BIBLIOGRAPHY

MONTES, FROILAN R. APRIL 2006. Growth and Yield of Potato Genotypes in an Organic Farm at Puguis, La Trinidad, Benguet. Benguet State University, La Trinidad Benguet.

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ABSTRACT

The study was conducted to: determine the growth and yield of potato genotypes at Master's Garden, Puguis, La Trinidad, Benguet; determine the best potato genotypes in terms of yield, disease and insect pest resistance; determine the economic benefit of organic potato production using different genotypes; and determine which of the genotypes will be selected by the farmer.

Genotypes 676089, 5.19.2.2, Kennebec and Ganza were observed to have produced plants which are highly vigorous at 35 days after planting (DAP). Genotype 676089 produced the tallest plants, the highest weight of tubers and highest dry matter content of tubers. Genotypes IP84007.67, 676070, and 13.1.1 were observed to be resistant to late blight at 60 and 75 DAP. For the cost and returns for seed tuber production, genotype 380251.17 obtained the highest return on cash expense.

Based on the results, genotype 676089 is the best grown in plastic pots under organic production at Master's Garden due to highly vigorous and tall plants, high yield, high dry matter content of tubers and resistance to late blight. Genotypes IP84007.67,

676070, and 13.1.1 could be grown under the conditions of the study as shown by their resistance to late blight.

IP84007.67, 676089 and Ganza were selected by the organic practitioner based on yield and resistance to late blight.

Profits can be obtained in most of the genotypes if sold as seed tubers. High profit could be obtained if G_1 tubers will be sold as organic seeds or planting materials.

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INTRODUCTION

The potato (*Solanum tuberosum* L.) is one of mankind's most valuable food. It produces more energy and protein per cultivated area and per unit of time than most other major crops (CIP 1988). Potato has a high nutritive value being particularly rich in carbohydrates, protein, minerals and vitamins. It ranks first, both in popularity and value among the vegetable crops grown in the northern provinces of the Philippines. A total area of 2,000 to 3,000 hectares is planted annually to potato in Benguet and Mountain Province, the country's main potato production areas, but productivity has not yet reached maximum potential (PCARRD, 1982).

Conventional practices of potato production employs the use of inorganic fertilizers and chemical pesticides. However, this kind of practice will lead to environmental degradation according to researches. The water is contaminated, the air is being polluted and the soil is turning acidic. An alternative practice to these problems is organic farming. According to Briones (1997), organic farming employs the use of organic fertilizers, diverse cropping system, sanitation and without the use of any chemical pesticides. An example of an organic farm is the Master's garden at Puguis, La Trinidad, Benguet.

Another practice in organic farming is the use of resistant varieties against diseases and insects. Resistant varieties would minimize the use of synthetic fungicides and insecticides, thus, evaluation of varieties under organic production is important. In this kind of practice, food production will become sustainable, because not only soil fertility is improved but also increased crop production. Farmers not only use low inputs in the production but also they can gain high profit. Products are also safe to eat since there are no harmful chemical content.

The objectives of the study were to:

1. determine the growth and yield of potato genotypes at Master's Garden, Puguis, La Trinidad, Benguet;

2. determine the best potato genotypes in terms of yield, disease and insect pest resistance;

3. determine the economic benefit of organic potato production using different genotypes; and

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

This study was conducted at Master's garden, Puguis, La Trinidad, Benguet from October 2005 to January 2006.

REVIEW OF LITERATURE

Organic Farming Defined

According to Briones (1997), Organic Agriculture (OA) is the traditional term used by the farmers to include all the diverse farming system without the use of chemical inputs. Further, organic agriculture promotes and enhances a holistic production management, which includes agro-ecosystem, health including bio-diversity, biological cycles and soil biological activity. Crop rotations, green manuring recycling of farm manure as other ecological ways of building up soil fertility and productivity were the appropriate practiced in organic farming.

Components of Organic Farming

Use of organic fertilizers. Composting can be an effective strategy to stabilize paper mill residuals prior to land application (Valente *et al*, 1987; Campbell *et al*, 1995). According to Evanylo and Daniels (1991) the composting process biologically stabilize heterogeneous raw paper mill residuals reduces mass and volume and thus handling and hauling cost.

According to Balaoing (1995), the nutrient content of organic fertilizer particularly in rice straw has N, P, K, Ca, Mg, Na and S. The soil reaction with the exception of urea, becomes acidic if inorganic fertilizers are used for a longer period of time. Organic fertilizers stimulate and increase a much greater extent of microbial populations in the soil. Organic fertilizer aids the plants in absorbing more nutrients already present in the soil, the soil turns black because of rich in humus. Moisture retains longer, and preventing the crops from drying up when the soil is rich in organic matter. It minimizes pollution because the compost was recycled from rotten wastes. And most of all organic fertilizer is cheaper.

Organic farmers build healthy soils by nourishing the living component of the soil, its microbial inhabitants that release, transform and transfer nutrients. The soil organic matter, will contributes to good soil structure and water holding capacity, Organic farmers feed soil biota and built soil organic matter with the practice of cover crops, compost and biologically based soil amendments. This kind of practice will produce healthy plants that able to resist disease and insect predation (Anonymous, 2005).

Crop protection in organic farming. Pest control is done without applying chemical methods. The strategy of organic farmers in controlling pest and diseases is prevention through good plant nutrition and management. With the use of cover crops and sophisticated crop rotations that will change the field ecology, effectively disrupting the habitat for weeds, insects and disease organisms. Organic farmers are relying on a diverse population of soil organisms, beneficial insects and birds to keep the pests in check. When pest populations get out of balance, growers will implement a variety of strategies such as the use of predators, mating disruption, traps and barriers, growers are required to use sanitation and cultural practices first before they can resort to applying an organic pesticides to control the weed, pests and disease problems (Pawar, 2005).

Diversity in organic farming. As cited by Pawar (2005), diverse cropping as crop production will follow the pattern in time and space. This practice will include multistory cropping, mixed cropping, crop rotation, strip and relay intercropping etc. It enhances ecological benefits simultaneously, which maintains efficiency of production. The benefits of crop diversification includes: increased yield, reduced pest incidence improved weed control, reduced soil erosion, the recycling of nutrient reserves from depth of soil and transfer of nitrogen from nitrogen fixing species.

