BIBLIOGRAPHY

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ABSTRACT

The study was conducted at Loo, Buguias, Benguet to evaluate the growth and yield of potato entries, identify the highest yielding and most resistant potato entry to pest and diseases under organic production.

Potato entries CIP 380251.17, CIP 676089, CIP 13.1.1 and PHIL 5.19.2.2 were observed to have highly vigorous plants at 45 DAP. PHIL 5.19.2.2 registered the highest canopy cover at 45 and 60 DAP. CIP 676089 was highly resistant to late blight infection at 45 DAP while all the entries were moderately resistant at 60 DAP except for Granola. CIP 13.1.1 produced the highest number of small sized tubers and marketable tubers. CIP 380251.17 produced the highest total yield (kg/5m^2) and computed yield (tons/ha).

In terms of cost and return analysis, potato entry CIP 380251.17 obtained the highest ROCE. All potato entries except Granola are recommended for organic production at Loo, Buguias, Benguet.

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INTRODUCTION

Potato (*Solanum tuberusom*) belongs to the family of Solanacious crops (PCARRD, 1985). It is the major tuber crop grown by farmers in Benguet and its production is mostly conventional (Ganga, 1996).

The conventional potato production employ the use of chemical pesticides and synthetic fertilizers. Such practices may bring high profit to farmers but could contribute to the degradation in the environment. Continuous application of chemicals and synthetic fertilizers can also affect the health of human beings and cause new strains of pest and diseases to develop (Donahue, *et al*, 1971).

Producing potatoes organically might be an alternative practice not only to increase profit of the farmers but also preserve the quality of our environment.

Organic farming is a production system, which excludes the synthetically compounded fertilizers, pesticides, growth regulators and others. Instead, it relies in crop rotation, crop residue and animal manures application and mechanical cultivation to maintain soil productivity and tilth (Anonymous, 2005).

One of the important practices in organic production is the use of varieties resistant to pests and diseases. Varieties adapted to organic production may contribute to enhancing the quality of the environment since no application of pesticides is done.

Thus, evaluation and screening of varieties under organic production sites is necessary.

The study aimed to evaluate the growth and yield of potato entries under organic production at Loo, Buguias, Benguet and identify the highest yielding and most resistant potato entry to pest and diseases at Loo, Buguias, Benguet.

The study was conducted at Loo, Buguias, Benguet from September to December 2007.

REVIEW OF LITERATURE

Definition of Organic Farming

Organic farming methods are practical and economical way to increase yield, conserve the soil, and maintain the water quantity and lower operating costs. Organic farming procedure has the same amount of yield of same quality for same costs as conventional farms of the same size. Moreover, organic farms are relatively free from the possible toxicities to soil, to flora and fauna in general (NPRCRTC, 1998).

According to Broines (1997) organic farming include various forms of sustainable agriculture such as organic agriculture, biodynamic agriculture and natural way of farming share a concern for the health and welfare of the farmer in the future. A way of farming that avoids the use of synthetic fertilizer as well as genetically modified organism (GMO's) and usually subscribers to the principles of sustainable agriculture. Organic management relies on developing biological diversity in the field to disrupt habitat for pest organism, and replenishment of soil fertility.

Anonymous (2002) defined organic farming as whole system approach that works to optimize the natural fertility resources of the farm. This is done through traditional practices of recycling farm-produced livestock manures, composting, crop rotation, green manuring, and crop residue management. Organic agriculture also looks to local waste product manures – off leaching and erosion.

Components of Organic Farming

Use of organic fertilizers. 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 becoming acidic if inorganic fertilizer is used for a longer period of time. Organic fertilizers stimulate, increase a much greater extent from confinement feeding food processing waste and to supplement soil fertility economically.

Crop protection in organic farming. Organic farmers apply the soil and build soil organic matter with cover crops, compost and biologically based soil amendments. Organic matter in the soil produces healthy plants that are better and able to resist disease and insects. Organic farmers use cover crops and crop rotations to change the field ecology, effectively disrupting habitat for weeds, insect and disease organisms. Weeds are controlled through crop rotation, mechanical tillage, and hand weeding and other management methods. Organic farming relies on a diverse population of soil organism, beneficial insects and buds to keep pest in check. When pest population get out of balance, growers implement a variety of strategies such as the use of insect predators, mating disruption, traps and barriers (Pawar, 2005).

Diversity in organic farming. Pawar (2005) stated that 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 nutrients reserves from depth of soil and transfer of nitrogen from nitrogen fixing species.

Variety Evaluation in Organic Farming

According to Singh (1999), the proposed standard of variety selection in organic farming was expectedly adapted locally that are common in the area, with the resistance

to pests and diseases so that the crop planted have high production. However, the new revision limit is the use of organic seeds, bulbs, tubers, cuttings, and annual seedlings that should be transplanted when readily available. All propagation materials used in organic farming must be 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 selecting the right variety, the farmers must also consider the consumer requirement, supermarket requirement and variety maturity in order to achieve the best production needed.

Montes (2006) found that genotype 676089 is the best potato entry grown under organic production at Puguis, La Trinidad, Benguet. The entry was observed to have vigorous and tall plants, high yield, high dry matter content of tubers and resistant to late blight. Genotypes IP84007.67, 676070 and 13.1.1 could also be grown under the same condition.

