^{bc}	653^{cdef}
Ganza	477^{de}	28^{bc}	505^{def}
285411.22	249^{e}	55^{abc}	304^{ef}
573275	781^{cd}	48^{bc}	829^{cde}
676089	880^{cd}	58^{abc}	9.38^{cd}
5.19.2.2	$1,124^{bc}$	33^{bc}	$1,157^{c}$
575003	465^{de}	71^{ab}	536^{def}
13.1.1	$2,570^{a}$	103^{a}	$2,673^{a}$
CV (%)	15.79	30.14	29.38

Means with the same letter are not significantly different by DMRT (P>0.05).

Potato Genotypes Selected by the Farmer

Out of the ten potato genotypes, the farmer selected only 380251.17, 676070, 5.19.2.2, and 13.1.1 (Table 9). These genotypes were selected due to their resistance to late blight, medium to large tuber size, attractive skin color (676070), and high plant vigor. Furthermore, these genotypes are considered adapted to the area since it can withstand the unfavorable environment condition in the farm.

Table 9. Potato genotypes selected by the farmer and his reasons for selection

POTATO GENOTYPES	REASONS FOR SELECTION
380251.17	Resistant to late blight, medium sized tubers, highly vigorous, and can withstand the unfavorable environmental condition in the farm.
676070	Resistant to late blight, large tubers even, uniform number of tubers per plant, and attractive red skin color.
5.19.2.2	Resistant to late blight, medium sized tubers, highly vigorous, and can withstand the unfavorable environmental condition in the farm.
13.1.1	Resistant to late blight, large sized tubers, highly vigorous, and can withstand to the unfavorable environmental condition in the farm.