Importance of Variety Evaluation in Organic Farming

The proposed standard of variety selection in organic farming was expectedly adopted locally that are common in the area, with resistance to pests and diseases, so that the crop planted have high production. However, the new revisions limit the use of non-organically produced seeds. Therefore, farmers are required to use-certified organic seed; bulbs, tubers, cuttings, annual seedlings, that it should be transplanted when readily available. All propagation materials used in organic farming must be of organic in origin. Organic farmers need the varieties that are adapted well to specific soil and fertility conditions. In several circumstances varieties that do not perform well in organic system have different yield rankings. In selection the right variety the farmer must also consider the consumer requirement, supermarket requirement, variety maturity in order to achieve the best production needed (Singh, 1999).

MATERIALS AND METHODS

The Farm

The Master's Garden is located at Sitio Pinalyok, Puguis, La Trinidad, Benguet. It is 2 km from Naguilan Road. When passing at Tam-awan Village Longlong, La Trindad, Benguet, the farm is 2 km away. The elevation of the farm is 1,342 m asl and 15^{o}13" east latitude and longitude (Fig. 1).

The Master's Garden is an organic farm, with an area of 1,500 m^2 producing mainly vegetables. The topography is terraced and every terrace is constructed with a greenhouse. The planting area were beds constructed with bricks measuring 1 m width with no constant length. These bricks are permanently cemented (Fig. 2).

The crops being planted are different varieties of lettuce and other greens like zucchini garden peas, arugula and bush beans. Other vegetables include carrots, broccoli, cucumber, tomatoes and cabbage and sugar beets. Some herbs are also planted in small scale like marjoram, thyme, basil, rosemary, parsely, lemon balm, dill, sage, mint, chives, oregano and tarragon.

The Farmer and His Practices

Mr. Ambrosio L. Acosta is 46 years old, completed a degree of Bachelor of Science in Agriculture major in Horticulture at the University of the Philippines, Los Baños, Laguna (UPLB).

Mr. Acosta is an organic practitioner for six years producing various crops. He attended various trainings such as; Organic Farming seminar at Sta. Cruz, California, USA; Willitt's Bio Intensive Farming at California; Rodale Organic farming at New

York, USA and the first Organic Congress held at BSU this year. He is a full time farmer and has three employees. The income he generated in 2004 and 2005 is P 360,000.00 from his main crop, lettuce.

Compost making. Fresh shredded grasses are placed in one corner and sprayed with Effective Microorganism (EM1). After two weeks, the compost is ready to be applied as fertilizer for seedling production.

Nursery management. Seedlings are planted in trays. After two weeks from seed emergence, the seedlings are transferred to small plastic pots. Two weeks after, the seedlings are transplanted in beds of the greenhouse.

Land preparation. The soil is dug with the use of Japanese hoe with a deep plow of about 12 inches.

Organic fertilizer application. Fertilizer application is basal. Hilling up is done only in cabbage and broccoli, by making mounds between rows before planting. After two weeks mounds are spread at the base of the plants.

Irrigation. Sprinkler method is used.

Pest and disease management. Insect pest and diseases are controlled by a combination of the following: crop rotation; mix cropping; spraying of *Bacillus thurengiensis* (Bt) and use of resistant varieties.

Harvesting. Harvesting is staggered, because of diversity of crops planted in the farm.

The Experiment Proper

Preparation of Planting Materials

First, potato mother plants were established from the different genotypes. When the mother plants have produced apical shoots, these were ready for stem cutting production. Apical shoots were cut when mother plants have three to four simple leaves. The shoots were cut just above the node using a sterilized sharp scarpel or blade. The blades were dipped in soap or lysol solution before cutting the next plant. Sanitation was employed to prevent the spread of diseases and viruses.

The composition of the soil for rooting is one sack carbonized rice hull, 1/3 sack of compost and two sacks of subsoil. The soil mixture was moistened, covered with plastic and left for two weeks before used for rooting. The stem cuttings were rooted for 10 to 14 days in the nursery before transplanting in pots.

Lay-out of the Experiment and Treatments

The genotypes were laid out following randomized complete block design (RCBD) with three replications as follows:

GENOTYPE	ORIGIN
T_1 – IP84007.67	CIP, Peru
T_2 – 380251.17	CIP, Peru
T_3 – 676070	CIP, Peru
T_4 – 5.19.2.1	Philippines
T_5 – 573275	CIP, Peru
T_6 – 676089	CIP, Peru
T_7 – 5.19.2.2	Philippines
T_8 – 13.1.1	CIP, Peru

T_9 – Kennebec	USA
T_{10} – Ganza	CIP, Peru

Preparation of Medium for the Establishment of Plants

The planting medium was a mixture of one part compost and two parts of garden soil. The compost were purely grasses of different species. The collected grasses were shredded and composted within 14 days with the help of effective microorganisms. Four kilograms soil mixture was placed in plastic pots to reach 3 to 4 inches depth before planting. When the plants reached a height of 6 inches, fresh shredded grasses and soil were added. Green manure was added twice until the pots are filled-up with soil.

Planting and Plant Establishment

Pots measuring 8 x 16 inches were planted with two rooted stem cuttings per pot, thus a total of 10 plants per treatment in every replication there were 50 pots (Fig. 3 and 4).

Management Practices

All management practices employed from planting to postharvest were all farmer's practices. There were no chemical spraying done. Instead, crop protection relied on diversity of the crops present in the farm.

Irrigation was done using the sprinkler method.

Data Gathered

A. Climatic data

The following meteorological data were taken from BSU- PAGASA:

1. Temperature

2. Relative Humidity
3. Rainfall
4. Sunshine duration

B. Growth parameters

1. Plant vigor. Plant vigor was taken at 35 days after planting (DAP) using CIP rating scale (NPRCRTC, 2003).

SCALE	DESCRIPTION	REMARKS
1	Plants are weak with few stems and leaves; very pale	Poor vigor
2	Plants are weak with few thin stems and leaves; pale	Less vigorous
3	Better than less vigorous	Moderately vigorous
4	Plants are moderately strong with robust stems and leaves; leaves are light green in color	Vigorous
5	Plants are strong with robust stems and leaves; leaves are light to dark green in color	Highly vigorous

2. Height at 30 and 85 DAP. Heights of the plants were measured at 30 and 85 DAP from the base of the plant to the tip of the tallest shoot.