Potato entries grown under organic production at Balili, La Trinidad, Benguet showed highly significant differences of percent survival. Potato entries 6573.75 and Kennebec showed the highest percentage survival, while 676089 had the lowest survival. The high percentage survival could be due to favorable environmental condition during the early growth stage of the potato entries (Aguirre, 2006).

It was reported by Panico (2006) that all potato entries at Englandad, Atok, Benguet are highly vigorous at 30 days after planting. At 65 days after planting, potato entries 380251.17, Ganza, 573275 and Kennebec showed a decrease in their plant vigor. The poor vigor of different potato entries grown organically may be due to unfavorable temperature during the conduct of the study.

Tabon (2007) reported that leaf miner occurred at 45, 60 and 75 DAP in Loo, Buguias. At Englandad, there were no leaf miner occurrence observed. The absence of leaf miner at Englandad might be attributed to the temperature and relative humidity which inhibited leaf miner infestation. Occurrence of the leaf miner within the farm at Loo may be due to late season of planting. When most of the conventional farmers had harvested their potato plants, leaf miner was prevalent in the area during the conduct of the study. Among the potato accessions planted in Loo, it was observed that Granola is susceptible to leaf miner.

MATERIALS AND METHODS

Land Preparation

An area of 90 m^2 was thoroughly prepared. The area was divided into 18 plots measuring 1 m x 5 m to accommodate six potato entries and replicated three times. The distance of planting was 25 cm x 30 cm between hills and rows.

Planting Materials

Sprouted tubers acquired from the Northern Philippine Root Crops Research and Training Center, Benguet State University (NPRCRTC-BSU) were used as planting materials.

The treatments were:

Entry	Origin
13.1.1	CIP
380251.17	CIP
676089	CIP
5.1.9.2.2	Philippines
Ganza (check)	CIP
Granola (check)	Germany

Cultural Management Practices

Organic production practices in the production of the study include hilling-up of prepared compost such as rice hull, grasses and chicken dung at a rate of 5 kg per 1 m x 5 m plot at 20 days after planting. Irrigation was employed through overhead irrigation,

with the use of sprinkler and spraying of marigold extract as botanical insecticide and baking soda for fungus.

The data gathered were:

A. Vegetative Characters

1. Plant survival (%). This was the percentage of plants that survived taken at 30 days after planting and calculated using the formula:

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

2. Plant vigor. This was recorded at 35, 40, 60 and 75 days after planting using the CIP scale (NPRCRTC, 2000).

Scale	Description	Reaction
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 Vigor
3	Better than less vigorous	Moderately Vigorous
4	Plants that are moderately strong with robust Stem and 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

3. Canopy cover. This was gathered at 30, 40, 60 and 75 days after planting using a wooden frame using 120 cm x 60 cm with equal sized 12 cm and 6 cm grids

holding the grid over the foliage of four plants representatives previously marked; grids covered with effective leaves were counted.

B. Pest and disease incidence

1. Leaf miner incidence. The occurrence of leaf miner was observed at 45, 60 and 75 days after planting using the rating scale (CIP, 2001).

2. Late blight incidence. Rating was done at 30, 45 and 60 DAP using CIP (Henfling, 1987) rating scale as follows:

BLIGHT	SCALE	DESCRIPTION
0	1	No late blight to be observable
Trace < 5	2	Late blight present. Maximum 10 lesions per plant
5 - < 15	3	Plants look healthy, but lesions are easily seen at closer distance.
15-< 35	4	Late blight easily seen on most plants. About 25% of foliage is covered with lesions or destroyed
35- < 65	5	Plants look green: however, all plants are affected. Lower leaves are dead. About half of the foliage area is destroyed.
65 - < 85	6	Plants look green with brown flecks. About 75% of each plant is affected. Leaves of the lower half of the plant are destroyed
85 - < 95	7	Plant neither predominantly green or brown. Only leaves are green. Many stems have large lesions
95 - < 100	8	Plant is black colored. A few top leaves still have green area. Most stems have lesions are dead.
100	9	All leaves and stems are dead.

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

C. Yield and Yield Components

1. Number and weight of marketable tubers per plot (g). All tubers of marketable quality were counted and weighed at harvest and classified into sizes: XL, large, medium, small and marble size.

2. Number and weight of non-marketable tubers per plot (g). Tubers damaged by pests, cracked, deformed, and rotten were counted and weighed at harvest.

3. Total yield per plot (g). This is the sum of the weight of marketable and non-marketable tuber yield in each plot.

4. Computed yield in tons per hectare. This was computed in a hectare basis using the formula:

$$\text{Yield (tons/ha)} = \frac{\text{Total yield}}{\text{Plot size (m/1,000)}} \times 10{,}000$$

D. Cost and Return Analysis

$$\text{Return on Cash Expense (ROCE)} = \frac{\text{Net Income}}{\text{Total Cost of Production}} \times 100$$

E. Morphological Characterization

Characterization was done on different potato entries based on agromorphological characters using the descriptive list for potato by the International Potato Center.