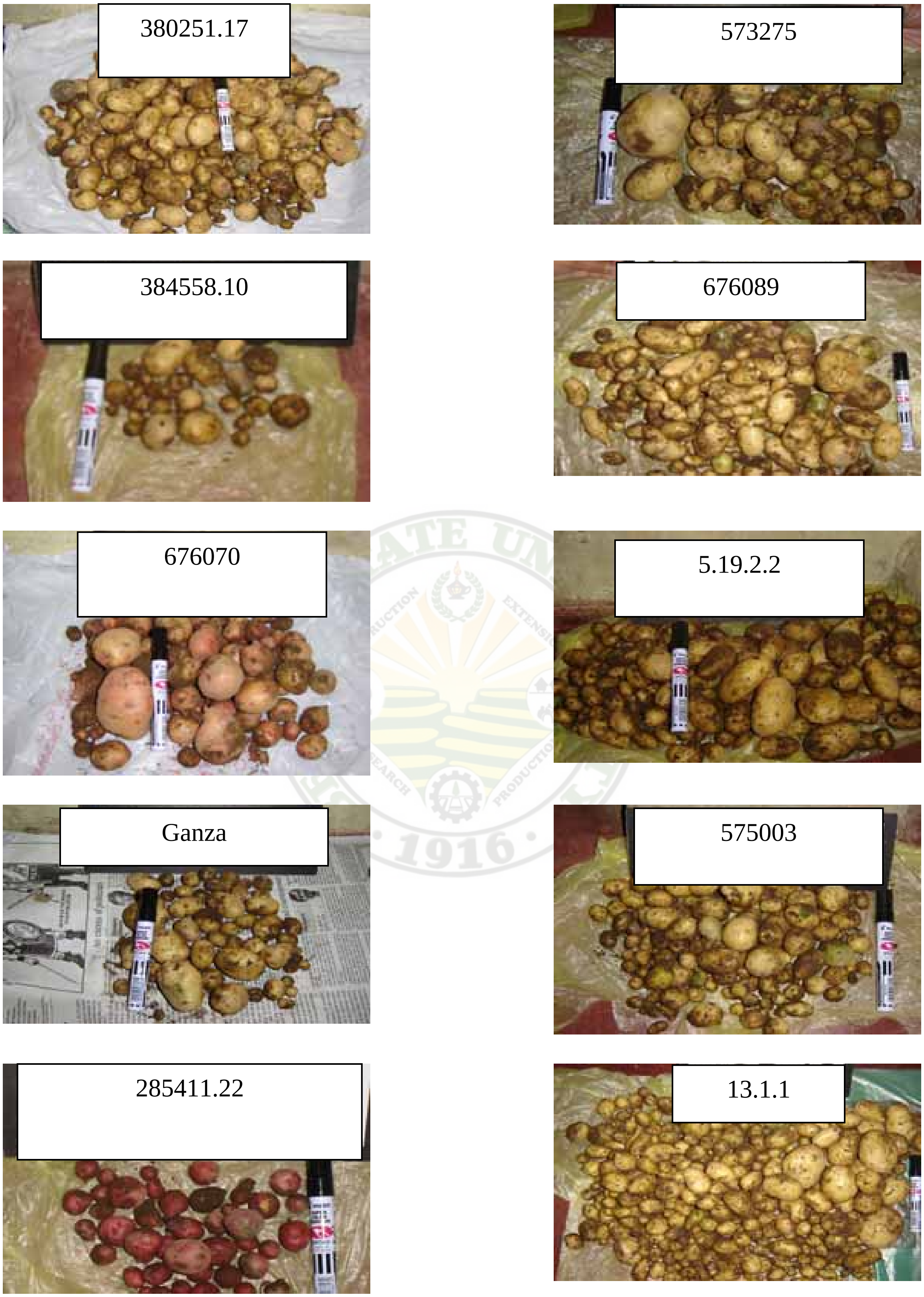

Fig. 2. Tubers of ten potato genotypes harvested at 90 DAP

Cost and Return Analysis

Table 10a shows the cost of producing seed tubers from the ten potato genotypes in an area of 5 m^2. Genotype 13.1.1 had the highest ROCE of 896 % while 384558.10 had the lowest ROCE of 22 %. This result indicates that the genotypes with the highest yield also had the highest profit.

Most of the potato genotypes had a negative return on cash expense (% ROCE) if produced as table potatoes (Table 10b). This negative result might be due to the small tuber sizes and low weight of tubers of the different genotypes. Genotype 13.1.1, however, had a positive albeit low ROCE (%). This might be due to the presence of a few large tubers which contributed to the increased weight of the genotype.

Table 10a. Cost and return analysis of the ten potato genotypes per 5 m^2 for seed tuber production

GENOTYPE	YIELD (No./5m^2)	GROSS SALE (Php)	TOTAL EXPENSES (Php)	NET INCOME (Php)	ROCE (%)
380251.17	93	372	98	274	280
384558.10	30	120	98	22	22
676070	72	288	98	190	194
Ganza	55	220	98	122	124
285411.22	52	208	98	110	112
573275	64	256	98	158	161
676089	62	248	98	150	153
5.19.2.2	112	448	98	350	357
575003	47	188	98	90	92
13.1.1	244	976	98	878	896

Note: Php 4.00 is the selling price per G_1 tuber.
Total expenses include labor cost, cost of planting material, fertilizer and botanical fungicide (Virtouso).

Table 10c shows that the return on cash expense of seed tubers is much higher than the return on cash expense for table potato. This result indicates that production of the ten different potato genotypes for G_1 seed tubers is more profitable.

Table 10b. Cost and return analysis of the ten potato genotypes per 5 m^2 for table potato production

GENOTYPE	GROSS SALE (Php)	TOTAL EXPENSES (Php)	NET INCOME (Php)	ROCE (%)
380251.17	63	98	-35	-36
384558.10	9	98	-89	-91
676070	24	98	-74	-76
Ganza	19	98	-79	-81
285411.22	10	98	-88	-90
573275	31	98	-67	-68
676089	35	98	-53	-54
5.19.2.2	45	98	-53	-54
575003	19	98	-79	-81
13.1.1	103	98	5	5

Note: Php 4.00 is the selling price of table potato tubers per kilogram.
Total expenses include cost of labor, fertilizer, planting material and botanical fungicide (Virtouso).

Table 10c. Cost and return analysis of the ten potato genotypes per 5 m^2 for both seed and table potato production

GENOTYPE	ROCE (%)	
	SEED TUBER	TABLE POTATO
380251.17	280	-36
384558.10	22	-91
676070	194	-76
Ganza	124	-81
285411.22	112	-90
573275	161	-68
676089	153	-54
5.19.2.2	357	-54
575003	92	-81
13.1.1	896	5

<u>Dry Matter Content</u>

Table 11 shows the significant differences in the dry matter content of the different genotypes. Highest dry matter content was obtained from genotypes 5.19.2.2 and 13.1.1. The differences of dry matter among the genotypes are due to varietal characteristics (Hesen, 1985) since dry matter content of the tubers is related to the potato variety.