3. Haulm weight. This was weighed after separating the roots and tubers at harvest.

C. Reaction to late blight infection and leaf miner infestation

1. Late blight infection. Rating was done at 45, 60 and 75 DAP using CIP (Henfling, 1982) rating scale as follows:

BLIGHT	SCALE	DESCRIPTION
1	1	No blight to be seen
01-1	1	Very few plants in larger treatment with lesions. Not more than 2 lesions per 10m of row (+/-30 plants).
1.1- 2	2	Up to 10 small lesions per plant.
3.1-10	3	Up to 30 small lesions per plant or up to 1 each leaflets attacked.
10.1-24	4	Most plants are visibly attacked and 1 in 3 leaflets infected. Multiple infections per leaflets.
25-49	5	Nearly every leaflet with lesions. Multiple infections per leaflets are common. Field or plot looks green, but all plants in pots are blighted.
50-74	6	Every plant blighted and half the leaf area destroyed by blight fields look green-flecked, and brown, blight is very obvious.
75-90	7	As previous, but 3/4 of each plant blighted. Lower branches may be overwhelmingly killed off, and the only green leaves, if any, are spindly due to extensive foliage loss. Field looks neither brown nor green.
91-97	8	Some leaves and most stems are green. Field looks brown with some leaves patches.
97.1-99.9	9	Few green leaves almost all with blight lesions remain. Many stem lesions field looks brown.
100	9	All leaves and stems dead.

Description: 1-Highly resistant; 2-3–Resistant; 4-5–Moderately resistant; 6 -7–Moderately susceptible; 8-9–Susceptible.

D. Yield and yield components

1. Weight of marketable tubers per plant (g). All tubers with diameter of more than 1.5 cm were weighed.

2. Weight of non-marketable tubers per plant (g). All tubers that were malformed, damaged by pest and diseases, injured with greening were weighed.

3. Total yield per plant (g). The total weight of marketable and non-marketable tubers were taken.

E. Other parameters

1. Dry matter content (DMC). A 20 g fresh tuber sample was weighed and oven dried for 24 hours at 80 $^{\circ}$C. After 24 hours, dry weight was obtained using a sensitive balance.

Dry matter content of tubers was obtained by the following formula.

$$\% \text{ DMC} = 100 - \% \text{ MC}$$

$$\text{Where: } \% \text{ MC} = \frac{\text{Fresh weight} - \text{Oven dry weight}}{\text{Fresh weight}} \times 100$$

2. Cost and return analysis. The cost of production, gross sales, net profit and return on cash expense were determined. Return on cash expense was computed by the following formula:

$$\text{ROCE } \% = \frac{\text{Net Profit}}{\text{Total cost of Production}} \times 100$$

3. Farmer's selection. At harvest, the farmer selected the genotype of his choice and cited the reasons for choosing the genotypes.

Data Analysis

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

Fig. 1. Overview of the greenhouses

Fig. 2. Planting area composed of beds constructed with bricks

Fig. 3. Planting of rooted stem cuttings in pots

Fig. 4. Pots planted with rooted stem cuttings

RESULTS AND DISCUSSION

Climatic Data

Table 1 shows the climatic data during the conduct of the study. The temperature ranged from 15.57 °C to 24.51°C. Mean relative humidity was 80.81 %. Rainfall is quite low with an average of 2.01 mm. Sunshine duration ranged from 243.4 to 369.17 Kj during the conduct of the study.

Temperature, relative humidity and sunshine duration during the conduct of the study were favorable for potato production as reported by researchers (PCARRD, 1982). The occurrence of rainfall may have contributed to high humidity which indirectly caused occurrence of late blight at the later stages of growth.

Table 1. Climatic data of the area during the experiment

MONTH	TEMPERATURE (°C)		RELATIVE HUMIDITY	RAINFALL AMOUNT (mm)	SUNSHINE DURATION (Kj)
	MAX	MIN			
October	24.25	18.25	82.5	0.9	287.1
November	24.51	17.91	79.75	1.6	303.65
December	23.42	16.81	78.62	0	243.4
January	23.15	15.57	82.37	5.57	369.17
MEAN	23.83	17.13	80.81	2.01	301.65

SOURCE: BSU- PAG – ASA (2006).

Chemical Properties of the Planting Medium

Soil pH. Table 2 shows that pH after harvest increased. The increase might be due to the application of green manure and compost as claimed by earlier researches on organic fertilizers.

According to Motes and Criswell (2000), potatoes grow well in a wide variety of soils and soil pH range from 5.0 to 6.5 with satisfactory production.

Soil Organic Matter. Table 2 shows that the organic matter of the medium decreased from 17.5 % to 6.0 %. The decline could be due to the fact that total amount of crop residues returned to the soil is low when there is continuous production of crops such as potato (Motes and Criswell, 2000).

Nitrogen. Nitrogen of the medium also decreased. This could be due to the high uptake of nutrient needed by the potato plant. Several researchers reported that potatoes need high amount of nitrogen for growth and development (Motes and Criswell, 2000).

Phosphorous. There was an increase in the total phosphorous content in the medium. The increase in the phosphorous content may be due to the green manure and compost incorporated in the soil. This corroborates with the study of Haluschak *et al*. (2004) that green manure and compost increase the phosphorus content of the soil. Balaoing (1995) likewise claimed that rice straw contains N, P, K, Ca, Mg, Na and S. Since the compost used are plant-based materials, these may have the same composition.

Potassium. Potassium in the soil increased. The increase could be attributed to more available potassium of the planting medium after green manure application.