1. Growth habit. This was taken by describing the type of growth habit at the beginning of flowering using the rating scale as follows:

Scale	Description
1	Erect
2	Semi-erect

3	Decumbent
4	Prostrate
5	Semi-rosette
6	Rosette

2. Branching Habit. This was determined by visual observation using the scale as follows:

Scale	Description
1	Single
2	Branched

3. Number of primary stems. This was obtained by counting the primary stems using the CIP descriptors list.

Scale	Description
1	Single
2	Few
3	Medium
4	Many

4. Abaxial leaf pubescence. The degree to which the lower surfaces of the leaves which are covered by hairs (trichomes) was described using the scale as follows:

Scale	Description
0	Glabrous
1	Glabrescent
2	Pubescent
3	Strong pubescent

5. Adaxial leaf pubescent. The degree to which the upper surfaces of the leaves were determined are covered by hairs (trichomes) using the scale as follows:

Scale	Description
0	Glabrous
1	Glabrescent
2	Pubescent
3	Strong pubescent

6. Predominant sprout color. This was determined by visual observation using the scale as follows:

Scale	Description
1	Single
2	Few
3	Medium
4	Many

7. Secondary stem color. This was observed using the CIP descriptors list:

Scale	Description
0	Absent
1	White green
2	Pink
3	Red
4	Violet
5	Purple
6	Green

8. Distribution of secondary color. This was observed using the CIP descriptors list.

Scale	Description
0	Absent
1	At the base
2	At the apex
3	Lightly scattered throughout
4	Heavily scattered throughout
5	Other
6	Green

9. Tuber skin type. This was recorded using the CIP descriptors list.

Scale	Description
1	Smooth
2	Rough

10. Tuber shape. The shape of the tuber was obtained using the following ratio scale.

Scale	Description
1	Round
2	Oviate
3	Oblong

11. Tuber size. The tubers were classified into

Scale	Description
1	Small

2	Medium
3	Large

12. Depth of eyes. This was described using the descriptors list as follows:

Scale	Description
1	Protruding
2	Shallow
3	Medium
4	Deep
5	Very deep

13. Predominant tuber skin color. The color which covers most of the surface of the tubers were determined using the rating scale:

Scale	Description
1	White cream
2	Yellow
3	Orange
4	Brownish
5	Pink
6	Red
7	Purple-red
8	Purple

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 will be tested using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Meteorological Data

Table 1 shows the temperature, relative humidity and rainfall during the conduct of the study. The highest temperature recorded was 22^0C taken during taken in September. Highest relative humidity was observed during the months of October and November. Rainfall of 988 mm occurred in November.

Temperature and relative humidity during the conduct of the study were favorable for potato production. The occurrence of rainfall might have contributed to high relative humidity in November which indirectly caused the occurrence of late blight at the later stages of growth.

Table 1. Meteorological data during the conduct of the study from September to December 2007

MONTH	MEAN TEMPERATURE (^{0}C)	RELATIVE HUMIDITY (%)	RAINFALL (mm)
September	22	75	0
October	19	82	0
November	19	82	988
December	17	67	0
MEAN	19.25	76.5	247

Chemical Properties of the Soil

Soil pH. Table 2 shows that pH increased. The increase might be due to the application of compost as claimed by earlier researchers.

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

Soil organic matter. Organic matter decreased from 4.0% to 3.5% (Table 2). The decline could be due to the fact that the total amount of crop residues returned to the soil is low when there is continuous production of crops (Motes and Criswell, 2000).

Nitrogen. Nitrogen content of the soil increased (Table 2). Nitrogen is needed for vegetative growth as claimed by past researchers. It is known that high nitrogen application may prolong the maturity of the crop.

Phosphorous. There was increase in the phosphorous content of the soil. The increase in the phosphorous content may be due to the compost incorporated in the soil. Phosphorous contributed to the early development of the crop and early tuberization. It may increase the number of tuber per plant. Although organic sources of phosphorous are slowly available, they are very important since organic phosphorous may account up to 90% of the total soil phosphorous. Organic phosphorous can be supplied to the soil by the addition of manure, municipal waste and the accumulation of microbial and plant residues.

Potassium. There was increase in the total potassium. The increase could be attributed to more available potassium of the compost fertilizers applied.

Table 2. Soil chemical properties before planting and after harvesting

	pH	ORGANIC MATTER (%)	NITROGEN (%)	PHOSPHOROUS (ppm)	POTASSIUM (ppm)
Before planting	6.88	4.0	0.85	90	557
After harvesting	6.80	3.5	0.93	95	668

Source: Bureau of Soils, Pacdal, Baguio City (2008)

Plant Vigor at 45 and 60 DAP

All potato entries at 45 DAP were highly vigorous except for Ganza which is vigorous and Granola which had poor vigor (Table 3). On the other hand, potato entries at 60 DAP were all moderately vigorous except for Granola which has poor vigor.

Highly vigorous plants may be due to amendments incorporated in the soil. The compost used nutrients that sustained the plants (Montes, 2006). According to Balaoing (1995), organic fertilizers aid the plants in absorbing more nutrients and the soil is rich in humus.