Furthermore, genotypes 5.19.2.2 and 13.1.1 may be good for chips and French fry processing since high dry matter content of potatoes results in lower oil content of the fried product (Hesen, 1985).

Table 11. Dry matter content of the ten different potato genotypes

GENOTYPE	DRY MATTER (%)
380251.17	17[c]
384558.10	18[b]
676070	16[d]
Ganza	17[c]
285411.22	17[c]
573275	17[c]
676089	18[b]
5.19.2.2	19[a]
575003	18[b]
13.1.1	19[a]
CV (%)	2.34

Means with the same letter are not significantly different by DMRT (P>0.05).

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted in an organic farm at Sinipsip, Buguias, Benguet to evaluate the growth and yield performance of different potato genotype in an organic farm, to identify the best performing potato genotypes based on yield, to determine the profitability of the different potato genotypes, and to determine which of the potato genotypes will be selected by the organic farmer.

Temperature was low and the relative humidity was high in the organic farm during the growth of the different potato genotypes. The soil pH, organic matter, nitrogen and potassium increased after harvest while the phosphorous content of the soil decreased.

No significant differences were observed among the genotypes but 380251.17 had the highest percentage survival. Moreover, genotype 5.19.2.2 was the tallest at 35 and 83 days after planting. Genotypes 380251.17, 5.19.2.2, and 13.1.1 also were found to be highly vigorous while the rest were either moderately vigorous or vigorous.

An increasing trend of canopy cover was observed from genotypes 13.1.1, 5.19.2.2 and 676089 which could be an indication of resistance to late blight.

Genotypes 380251.17, 676070, 5.19.2.2 were selected by the farmer due to their resistance to late blight, medium to large tubers and high plant vigor. These genotypes can also withstand the unfavorable environmental condition in the farm.

Genotype 13.1.1 also had the highest ROCE (%) in both seed and table potato. Furthermore, genotypes 13.1.1 and 5.19.2.2 significantly had the highest dry matter content. These genotypes might therefore be good for processing.

Conclusion

Based on the results, genotype 13.1.1 which had the highest canopy cover and highest resistance to late blight infection also had the highest total yield. Furthermore, genotype 13.1.1 also had the highest ROCE (%) for both seed and table potato. Thus, it appears that wide canopy cover and resistance to late blight infection may enhance better yield.

Genotype 13.1.1 is therefore adopted and could be produced at Sinipsip, Buguias. In addition, genotypes 380251.17, 676070 and 5.19.2.2 might also be produced since these genotypes were selected by the farmer.

A low yield was observed in most of the genotypes which could be due to the very low temperature and high relative humidity at Sinipsip. This occurrence may explain the negative values of ROCE (%) for table potatoes.

Recommendation

Genotype 13.1.1 can be recommended for both seed and table production in Sinipsip, Buguias, Benguet.

Furthermore, to verify the results gathered, the genotypes could be planted during the months of February to May since conditions are more favorable for potato production during these months.

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APPENDICES

APPENDIX TABLE 1. Percent survival of the different potato genotypes at 30 days after planting

GENOTYPE	BLOCK			TOTAL	MEAN
	I	II	III		
380251.17	100	95	100	285	98
384558.10	48	78	93	219	73
676070	85	100	95	280	93
Ganza	90	83	78	251	84
285411.22	80	63	95	238	79
573275	75	58	73	206	67
676089	100	93	75	268	89
5.19.2.2	83	88	98	269	90
575003	85	100	100	285	95
13.1.1	75	83	98	256	85

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	385.067	192.533			
Treatment	9	2,488.033	276.448	2.05[ns]	2.46	3.60
Error	18	2,488.267	134.904			
TOTAL	29	5,301.367				

[ns] – Not significant

Coefficient of Variation = 13.57 %

APPENDIX TABLE 2. Plant vigor of the different potato genotypes at 30 days after planting

GENOTYPE	BLOCK			TOTAL	MEAN
	I	II	III		
380251.17	5	3	5	13	4
384558.10	5	3	3	11	4
676070	3	3	3	9	3
Ganza	5	5	5	15	5
285411.22	5	5	3	13	4
573275	3	3	5	11	4
676089	5	3	3	11	4
5.19.2.2	5	5	5	15	5
575003	3	3	5	11	3
13.1.1	3	5	3	11	3