Table 2. The initial and final analysis of the planting medium

	pH	OM (%)	N (%)	P (ppm)	K (ppm)
Before planting	6.64	17.5	0.87	75	2,960
			5		
After harvest	6.76	6.0	0.3	360	3,000

Source: Bureau of Soils, Pacdal, Baguio City

Growth Parameters

Plant Vigor at 35 DAP

Genotypes 676089, 5.19.2.2, Kennebec and Ganza were highly vigorous at 35 DAP (Table 3). Highly vigorous plants maybe due to the amendments incorporated in the soil. The compost used nutrients that sustained the plants (Acosta, 2005). According to Balaoing (1995), organic fertilizers aid the plants in absorbing more nutrients and the soil is rich in humus.

Table 3. Plant vigor of ten potato genotypes at 35 DAP

GENOTYPE	PLANT VIGOR
IP84007.67	Vigorous
380251.17	Highly vigorous
676070	Vigorous
5.19.2.1	Vigorous
573275	Vigorous
676089	Highly vigorous
5.19.2.2	Highly vigorous
13.1.1	Highly vigorous
Kennebec	Highly vigorous
Ganza	Highly vigorous

Height at 30 and 85 DAP

Table 4 shows the height of the plants at 30 and 85 DAP. Genotype 676089 significantly produced the tallest plants, while genotype 5.19.2.2 had the shortest plants. As for height at 85 DAP, genotype 676089 maintained the tallest plants, not significantly different with genotype 13.1.1 but was comparable with IP84007.67 and 5.19.2.2.

Among the ten genotypes, eight have increased in height. Two genotypes showed decrease in height at 85 DAP. The decrease could be attributed to late blight infection which affected the main branch of the plants. The measured part was the remaining secondary branches. Fig. 5 and 6 show the plants at 45 DAP.

Table 4. Height at 30 and 85 DAP of ten potato genotypes

GENOTYPE	HEIGHT* (cm)	
	30 DAP	85 DAP
IP84007.67	24.33	25.43[ab]
380251.17	21.20	11.87[cd]
676070	21.30	25.90[ab]
5.19.2.1	11.87	16.53[bcd]
573275	19.13	19.43[abcd]
676089	26.67	30.83[a]
5.19.2.2	23.50	29.27[ab]
13.1.1	16.43	30.70[a]
Kennebec	13.47	6.67[d]
Ganza	17.83	22.77[abc]
CV (%)	16.29	24.70

*Means with common letter are not significant by DMRT (P > 0.05).

Fig. 5. The plants at 45 days after planting

Fig. 6. The plants at 45 days after planting

Haulm Weight

Table 5 shows the haulm weight of ten potato genotypes per plant. There were no significant differences observed, however, numerically genotype IP84007.67 had the highest haulm weight. Kennebec had the lowest haulm weight produced. Low haulm weights were obtained from the most of the genotypes, which could be due to late blight infection.

Table 5. Haulm weight of ten potato genotypes

GENOTYPE	HAULM WEIGHT (g/plant)
IP84007.67	28.5
380251.17	10.6
676070	22.6
5.19.2.1	10.7
573275	9.0
676089	10.0
5.19.2.2	20.1
13.1.1	10.7
Kennebec	2.1
Ganza	14.6
CV (%)	38.7

Late Blight Incidence

Late blight rating of the ten potato genotypes at 45, 60 and 75 DAP is shown in Table 6. At 45 DAP, all of the genotypes were highly resistant. At 60 DAP, genotypes 380251.17, 5.19.2.1 and Kennebec were still resistant. At 75 DAP, IP84007.67, 676070 and 13.1.1 remained resistant while the other genotypes were susceptible to late blight.

The late blight infection maybe attributed to the high rainfall which directly affected the relative humidity. Pathologists reported high late blight infection when relative humidity is increased (Anonymous, 2006).

It was observed that all genotypes were resistant to late blight at 60 DAP before rainfall had occurred. The resistance of the genotypes could be due to the organic matter present in the medium which nourished the plants. This was confirmed by claims that soil organic matter feed soil biota with the practice of cover crops, compost and biologically-based soil amendments. This kind of practice produces healthy plants that able to resist disease and insect predation (Anonymous, 2005).

Table 6. Late blight incidence of ten potato genotypes at 45, 60 and 75 DAP

GENOTYPE	LATE BLIGHT RATING		
	45 DAP	60 DAP	75 DAP
IP84007.67	1	1	3
380251.17	1	3	7
676070	1	1	3
5.19.2.1	1	2	6
573275	1	1	5
676089	1	1	6
5.19.2.2	1	2	8
13.1.1	1	1	3
Kennebec	1	2	8
Ganza	1	1	6
CV (%)	25.35	20.70	22.08

Rating scale: 1 – Highly resistant; 2-3 – Resistant; 4-5 – Moderately resistant; 6-7 – Moderately susceptible; 8-9 – Susceptible.

Leaf Miner Incidence

There was no incidence of leaf miner among the ten potato genotypes. Plants were not infested with any insect during the conduct of the study. This could be attributed to the diversity of plants present in the area. This confirms the claim of Pawar (2005) that crop diversification could reduce pest incidence, improved weed control, reduced soil erosion, the recycling of nutrient reserves from depth of soil and transfer of nitrogen from nitrogen fixing species.

Yield and Yield Components

Marketable, Non-marketable and Total Yield Per Plant

Table 7 shows the marketable yield of ten potato genotypes per plant. Numerically, genotype 676089 and Ganza produced the highest yield of marketable tubers while genotype 5.19.2.1 produced the lowest. However, there were no significant differences observed among the ten genotypes.

Genotype 676089 produced the highest non-marketable yield per plant, but no significant differences were observed (Table 7). Genotype 676089 had the highest total yield per plant. The high yield of 676089 and Ganza could be attributed to highly vigorous plants and moderate resistance to blight infection. Fig. 7 A-J shows the marketable and non-marketable tuber of the ten potato genotypes.