Canopy Cover

Significant differences were observed on the canopy cover of the different entries at 30, 45 and 60 DAP (Table 4). Canopy cover increased from 30 and 45 DAP except for entries Ganza and Granola. At 60 DAP, canopy cover of all potato entries decreased, which might be an indication of susceptibility to late blight infection. It was observed that a potato entry with high canopy cover is also resistant to late blight such as PHIL 5.19.2.2 which registered the highest canopy cover at 30 DAP. At 45 and 60 DAP the

Table 3. Plant vigor of potato entries at 45 and 60 DAP

ENTRY	45 DAP	60 DAP
CIP 380251.17	5[a]	3[a]
CIP 676089	5[a]	3[a]
CIP 13.1.1	5[a]	3[a]
PHIL 5.19.2.2	5[a]	3[a]
Ganza	4[b]	3[a]
Granola	1[c]	1[b]
CV (%)	5.58	11.16

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

Table 4. Canopy cover of potato entries at 30, 45 and 60 DAP

ENTRY	30 DAP	45 DAP	60 DAP
CIP 380251.17	61[ab]	64[ab]	50[bc]
CIP 676089	56[b]	68[ab]	53[ab]
CIP 13.1.1	58[ab]	70[ab]	54[a]
PHIL 5.19.2.2	64[a]	73[a]	51[abc]
Ganza	60[ab]	54[b]	49[c]
Granola	36[c]	7[c]	0[d]
CV (%)	6.17	16.47	5.35

Means with the same letter are not significantly different by DMRT (P > 0.05)
Description: 1 = poor vigor; 2 = less vigor; 3 = ,moderately vigorous; 4 = vigorous; 5 = highly vigorous

same entry registered the highest canopy cover, CIP 13.1.1 and CIP 676089 followed with comparable canopy covers at 45 and 60 DAP.

The decrease of canopy cover could be due to insect infestation and high late blight infection during the conduct of the study (Table 4). Potato leaves infected with the disease slowly senesced and fell-off.

Late Blight Incidence

Consistent trend was observed on late blight occurrence. As early as 45 DAP, Granola had already a susceptible rating (8). Entry CIP 676089 is highly resistant to late blight infection at 45 DAP while all entries at 60 DAP were moderately resistant to late blight infection. At 45 DAP, all the entries were resistant to late blight infection.

Increased in late blight infection at 60 DAP could be due to the continuous rain that occurred during the conduct of the study.

Leaf Miner Incidence

Visual rating for leaf miner incidence was done at vegetative stage. It was observed that most of the entries were moderately resistant at 60 DAP except for Granola which was observed to be very susceptible. Low leafminer incidence could be due to crop diversity, set-up of sticky yellow traps and spraying of marigold extract.

Yield and Yield Components

Number of Marketable and Non-marketable Tubers of Potato Entries

Marketable tubers were classified according to size such as extra large, large, medium, small and non-marketable size. Statistically, significant differences were noted on the number of marketable tubers. Entry CIP 380251.17 had significantly produced the highest number of extra-large and large tubers. Entry PHIL 5.19.2.2 produced the highest medium-sized tubers while CIP 13.1.1 produced the highest number of small-sized tubers and marketable tubers. Granola produced only small tubers.

Table 5. Number of marketable and non-marketable tubers of potato entries at harvest

ENTRIES	MARKETABLE YIELD				TOTAL NUMBER OF MARKETABLE TUBERS	NON-MARKETABLE TUBERS ($g/5m^2$)
	XL	L	M	S		
CIP 380251.17	17^{a}	27^{a}	28^{a}	31^{b}	103^{a}	6^{cd}
CIP 676089	15^{ab}	15^{b}	27^{a}	18^{d}	75^{b}	22^{a}
CIP 13.1.1	10^{c}	10^{c}	27^{a}	39^{a}	86^{d}	13^{b}
PHIL 5.19.2.2	14^{ab}	14^{b}	31^{a}	26^{c}	85^{ab}	26^{a}
Ganza	13^{bc}	13^{bc}	21^{b}	33^{b}	80^{ab}	7^{c}
Granola	0^{c}	0^{d}	0^{c}	3^{c}	3^{c}	1^{d}
CV (%)	20.10	20.36	28.45	29.89	16.39	17.43

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

Weight of Marketable and Non-marketable Tubers of Potato Entries

Presented on Table 6 is the weight of marketable and non-marketable tubers classified according to size. Entry CIP 13.1.1 produced the heaviest weight of extra-large tubers. With regards to large and medium tubers, entry CIP 380251.17 produced the heaviest weight. Lowest weight of marketable tubers were obtained for Granola (Table 6).

Total Yield per $5m^2$

Table 7 shows the total yield of six potato entries. Potato entry CIP 380251.17 produced the highest yield (5.69 kg/m^2) while Granola had the lowest at 0.2 $kg/5m^2$. Medium to high yield could be attributed to the favorable environment condition that leads to better growth and yield of the potato entries (Table 7).