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	0.800	0.400			
Treatment	9	11.333	1.259	1.27^{ns}	2.46	3.60
Error	18	17.867	0.993			
TOTAL	29	30.000				

^{ns} – Not significant

Coefficient of Variation = 24.91 %

APPENDIX TABLE 3. Plant vigor of the different potato genotypes at 45 days after planting

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
380251.17	5	5	5	15	5[a]
384558.10	3	3	3	9	3[c]
676070	3	3	3	9	3[c]
Ganza	3	3	3	9	3[c]
285411.22	3	3	3	9	3[c]
573275	5	3	3	11	4[b]
676089	5	5	3	13	4[b]
5.19.2.2	5	5	5	15	5[a]
575003	3	3	3	9	3[c]
13.1.1	5	5	5	15	5[a]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Block	2	0.800	0.400			
Treatment	9	23.467	2.607	10.35**	2.46	3.60
Error	18	4.533	0.252			
TOTAL	29	28.800				

** – Highly significant

Coefficient of Variation = 13.21 %

APPENDIX TABLE 4. Plant height of the different potato genotypes at 35 days after planting

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
380251.17	7.8	8.0	8.5	24.3	8.1[e]
384558.10	4.9	4.5	4.1	13.5	4.5[f]
676070	8.4	8.4	8.0	24.8	8.3[de]
Ganza	9.1	8.9	8.0	26.0	8.7[cd]
285411.22	11.7	11.0	10.0	32.7	10.9[b]
573275	9.0	9.3	9.2	27.3	9.1[c]
676089	10.7	10.5	10.0	31.2	10.4[b]
5.19.2.2	11.7	11.2	11.1	34.0	11.3[a]
575003	9.2	9.0	8.9	27.1	9.0[c]
13.1.1	11.8	11.5	10.9	34.2	11.4[a]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Block	2	1.730	0.865			
Treatment	9	114.614	12.735	109.44**	2.46	3.60
Error	18	2.094	0.116			
TOTAL	29	118.438				

** – Highly significant

Coefficient of Variation = 3.72 %

APPENDIX TABLE 5. Plant height of the different potato genotypes at 83 days after planting

GENOTYPE	BLOCK			TOTAL	MEAN
	I	II	III		
380251.17	23.2	23.3	23.5	70.0	23.3[ab]
384558.10	16.0	13.8	12.7	42.6	14.2[bc]
676070	23.2	20.0	17.2	60.4	20.1[ab]
Ganza	15.3	22.3	9.0	46.6	15.5[bc]
285411.22	0	20.00	0	20.00	6.7[c]
573275	26.6	16.0	16.0	58.6	19.5[b]
676089	28.7	24.8	16.3	69.8	23.3[ab]
5.19.2.2	29.3	31.1	35.3	95.7	31.9[a]
575003	24.5	24.3	15.8	64.6	21.5[ab]
13.1.1	11.4	34.1	27.1	72.6	24.2[ab]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	161.406	80.703			
Treatment	9	1,244.936	138.326	3.50*	2.46	3.60
Error	18	711.081	39.504			
TOTAL	29	2,117.423				

* – Significant   Coefficient of Variation = 31.38 %

APPENDIX TABLE 6. Canopy cover of the different potato genotypes at 30 days after planting

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
380251.17	20	7	14	41	14[a]
384558.10	6	4	4	14	5[c]
676070	16	6	7	29	10[abc]
Ganza	13	9	12	34	11[ab]
285411.22	10	9	5	24	8[bc]
573275	15	5	8	28	9[abc]
676089	15	6	6	27	9[abc]
5.19.2.2	12	8	10	30	10[abc]
575003	7	7	5	19	6[bc]
13.1.1	12	11	6	29	10[abc]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Block	2	178.067	89.033			
Treatment	9	167.500	18.611	2.57*	2.46	3.60
Error	18	130.600	7.256			
TOTAL	29	476.167				

* – Significant   Coefficient of Variation = 29.38 %

APPENDIX TABLE 7. Canopy cover of the different potato genotypes at 45 days after planting