Table 7. Marketable, non-marketable and total yield per plant of ten potato genotypes

GENOTYPE	YIELD (g/plant)		
	MARKETABLE	NON-MARKETABLE	TOTAL
IP84007.67	47.69	8.39	56.09
380251.17	64.17	16.38	80.55
676070	37.80	6.19	43.99
5.19.2.1	23.50	5.67	29.17
573275	39.30	7.50	46.80
676089	82.50	32.33	114.83
5.19.2.2	45.18	5.71	50.59
13.1.1	50.41	14.58	65.00
Kennebec	47.14	5.42	52.57
Ganza	84.07	8.24	92.31
CV (%)	28.64	42.47	27.71

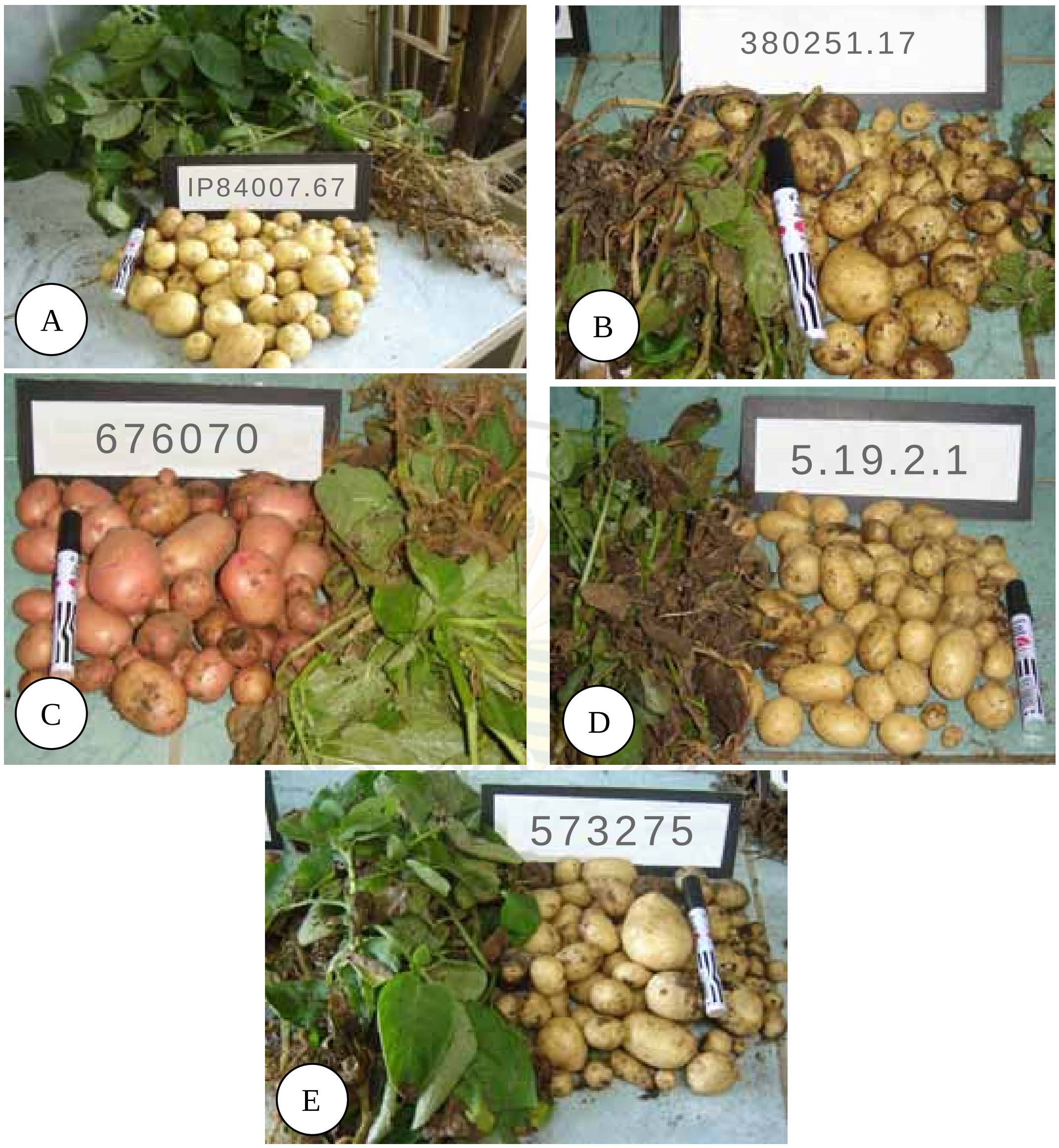

Fig. 7. Marketable and non-marketable yields of A- IP84007.67; B- 380251.17; C- 676070; D- 5.19.2.1; E- 573275