Table 6. Weight of marketable, non-marketable tubers of potato entries at harvest

ENTRY	MARKETABLE YIELD ($g/5m^2$)				TOTAL WIGHT OF MARKET-ABLE YIELD ($g/5m^2$)	NON-MARKETABLE TUBERS ($g/5m^2$)
	XL	L	M	S		
CIP 380251.17	1316.67^{b}	1666.67^{a}	1300^{a}	453.33^{ab}	4,737^{a}	233.33^{bc}
CIP 676089	1250^{b}	803.33^{b}	783.33^{b}	333.333^{ab}	3,170^{n}	1008.33^{a}
CIP 13.1.1	7750^{c}	1,200^{ab}	1016.67^{ab}	900^{a}	3,892^{n}	458.33^{abc}
PHIL 5.19.2.2	1133.33^{b}	1158.33^{ab}	1183.33^{ab}	783.33^{a}	4,259^{a}	766.67^{bc}
Ganza	1000^{b}	1035^{ab}	808.33^{b}	866.67^{a}	3,710^{ab}	104.67^{c}
Granola	0^{c}	0^{d}	16.67^{c}	83.33^{b}	100^{c}	16.67^{c}
C.V. (%)	20.28	31.90	28.18	31.05	17.76	37.07

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

Table 7. Computed yield of the potato entries

ENTRY	YIELD ($kg/5m^2$)
CIP 380251.17	5.69^{ab}
CIP 676089	4.26^{b}
CIP 13.1.1	4.87^{ab}
PHIL 5.19.2.2	5.21^{a}
Ganza	4.23^{b}
Granola	0.200^{c}
CV (%)	15.59

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

Computed Yield per Hectare

Total yield per hectare is shown in Table 8. Potato entry CIP 380251.17 registered the highest computed yield of 11 kg/ $5m^2$. The high yield of PHIL 5.19.2.2 could be attributed to high canopy cover and resistance to late blight.

Return on Cash Expense (ROCE)

Cash expense of potato entries is shown in Table 9. Potato entry CIP 380251.17 had the highest (117.23%) while Granola had a negative ROCE (-92%). These results indicate that the entries with the highest yield also gained the highest profit.

Table 8. Computed yield of potato entries

ENTRIES	COMPUTED YIELD (tons/ha)
CIP 380251.17	11[b]
CIP 676089	9[b]
CIP 13.1.1	10[ab]
PHIL 5.19.2.2	10[ab]
Ganza	8[b]
Granola	4[c]
CV (%)	15.60

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

Table 9. Cost and return analysis in organic potato production (15 m^2)

ENTRIES	COST OF PRODUCTION (Php)	MARKETABLE TUBERS ($kg/5m^2$)	GROSS SALE (Php)	NET INCOME (Php)	ROCE
CIP 380251.17	275	14.93	597.40	322.40	117.23
CIP 676089	275	12.61	504.40	229.40	83.41
CIP 13.1.1	275	13.27	530.60	225.40	92.94
PHIL 5.19.2.2	275	14.46	578.00	303.00	110.18
Ganza	275	12.39	495.40	202.40	80.14
Granola	275	0.55	22.00	-253.00	-92.00

* Total cost of production includes cost of planting materials, herbal insecticides, herbicides and labor

*Selling price of potato tubers was based on ₱ 40.00 per kilo regardless of size (palaspasan) economically produced

Morphological Characters

Growth Habit and Branching Habit

On the growth habit type, all of the entries are erect except for entries CIP 380251.17 and CIP 676089, which are semi-erect during the growth of the potato. With regards to branching habit, all the entries are single except again for entries CIP 380251.17 and CIP 676089 which are branched.

Number of Primary Stems and Plant at Flowering Stage of Potato Entries

All entries had one to three primary stems except for CIP 676089 and CIP 13.1.1 which had four to eight primary stems. Plant height at flowering stage are all medium.

Leaf Characters

Leaf Dissection, Abaxial and Adaxial Leaf Pubescence of Potato Entries

On leaf dissection, all the potato entries are weakly dissected. All potato entries had pubescent abaxial leaves. On the adaxial side, only the leaves of CIP 380251.17 and CIP 676089 are glabrescent.

Predominant Stem and Secondary Stem Color and Distribution of Secondary Stem Color of Potato Entries

Entries CIP 676089 and PHIL 5.19.2.2 had green as stem color. Entry CIP 13.1.1 showed white green stem while entry CIP 380251.17 has purple and pink stem for Ganza. As to secondary stem color, entries CIP 676089 and Ganza are green while 13.1.1 has pink stem while entry CIP 380251.17 has no secondary stem color. As to distribution of

secondary stem color, all entries did not show secondary color except for 676089 which is lightly scattered throughout and Ganza which is heavily scattered above the base of the sprout.

Tuber Character

Tuber Size, Defects, Uniformity and Number of Eyes and Eyes per Tuber

Tuber sizes are large except for entries CIP 676089 and CIP 13.1.1 which are medium. Tuber defects are present in all entries. All tubers have uniform tubers except for entry PHIL 5.19.2.2. Number of eyes per tuber are all intermediate.

Predominant Tuber Skin Color, Secondary Tuber Skin Color, Distribution of Secondary Tuber Skin Type of Potato Entries

All of the entries have yellow predominant skin color except for entry CIP 380251. Secondary tuber skin color is white cream and yellow. Distribution of secondary tuber color is observed on the eyes except for entry CIP 380251.17 which is on the eye-brows.

Predominant Tuber Flesh Color, Secondary Flesh Color, Depth of Eyes per Tuber and General Shape

Predominant tuber flesh color is yellow while secondary flesh color is yellow cream. Depth of eyes on the other hand is shallow except for entry CIP 380251.17. Tuber shapes of the entries are round and oblong.