GENOTYPE	BLOCK			TOTAL	MEAN
	I	II	III		
380251.17	23	13	16	54	18
384558.10	7	8	6	21	7
676070	17	10	9	36	12
Ganza	14	10	10	34	11
285411.22	7	10	6	23	8
573275	15	5	9	29	10
676089	20	12	8	40	13
5.19.2.2	12	12	13	37	12
575003	9	9	6	24	8
13.1.1	24	15	8	47	16

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	207.200	103.600			
Treatment	9	2,306.000	256.222	1.47^{ns}	2.46	3.60
Error	18	3,140.800	174.489			
TOTAL	29	5,654.000				

^{ns} – Not significant Coefficient of Variation = 31.57 %

APPENDIX TABLE 8. Canopy cover of the different potato genotypes at 60 days after planting

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
380251.17	21	14	23	58	19[b]
384558.10	3	9	7	19	6[d]
676070	17	14	13	44	15[bc]
Ganza	12	14	9	35	12[bcd]
285411.22	4	5	6	15	5[d]
573275	16	6	9	31	10[cd]
676089	22	15	9	46	15[bc]
5.19.2.2	17	16	21	54	18[b]
575003	11	13	7	31	10[cd]
13.1.1	34	23	23	80	27[a]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Block	2	56.267	28.133			
Treatment	9	1,136.033	126.226	8.08**	2.46	3.60
Error	18	281.067	15.615			
TOTAL	29	1,473.367				

** – Highly significant Coefficient of Variation = 28.70 %

APPENDIX TABLE 9. Canopy cover of the different potato genotypes at 75 days after planting

GENOTYPE	BLOCK			TOTAL	MEAN
	I	II	III		
380251.17	23	9	21	53	18[bc]
384558.10	5	4	4	13	4[e]
676070	19	12	13	44	15[bcd]
Ganza	4	16	4	24	8[dc]
285411.22	4	3	0	7	2[e]
573275	8	2	5	10	5[e]
676089	28	16	8	52	17[bcd]
5.19.2.2	20	15	25	60	20[b]
575003	12	13	6	31	10[cde]
13.1.1	38	38	31	101	36[a]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	104.867	52.433			
Treatment	9	2,664.800	296.089	11.20**	2.46	3.60
Error	18	475.800	26.433			
TOTAL	29	3,245.467				

** – Highly significant   Coefficient of Variation = 21.37 %

APPENDIX TABLE 10. Late blight incidence of the different potato genotypes at 45 days after planting

GENOTYPE	BLOCK			TOTAL	MEAN
	I	II	III		
380251.17	1	2	2	5	2[d]
384558.10	2	5	3	10	3[cd]
676070	3	3	3	9	3[cd]
Ganza	5	4	5	14	5[ab]
285411.22	7	5	6	18	6[a]
573275	3	4	4	11	4[bc]
676089	3	4	3	10	3[cd]
5.19.2.2	3	4	3	10	3[cd]
575003	2	3	3	8	3[cd]
13.1.1	3	1	3	7	2[d]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	0.600	0.300			
Treatment	9	34.867	4.430	6.26**	2.46	3.60
Error	18	12.733	0.707			
TOTAL	29	53.200				

** – Highly significant　　Coefficient of Variation = 24.74 %

APPENDIX TABLE 11. Late blight incidence of the different potato genotypes at 60 days after planting

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
380251.17	3	3	3	9	3[c]
384558.10	7	3	3	13	4[bc]
676070	3	4	3	10	3[c]
Ganza	6	5	5	16	5[b]
285411.22	8	6	6	20	7[a]
573275	4	3	3	10	3[c]
676089	3	3	3	9	3[c]
5.19.2.2	3	3	3	9	3[c]
575003	5	3	3	11	4[bc]
13.1.1	3	3	2	8	3[c]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Block	2	7.400	3.700			
Treatment	9	38.800	4.311	4.17**	2.46	3.60
Error	18	18.600	1.033			
TOTAL	29	64.800				

** – Highly significant   Coefficient of Variation = 26.75 %

APPENDIX TABLE 12. Late blight incidence of the different potato genotypes at 75 days after planting