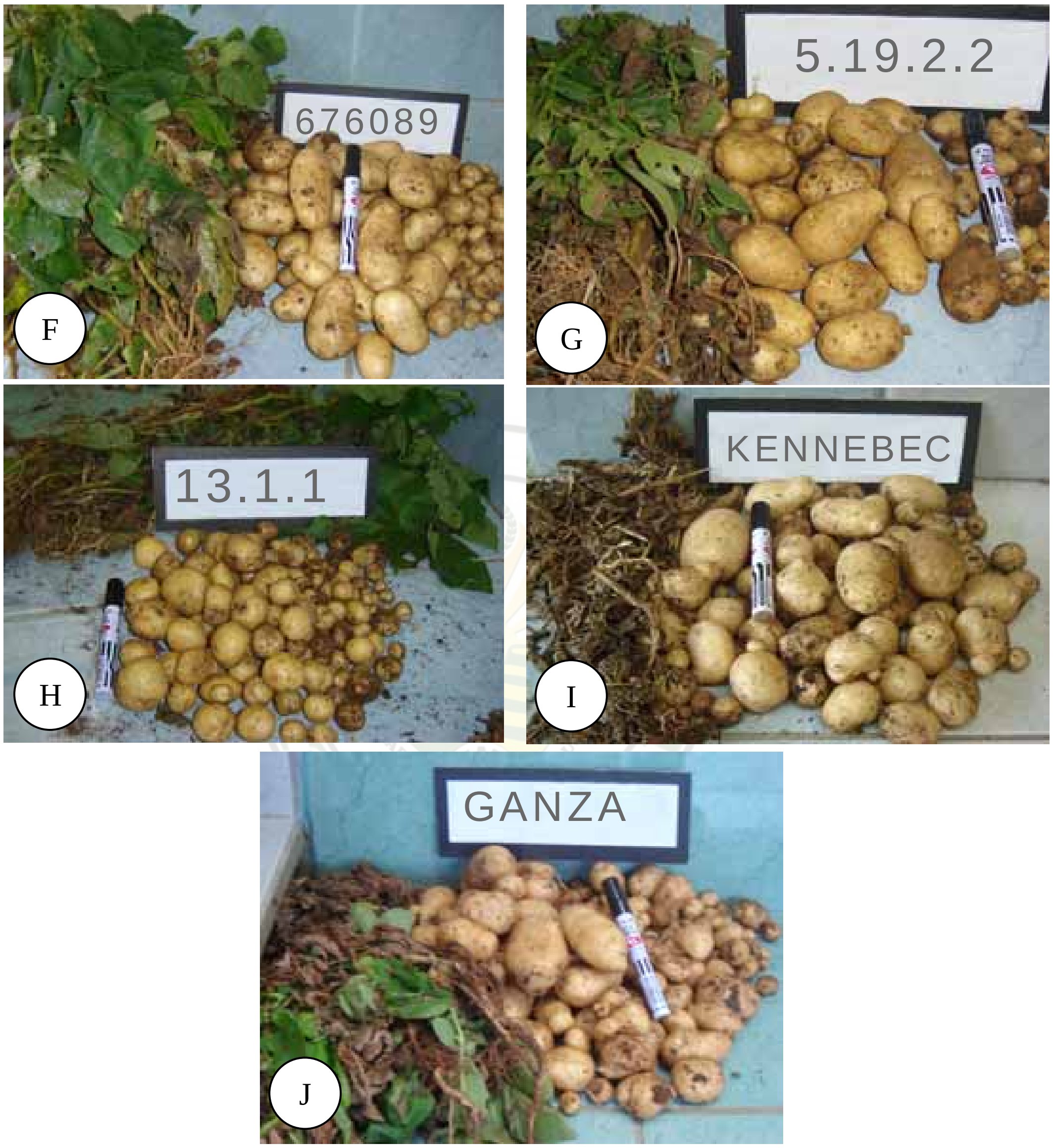

Fig. 7. Marketable and non-marketable yields of F- 676089; G- 5.19.2.2; H- 13.1.1; I- Kennebec; J- Ganza

Other Parameters

Dry Matter Content (DMC)

Table 8 shows the dry matter content of tubers of the ten potato genotypes. Highly significant differences of tubers were noted among the ten genotypes. Genotype 676089 obtained the highest tuber DMC, but not significantly different with Kennebec. Genotype 380251.17 had the lowest DMC of tubers.

DMC of tubers ranged from 18 to 24 %, an indication of good processing types of potatoes. Earlier reports show that processing potatoes should have at least 18 % DMC.

Table 8. Dry matter content of tuber of ten potato genotypes

GENOTYPE	DRY MATTER CONTENT* (%)
IP84007.67	19^{cd}
380251.17	18^{d}
676070	21^{b}
5.19.2.1	20^{bc}
573275	20^{bc}
676089	24^{a}
5.19.2.2	20^{bc}
13.1.1	19^{cd}
Kennebec	23^{a}
Ganza	20^{bc}
CV (%)	3.17

*Means with common letter are not significant by DMRT (P > 0.05).

Cost and Return Analysis

The cost and return analysis is based on the intended use of the harvested tubers. The farmer intended to use the tubers as planting material or seed purposes. Since the tubers were grown from stem cuttings, these were considered as G_1 tubers. G_1 tubers were priced at P 2.00 per piece at the Bureau of Plant Industry and Northern Philippines Root Crops Research and Training Center (Table 9).

Positive ROCE was obtained from seven genotypes. Genotype 380251.17 had the highest with 188.0 % followed by Ganza with 92.0% and IP84007.67, 676070 and 676089 with 60.0 %.

A positive ROCE implies that organic seed tuber production is profitable considering the demand of organic potatoes by farmers and consumers in the locality (Acosta, 2006).

Table 9. Cost and return analysis on potato production (per ten plants basis)

GENOTYPE	TOTAL COST OF PRODUCTION*	TOTAL NUMBER OF TUBERS**	GROSS INCOME	NET INCOME	ROCE (%)
IP84007.67	62.50	50	100.00	37.50	60.0
380251.17	62.50	90	180.00	117.50	188.0
676070	62.50	50	100.00	37.50	60.0
5.19.2.1	62.50	30	60.00	-2.50	-4.0
573275	62.50	40	80.00	17.50	28.0
676089	62.50	50	100.00	37.50	60.0
5.19.2.2	62.50	30	60.00	-2.50	-4.0
13.1.1	62.50	40	80.00	17.50	28.0
Kennebec	62.50	30	60.00	-2.50	-4.0
Ganza	62.50	60	120.00	57.50	92.0

*Total cost of production includes cost of plastic pots, stem cuttings and labor.
**The tubers were sold as G_1 seed tubers and at P2 .00/tuber (NPRCRTC, 2005).

Farmer's Selection and Reasons for Choice

Table 10 shows the selected potato genotypes by the farmer. After harvest, the organic practitioner, Mr. Acosta selected only three genotypes. He based his selection on resistance to late blight, high yield and the physical appearance of the tubers. IP84007.67, 676089 and Ganza were the selected genotypes. Fig. 8 shows Mr. Acosta selecting the genotypes and the tubers of genotypes he selected.

Table 10. Genotypes selected by the farmers and reasons for choice

GENOTYPE	REASON
IP84007.67	Smooth skin, resistance to late blight
676089	High yield, resistance to late blight
Ganza	High yield, resistance to late blight

Fig. 8. A- Mr. Acosta selecting the potato genotypes; B-D – Selected potato genotypes by Mr. Acosta; B- IP84007.67; C- 676089; D- Ganza

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at Master's Garden, Puguis, La Trinidad, Benguet from October 2005 to January 2006. This study aimed to: determine the growth and yield of the potato genotypes; determine the best potato genotypes in terms of yield, disease and insect resistance; determine the economic benefit of organic potato production using different genotypes; and determine which of the genotypes will be selected by the farmer.