Table 10. Morphological characterization

ENTRIES	GROW-TH HABIT	BRANCH-ING HABIT	NUMBER OF PRIMA-RY STEM	ABAXIAL LEAF PUBES-CENCE	ADAXIAL LEAF PUBES-CENCE	PREDO-MINANT STEM COLOR	SECON-DARY STEM COLOR	DISTRIB-UTION OF SECOND-ARY COLOR	TUBER SIZE	PREDO-MINANT SKIN COLOR	SECON-DARY TUBER SKIN COLOR	SECON-DARY FLESH COLOR	DEPTH OF EYES	SHAPE
380251.17	Semi-erect	Branched	Few	Pubes-cent	Glabres-cent	Purple	Absent	Absent	Large	Yellow	White cream	Yellow cream	Protrud-ing	Round
676089	Semi-erect	Branched	Medium	Pubes-cent	Glabres-cent	Green	Green	Lightly scattered throughout	Medium	Yellow	White cream	Yellow cream	Shallow	Oblong
13.1.1	Erect	Single	Medium	Pubes-cent	Pubescent	White green	Green	Absent	Medium	Yellow	Yellow	Yellow cream	Shallow	Round
5.19.2.2	Erect	Single	Few	Pubes-cent	Pubescent	Green	Purple	Absent	Large	Yellow	Yellow	Yellow cream	Shallow	Oblong
Ganza	Erect	Single	Few	Pubes-cent	Pubescent	Green	Green	Heavily scattered above the base of the sprout	Medium	Yellow	Yellow	Yellow cream	Shallow	Round

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted in an organic farm at Loo, Buguias, Benguet to determine the growth and yield of potato entries and identify the highest yielding and most resistant potato entry to pests and diseases.

CIP 380251.17, CIP 676089, CIP 13.1.1 and PHIL 5.19.2.2 were observed to have highly vigorous plants at 45 DAP. PHIL 5.19.2.2 registered the highest canopy cover at 45 and 60 DAP. CIP 676089 is highly resistant to late blight at 45 DAP. All the entries were moderately resistant at 60 DAP except for Granola. CIP 13.1.1 produced the highest number of small sized tubers and marketable tubers and produced the highest total yield (kg/5 m^2).

In terms of cost and return analysis, CIP 38025.17 obtained the highest ROCE.

Conclusion

All potato entries except Granola exhibited good performance in terms of yield and resistance to late blight.

Among the entries, CIP 380251.17 performed the best as evidenced by its high yield and resistance to late blight.

Recommendation

Organic production using the entries CIP 13.1.1, CIP 676089, CIP 380251.17, PHIL 5.19.2.2 and Ganza is recommended in Loo, Buguias, Benguet.

There should be continuous evaluation of potato entries under organic production until a stable variety could be recommended.

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APPENDICES

APPENDIX TABLE 1. Plant vigor of potato entries at 45 DAP

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	5	5	5	15	5
676089	5	5	5	15	5
13.1.1	5	5	5	15	5
5.19.2.2	5	5	5	15	5
Ganza	4	4	5	13	4.33
Granola	1	1	1	3	1
TOTAL	25	25	26	76	25.33

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.111	0.056			
Treatment	6	38.444	7.689	138.4**	3.00	4.82
Error	12	0.556	0.056			
TOTAL	20	39.111				

** - highly significant

Coefficient of Variation = 5.58%
Sx = 0.14

APPENDIX TABLE 2. Plant vigor of potato entries at 60 DAP

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	3	3	3	9	3
676089	4	3	3	10	3.33
13.1.1	4	3	3	10	3.33
5.19.2.2	3	3	3	9	3
Ganza	4	3	3	10	3.33
Granola	1	1	1	3	1
TOTAL	19	16	16	51	16.99

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	1.000	0.500			
Treatment	6	12.500	2.500	25.0**	3.00	4.82
Error	12	1.000	0.100			
TOTAL	20	14.500				

** - highly significant

Coefficient of Variation = 11.16%
Sx = 0.18

APPENDIX TABLE 3. Canopy cover of potato entries at 30 DAP

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	59	65	59	183	61
676089	57	57	55	169	56.33
13.1.1	54	60	55	175	58.33
5.19.2.2	60	73	60	193	64.33
Ganza	64	60	56	180	60
Granola	37	35	35	107	35.67
TOTAL	331	356	320	1007	335.66

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	76.778	38.389			
Treatment	6	1569.611	313.922	26.63**	3.00	4.82
Error	12	117.889	11.789			
TOTAL	20	1764.278				

** - highly significant

Coefficient of Variation = 6.17%
Sx = 1.98

APPENDIX TABLE 4. Canopy cover of potato entries at 45 DAP

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	66	71	56	193	64.33
676089	73	64	67	204	68
13.1.1	68	70	72	210	70
5.19.2.2	68	79	71	218	72.67
Ganza	74	53	36	163	54.33
Granola	4	6	12	22	7.33
TOTAL	353	343	314	1010	336.67