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
380251.17	3	4	5	12	4^{bcd}
384558.10	6	7	2	15	5^{bc}
676070	3	4	4	11	4^{bcd}
Ganza	6	5	7	18	6^{b}
285411.22	7	8	9	24	8^{a}
573275	3	6	6	15	5^{bc}
676089	2	3	4	9	3^{cd}
5.19.2.2	4	5	4	13	4^{bcd}
575003	3	4	4	11	4^{bcd}
13.1.1	2	3	2	7	2^{d}

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Block	2	5.600	2.800			
Treatment	9	70.833	7.870	6.65^{**}	2.46	3.60
Error	18	25.067	1.393			
TOTAL	29	101.500				

** – Highly significant   Coefficient of Variation = 26.22 %

APPENDIX TABLE 13. Weight of marketable tubers of the different potato genotypes per $5m^2$ (g)

GENOTYPE	BLOCK			TOTAL	MEAN
	I	II	III		
380251.17	2,000	1,043	1,697	4,740	1,580[b]
384558.10	267	178	240	685	228[e]
676070	632	522	667	1,821	607[de]
Ganza	667	364	400	1,431	477[de]
285411.22	325	182	240	747	249[e]
573275	1,500	343	500	2,343	781[cd]
676089	1,520	720	400	2,640	880[cd]
5.19.2.2	1,667	667	1,037	3,371	1,124[bc]
575003	490	433	473	1,396	465[de]
13.1.1	2,609	2,727	2,375	7,711	2,570[a]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	1,142,080.267	571,040.133			
Treatment	9	13,436,513.500	1,548,501.500	19.25**	2.46	3.60
Error	18	1,447,676.400	80,426.467			
TOTAL	29	1+,526,270.167				

** – Highly significant

Coefficient of Variation = 15.79 %

APPENDIX TABLE 14. Weight of marketable tubers of the different potato genotypes per $5m^2$ (g)

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
380251.17	114	87	30	231	77^{ab}
384558.10	0	4	40	44	15^{e}
676070	84	26	27	137	46^{bc}
Ganza	17	18	50	85	28^{bc}
285411.22	50	36	80	166	55^{abc}
573275	67	6	67	140	48^{bc}
676089	56	64	53	173	58^{abc}
5.19.2.2	22	33	44	99	33^{bc}
575003	40	100	73	213	71^{ab}
13.1.1	87	91	130	308	103^{a}

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Block	2	835.800	417.900			
Treatment	9	17,896.133	1,988.459	2.66*	2.46	3.60
Error	18	13,454.867	747.493			
TOTAL	29	32,186.800				

* – Significant Coefficient of Variation = 30.14 %

APPENDIX TABLE 15. Total yield of the different potato genotypes per $5m^2$ (g)

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
380251.17	2,114.4	1,130.4	1,727.2	4,972.0	1,657[b]
384558.10	266.8	182.4	280.0	729.2	243[f]
676070	716.0	548.0	6932.2	1,957.2	653[cdef]
Ganza	683.2	382.0	450.0	1,515.2	505[def]
285411.22	374	218.4	320.0	912.0	304[ef]
573275	1,520.3	400.0	566.8	2,487.1	829[cde]
676089	1,576.0	784.0	453.2	2,813.2	938[cd]
5.19.2.2	1,688.8	700.0	1,0813.6	3,470.4	1,157[c]
575003	530.0	533.2	544.8	1,608.0	536[def]
13.1.1	2,695.6	2,818.0	2,505.2	8,018.8	2,673[a]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Block	2	720.319	360.160			
Treatment	9	9,104.912	1,011.657	20.14**	2.46	3.60
Error	18	904.201	50.233			
TOTAL	29	10,729.433				

** – Highly significant

Coefficient of Variation = 29.68 %

APPENDIX TABLE 16. Dry matter content (%) of the different potato genotypes

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
380251.17	17	17	17	51	17[c]
384558.10	18	18	18	54	18[b]
676070	16	16	16	48	16[d]
Ganza	17	17	17	51	17[c]
285411.22	17	17	18	52	17[c]
573275	17	17	16	50	17[c]
676089	17	18	18	53	18[b]
5.19.2.2	19	19	20	58	19[a]
575003	18	18	18	54	18[b]
13.1.1	19	20	19	58	19[a]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Block	2	0.267	0.133			
Treatment	9	31.633	3.575	20.63**	2.46	3.60
Error	18	3.067	0.170			
TOTAL	29	34.967				

** – Highly significant   Coefficient of Variation = 2.37 %