Genotypes 676089, 5.19.2.2, Kennebec, and Ganza were observed to have highly vigorous plants at 35 DAP. Genotype 676089 produced the tallest plants, had the highest weight of tubers and highest dry matter content of tubers. Genotypes IP84007.67, 676070 and 13.1.1 were resistant to late blight. In terms of ROCE for seed tuber production, genotype 380251.17 obtained the highest.

Conclusion

Based on the results, genotype 676089 could be best grown in plastic pots under organic production at Master's Garden due to highly vigorous plants, tallest plants, high yield and high dry matter content of tubers and resistance to late blight. Genotypes IP84007.67, 676070 and 13.1.1 could also be grown under the conditions of the study as shown by their resistance to late blight.

Most of the genotypes are profitable when sold as seed tubers. Yield and resistance to late blight are the primary basis for selection by the organic practitioner and was satisfied by genotypes IP84007.67, 676089 and Ganza.

Recommendation

Based on the findings of this study, genotypes IP84007.67, 676089 and Ganza are recommended at Master's Garden, Puguis, La Trinidad, Benguet.

High profit could be obtained if G_1 tubers will be sold as organic seeds or planting materials.

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APPENDICES

APPENDIX TABLE 1. Plant vigor at 35 DAP of ten potato genotypes

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
IP84007.67	3	4	4	11	4^{b}
380251.17	5	5	4	14	5^{ab}
676070	5	3	5	13	4^{ab}
5.19.2.1	3	4	4	11	4^{b}
573275	4	4	5	13	4^{ab}
676089	5	5	5	15	5^{a}
5.19.2.2	5	5	5	15	5^{a}
13.1.1	4	5	5	14	5^{ab}
Kennebec	5	5	5	15	5^{a}
Ganza	5	5	5	15	5^{a}
TOTAL	44	45	47	136	46

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Replication	2	0.467	0.233			
Treatment	9	7.467	0.830	2.69*	2.46	3.60
Error	18	5.533	0.307			
TOTAL	29	13.467				

* – Significant   Coefficient of Variation = 12.23 %

APPENDIX TABLE 2. Plant height at 30 DAP of ten potato genotypes

GENOTYPE	BLOCK			TOTAL	MEAN
	I	II	III		
IP84007.67	18.6	24.0	30.4	73.0	24.33
380251.17	19.6	25.7	18.3	63.3	21.20
676070	22.5	18.0	23.4	63.9	21.30
5.19.2.1	7.1	14.0	14.5	35.6	11.87
573275	18.6	22.0	16.3	57.4	19.13
676089	27.1	28.7	24.2	8.0	26.67
5.19.2.2	23.3	23.5	23.7	70.5	23.50
13.1.1	12.8	17.0	19.5	49.3	16.43
Kennebec	12.7	13.9	13.8	40.4	13.47
Ganza	18.0	15.2	20.3	53.5	17.83
TOTAL	180.3	202.5	204.4	587.2	195.73

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	35.909	17.954			
Treatment	9	611.352	67.928	6.68**	2.46	3.60
Error	18	183.038	10.169			
TOTAL	29	830.299				

** – Highly significant   Coefficient of Variation = 16.29 %

APPENDIX TABLE 3. Plant height at 85 DAP of ten potato genotypes

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
IP84007.67	26.6	23.7	26.0	76.3	25.43[ab]
380251.17	20.0	0	15.6	35.6	11.87[cd]
676070	35.6	17.6	24.5	77.7	25.90[ab]
5.19.2.1	14.7	17.2	17.7	49.6	16.52[bcd]
573275	25.0	16.3	17.0	58.3	19.43[abcd]
676089	37.0	26.8	28.7	92.5	30.83[a]
5.19.2.2	45.0	24.5	18.3	87.0	29.27[ab]
13.1.1	37.6	25.0	29.5	92.1	30.70[a]
Kennebec	0	20.0	0	20.0	6.67[d]
Ganza	29.8	13.6	24.9	68.3	22.77[abc]
TOTAL	271.3	184.7	202.2	657.4	219.39

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Replication	2	419.562	209.781			
Treatment	9	1,825.343	202.816	3.81**	2.46	3.60
Error	18	958.452	53.247			
TOTAL	29	3,203.352				

** – Highly significant   Coefficient of Variation = 24.73 %

APPENDIX TABLE 4. Haulm weight (g) of ten potato genotypes per plant

GENOTYPE	BLOCK			TOTAL	MEAN
	I	II	III		
IP84007.67	50.0	16.7	18.8	85.5	28.5
380251.17	6.7	0	25.0	31.7	10.6
676070	22.9	17.5	27.5	67.9	22.6
5.19.2.1	7.5	2.0	22.5	32.0	10.7
573275	15.0	1.0	11.0	27.0	9.0
676089	17.0	8.0	5.0	30.0	10.0
5.19.2.2	12.9	37.5	10.0	60.4	20.1
13.1.1	23.3	6.3	1.6	31.2	10.7
Kennebec	2.0	1.4	2.9	6.3	2.1
Ganza	9.4	10.0	24.4	43.8	14.6
TOTAL	166.7	100.4	149.2	416.3	138.8

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	237.173	118.586			
Treatment	9	1,616.485	179.609	1.54^{ns}	2.46	3.60
Error	18	2,096.321	116.462			
TOTAL	29	3,949.979				

^{ns} – Not significant

Coefficient of Variation = 38.70 %

APPENDIX TABLE 5. Late blight rating of ten potato genotypes at 45 DAP

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
IP84007.67	1	1	1	3	1
380251.17	2	1	1	4	1
676070	1	1	1	3	1
5.19.2.1	1	1	1	3	1
573275	1	1	1	3	1
676089	1	1	1	3	1
5.19.2.2	2	1	1	4	1
13.1.1	1	1	1	3	1
Kennebec	1	1	1	3	1
Ganza	2	1	1	4	1
TOTAL	13	10	10	33	10