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	136.778	68.389			
Treatment	6	9175.111	1835.022	21.49**	3.00	4.82
Error	12	853.889	85.389			
TOTAL	20	10165.778				

** - highly significant

Coefficient of Variation = 16.47%
Sx = 5.33

APPENDIX TABLE 5. Canopy cover of potato entries at 60 DAP

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	51	50	48	149	49.67
676089	56	54	50	160	53.33
13.1.1	58	54	50	162	54.00
5.19.2.2	53	50	49	152	50.67
Ganza	55	49	42	146	48.67
Granola	0	0	0	0	0
TOTAL	273	257	239	769	256.34

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	96.444	48.22			
Treatment	6	6634.94	1326.989	254.10**	3.00	4.82
Error	12	52.22	5.222			
TOTAL	20	6783.611				

** - highly significant

Coefficient of Variation = 5.35%
Sx = 1.32

APPENDIX TABLE 6. Late blight incidence of potato entries at 45 DAP

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	16	11	1	18	6
676089	1	1	2	4	1.33
13.1.1	4	3	2	9	3
5.19.2.2	2	1	2	5	1.67
Ganza	6	3	3	12	4
Granola	96	99	98	293	97.67
TOTAL	124	118	108	341	113.67

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	24.333	12.167			
Treatment	6	22121.833	4424.367	416.08**	3.00	4.82
Error	12	106.333	10.633			
TOTAL	20	22252.500				

** - highly significant

Coefficient of Variation = 16.72%
Sx = 1.88

APPENDIX TABLE 7. Late blight incidence of potato entries at 60 DAP

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	26	26	28	80	26.67
676089	26	27	27	80	26.67
13.1.1	25	25	27	77	25.67
5.19.2.2	26	26	27	79	26.33
Ganza	26	26	26	78	26
Granola	100	100	100	300	100
TOTAL	229	230	235	694	231.34

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	96.444	48.222			
Treatment	6	6634.944	1326.989	254.10**	3.00	4.82
Error	12	52.222	5.222			
TOTAL	20	6783.611				

** - highly significant

Coefficient of Variation = 1.47%
Sx = 1.32

APPENDIX TABLE 8. Leaf miner incidence of potato entries at 60 DAP

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	2	2	2	6	2.0
676089	1	2	2	5	1.67
13.1.1	1	2	2	5	1.67
5.19.2.2	2	2	2	6	2
Ganza	1	2	2	5	1.67
Granola	5	5	5	15	5
TOTAL	12	15	15	42	14.01

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	1.000	0.500			
Treatment	6	26.000	0.200	52.0**	3.00	4.82
Error	12	1.000	0.100			
TOTAL	20	28.00				

** - highly significant

Coefficient of Variation = 13.55%
Sx = 0.18

APPENDIX TABLE 9. Number of extra-large tubers per plot/replication

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	25	8	17	50	17
676089	23	11	12	46	15
13.1.1	9	13	9	31	10
5.19.2.2	17	15	11	43	14
Ganza	10	19	11	40	13
Granola	0	0	0	0	0
TOTAL	84	60	60	210	69

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	52.000	26.000			
Treatment	6	555.667	111.733	4.31**	3.00	4.82
Error	12	259.333	25.933			
TOTAL	20	870.000				

** - highly significant

Coefficient of Variation = 20.10%
Sx = 2.94

APPENDIX TABLE 10. Number of tubers per plot/replication

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	39	25	17	81	27
676089	23	11	12	46	15
13.1.1	9	13	9	31	10
5.19.2.2	17	15	11	43	14
Ganza	10	19	11	40	13
Granola	0	0	0	0	0
TOTAL	98	83	60	241	79

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	122.75	26.000			
Treatment	6	1130.800	111.733	4.31**	3.00	4.82
Error	12	292.414	25.933			
TOTAL	20	1545.488				

** - highly significant

Coefficient of Variation = 20.36%
Sx = 3.12

APPENDIX TABLE 11. Number of medium tubers per plot/replication

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	29	25	29	83	28
676089	15	17	50	82	27
13.1.1	23	25	34	82	27
5.19.2.2	23	39	31	93	31
Ganza	20	12	30	62	21
Granola	0	0	0	0	0
TOTAL	110	118	174	402	134

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	405.333	202.667			
Treatment	6	1965.333	393.067	5.33**	3.00	4.82
Error	12	737.333	73.733			
TOTAL	20	3100.000				

** - highly significant

Coefficient of Variation = 28.45%
Sx = 4.95

APPENDIX TABLE 12. Number of small tubers per plot/replication

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	29	39	26	94	31
676089	18	12	24	54	18
13.1.1	48	29	39	116	39
5.19.2.2	34	12	33	79	26
Ganza	37	34	29	100	33
Granola	6	0	4	10	3
TOTAL	135	126	151	453	150

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	142.984	71.492			
Treatment	6	2688.403	537.681	9.73**	3.00	4.82
Error	12	552.585	55.258			
TOTAL	20	3383.971				

** - highly significant

Coefficient of Variation = 29.89%
Sx = 4.29

APPENDIX TABLE 13. Non-marketable tubers per plot/replication

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	5	6	6	17	6
676089	16	34	16	66	22
13.1.1	19	12	9	40	13
5.19.2.2	40	30	7	77	26
Ganza	8	0	12	20	7
Granola	3	0	0	3	1
TOTAL	91	82	50	223	75