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Replication	2	0.600	0.300			
Treatment	9	0.700	0.078	1.0^{ns}	2.46	3.60
Error	18	1.400	0.078			
TOTAL	29	2.700				

^{ns} – Not significant   Coefficient of Variation = 25.35 %

APPENDIX TABLE 6. Late blight rating of ten potato genotypes at 60 DAP

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
IP84007.67	1	2	1	4	1
380251.17	5	2	1	8	3
676070	2	1	1	4	1
5.19.2.1	2	2	1	5	2
573275	1	1	1	3	1
676089	2	1	1	4	1
5.19.2.2	4	2	1	7	2
13.1.1	1	1	1	3	1
Kennebec	1	4	1	6	2
Ganza	2	1	1	4	1
TOTAL	21	17	10	48	15

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Replication	2	6.200	3.100			
Treatment	9	8.533	0.948	1.04^{ns}	2.46	3.60
Error	18	16.467	0.915			
TOTAL	29	31.200				

^{ns} – Not significant

Coefficient of Variation = 20.70 %

APPENDIX TABLE 7. Late blight rating of ten potato genotypes at 75 DAP

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
IP84007.67	2	7	1	10	3
380251.17	9	7	4	20	7
676070	6	2	1	9	3
5.19.2.1	4	5	9	18	6
573275	7	7	1	15	5
676089	8	7	4	19	6
5.19.2.2	8	7	8	23	8
13.1.1	2	5	2	9	3
Kennebec	6	9	9	24	8
Ganza	8	8	2	18	6
TOTAL	60	64	41	165	55

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Replication	2	30.200	15.100			
Treatment	9	92.833	10.315	1.85^{ns}	2.46	3.60
Error	18	100.467	5.581			
TOTAL	29	223.500				

^{ns} – Not significant

Coefficient of Variation = 22.08 %

APPENDIX TABLE 8. Weight of marketable (g) tubers per plant of ten potato genotypes

GENOTYPE	BLOCK			TOTAL	MEAN
	I	II	III		
IP84007.67	71.42	26.66	45.0	143.08	47.69
380251.17	40.00	12.5	140.0	192.50	64.17
676070	57.14	18.75	37.5	113.39	37.80
5.19.2.1	15.00	7.00	48.5	70.50	23.50
573275	36.33	43.75	37.5	117.91	39.30
676089	125	87.5	35.0	247.5	82.50
5.19.2.2	34.28	61.25	40.0	135.53	45.18
13.1.1	41.66	26.25	83.33	151.24	50.41
Kennebec	70.00	26.42	45.0	141.42	47.14
Ganza	77.77	80.00	94.44	252.21	84.07
TOTAL	568.93	380.08	606.27	1,565.28	521.76

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	2,670.657	1,335.329			
Treatment	9	10,118.656	1,124.295	1.23^{ns}	2.46	3.60
Error	18	116,436.311	913.239			
TOTAL	29	29,227.624				

^{ns} – Not significant Coefficient of Variation = 28.64 %

APPENDIX TABLE 9. Weight of non-marketable (g) tubers per plant of ten potato genotypes

GENOTYPE	BLOCK			TOTAL	MEAN
	I	II	III		
IP84007.67	11.42	10.00	3.75	25.17	8.39
380251.17	6.66	12.50	30.00	49.16	16.38
676070	8.57	5.00	5.00	18.57	6.19
5.19.2.1	5.00	2.50	9.50	17.00	5.67
573275	10.00	3.75	8.75	22.50	7.50
676089	11.00	75.00	11.00	97.00	32.33
5.19.2.2	7.14	5.00	5.00	17.14	5.71
Kennebec	5.00	4.28	7.00	16.28	5.42
13.1.1	18.33	8.75	16.66	42.74	14.58
Ganza	10.00	2.50	12.22	24.72	8.24
TOTAL	93.12	129.28	108.88	331.28	110.42

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	65.736	32.868			
Treatment	9	1,902.590	211.399	1.20^{ns}	2.46	3.60
Error	18	3,106.097	175.561			
TOTAL	29	5,128.423				

^{ns} – Not significant   Coefficient of Variation = 42.47 %

APPENDIX TABLE 10. Total yield (g) of tubers per plant of ten potato genotypes

GENOTYPE	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
IP84007.67	82.85	36.66	48.75	168.26	56.09
380251.17	46.66	25.00	170.00	241.66	80.55
676070	65.71	23.75	42.50	131.96	43.99
5.19.2.1	20.00	9.50	58.00	87.50	29.17
573275	46.66	47.50	46.75	140.41	46.80
676089	136.00	162.50	46.00	344.50	114.83
5.19.2.2	41.42	66.75	45.00	152.67	50.89
13.1.1	60.00	35.00	100.00	195.00	65.00
Kennebec	75.00	30.71	52.00	157.71	52.57
Ganza	87.77	82.50	106.66	276.93	92.31
TOTAL	662.01	519.37	715.16	1,896.6	632.20

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Replication	2	2,050.519	1,025.259			
Treatment	9	17,787.512	1,976.390	1.43^{ns}	2.46	3.60
Error	18	24,791.760				
TOTAL	29	44,629.791				

^{ns} – Not significant

Coefficient of Variation = 27.71 %

APPENDIX TABLE 11. Dry matter content (%) of tubers of ten potato genotypes

GENOTYPE	BLOCK			TOTAL	MEAN
	I	II	III		
IP84007.67	19	20	19	58	19[cd]
380251.17	18	18	18	54	18[d]
676070	21	22	21	64	21[b]
5.19.2.1	20	20	20	60	20[bc]
573275	20	20	19	59	20[bc]
676089	24	24	24	72	24[a]
5.19.2.2	21	20	18	59	20[bc]
13.1.1	19	20	18	57	19[cd]
Kennebec	23	24	23	70	23[a]
Ganza	19	20	20	59	20[bc]
TOTAL	204	208	200	612	204

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	3.350	1.675			
Treatment	9	101.242	11.249	27.06**	2.46	3.60
Error	18	7.483	0.416			
TOTAL	29	112.075				

** – Highly significant

Coefficient of Variation = 3.17 %