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	155.818	77.909			
Treatment	6	1422.544	284.509	3.71*	3.00	4.82
Error	12	766.156	76.616			
TOTAL	20	2344.518				

* - significant

Coefficient of Variation = 17.43%
Sx = 5.05

APPENDIX TABLE 14. Weight of extra-large tubers per plot/replication (g)

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	2050	650	1250	3950	1316.67
676089	1900	750	1100	3750	1250
13.1.1	700	1000	625	2325	7750
5.19.2.2	1450	1150	800	3400	1133.33
Ganza	900	900	1200	3000	1000
Granola	0	0	0	0	0
TOTAL	7000	4450	5025	16425	12450

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	604375.03	302187.50			
Treatment	6	3555729.17	711145.83	4.98**	3.00	4.82
Error	12	1427708.33	142770.83			
TOTAL	20	5587812.50				

** - highly significant

Coefficient of Variation = 20.28%
Sx = 0.14

APPENDIX TABLE 15. Weight of large tubers per plot/replication (g)

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	2300	1300	1400	5000	1666.67
676089	810	350	1250	2410	803.33
13.1.1	800	1750	1050	3600	1200.00
5.19.2.2	1000	1500	975	3475	1158.33
Ganza	980	1000	1125	3105	1035.00
Granola	0	0	0	0	0
TOTAL	5890	5900	5800	16590	586.33

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	1011.111	505.56			
Treatment	6	4638911.11	927782.22	5.51**	3.00	4.82
Error	12	1683488.89	168348.89			
TOTAL	20	6323411.11				

** - highly significant

Coefficient of Variation = 31.91%
Sx = 117.51

APPENDIX TABLE 16. Weight of medium tubers per plot/replication

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	1050	1550	1300	3900	1300
676089	550	600	1200	2350	783.33
13.1.1	900	1100	1050	3050	1016.67
5.19.2.2	1200	1250	1100	3550	1183.33
Ganza	900	400	1125	2425	808.33
Granola	0	50	0	50	16.67
TOTAL	4600	4950	5775	15325	5108.33

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	121319.44	60659.72			
Treatment	6	3126006.94	625201.39	10.86**	3.00	4.82
Error	12	575763.89	57576.389			
TOTAL	20	3823090.27				

** - highly significant

Coefficient of Variation = 20.18%
Sx = 97.96

APPENDIX TABLE 17. Weight of small tubers per plot/replication (g)

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	110	750	500	1360	453.33
676089	400	250	350	1000	333.33
13.1.1	1400	500	800	2700	900
5.19.2.2	1200	300	850	2350	783.33
Ganza	1150	800	650	2600	866.67
Granola	150	0	100	250	83.33
TOTAL	4410	2600	3250	10260	3419.99

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	280233.33	140116.67			
Treatment	6	1646666.67	329333.33	3.60*	3.00	4.82
Error	12	914500.00	91450.00			
TOTAL	20	2841400.00				

* - significant

Coefficient of Variation = 31.05%
Sx = 123.46

APPENDIX TABLE 18. Weight of non-marketable tubers per plot/replication (g)

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	250	250	200	700	233.33
676089	575	1800	650	3025	1008.33
13.1.1	650	525	200	1325	458.33
5.19.2.2	1150	1150	300	2600	766.67
Ganza	400	0	275	314	104.67
Granola	50	0	0	50	16.67
TOTAL	3075	3725	1625	8014	2588

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	385277.78	192638.89			
Treatment	6	2306423.61	461284.72	3.74*	3.00	4.82
Error	12	1234305.56	123430.56			
TOTAL	20	3926006.94				

* - significant

Coefficient of Variation = 35.07%
Sx = 143.43

APPENDIX TABLE 19. Total yield of 1 x 5m^2 of potato entries

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	5910	4825	4900	15635	5211.67
676089	4325	3800	4625	12750	4250
13.1.1	4940	4975	4675	14590	4863.33
5.19.2.2	7100	5600	4350	17050	5683.33
Ganza	4425	3550	4725	12699	4233
Granola	300	100	200	600	200
TOTAL	27000	21850	23475	73324	24441.33

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	1667966.78	833983.39			
Treatment	6	58714254.4	11742850.9	29.17**	3.00	4.82
Error	12	4025617.22	402561.72			
TOTAL	20	64407838.4				

** - highly significant

Coefficient of Variation = 15.59%
Sx = 259.02

APPENDIX TABLE 20. Computed yield of potato entries (tons/ha)

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	11.82	9.65	9.8	31.27	10
676089	8.65	7.6	9.256	25.506	9
13.1.1	9.88	9.95	9.25	29.08	10
5.19.2.2	14.2	11.2	8.7	34.1	11
Ganza	8.84	7.1	9.45	25.398	8
Granola	0.6	0.2	0.4	1.2	0
TOTAL	53.99	45.7	46.856	146.554	48

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	6.720	3.360			
Treatment	6	234.543	46.909	29.06**	3.00	4.82
Error	12	16.140	1.614			
TOTAL	20	257.402				

** - highly significant

Coefficient of Variation = 15.60%
Sx = 0.52