

## **BIBLIOGRAPHY**

ALUMIT, GENESIS B, April 2013. Characterization and Evaluation of Potato Entries for Organic Production System in La Trinidad, Benguet. Benguet State University, La Trinidad, Benguet.

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## **ABSTRACT**

The study was conducted to morphologically characterize the different potato entries; determine the best performing entries under organic production; and to determine the profitability of using the different potato entries under organic production.

Variation among the tuber skin color was observed. Tuber ranged from white cream, red and brown. High dry matter content was obtained in all the entries except for entry 306522. Entries 303223, 303405, 304416 and 307521 were acceptable based on their sensory characteristics.

Potato entries 305185, 304416 and 306522 out yielded the other potato entries and were observed resistant to late blight infection. These entries also obtained high return on cash expense, therefore, recommended for organic production in La Trinidad, Benguet.



## INTRODUCTION

The potato (*Solanum tuberosum* L.) is a high yielding short duration crop that produces high dry matter and protein per unit area and unit time. In terms of quantity, potatoes are the fourth on the list of the crop species after rice, wheat, and corn which are important to human nutrition worldwide. Thus, potatoes have a great potential to meet the increasing food demand worldwide. According to Perez *et al.* (2006) potato is major cash crop in highlands and mid elevation areas in Mindanao, because it has a short growing period, a potential for high yield in a growing market for fresh and process potato. In addition the total potato production comes from Benguet and Mountain Province is about 74 %, while the remaining 26% were from Southern and Northern parts of Mindanao (PCARRD, 1997).

It is known that farmers in Benguet and Mountain Province use tremendous amount of synthetic fertilizers and pesticides to increase their production, however, these practices as claimed by researchers may lead to soil acidity, decrease population of natural enemies, pollution of the soil, water, and air which may cause health hazards. In this case, alternative production practices should be practiced. One of these practices is organic farming or organic agriculture.

According to Petzoldt (2005) organic farming is a method of production that uses practices or materials which are biologically enhancing to the soil and plants. The principle of organic farming is to replenish and maintain long term soil fertility by providing the optimal condition for biological activity. Encouraging the use of local resources, recycled nutrient and maintaining Biodiversity that will minimize the occurrence of pests.



Potato is considered as one of the most important crops in Benguet, however, lack of superior cultivars, the destruction caused by insect pest and the unavailability of good quality seed tuber is a constraint as claimed by farmers.

Organic potato production needs a variety that is suitable to the environment, resistant against pests, and diseases and high yielding. Resistant varieties can help the farmers not to use synthetic insecticides and fungicides therefore, it is important to evaluate varieties for organic production. Evaluation of potato for organic production should be conducted to determine their adaptability and stability in terms of yield, resistance to pest and disease and level of uniformity in the farmers field (Anon, 2005).

The study was conducted to:

1. morphologically characterize the different potato entries;
2. determine the best performing potato entries in terms of yield and resistance to pests under organic production at La Trinidad, Benguet condition; and
3. determine the profitability of using the different potato entries under organic production.

The study was conducted at Balili, Experimental Station, Benguet State University, La Trinidad, Benguet from November 2012 to February 2013.



## REVIEW OF LITERATURE

### Significance of Varietal Evaluation

Thomson and Kelly in 1957 stated that testing of variety is essential, but after testing, attention should be given because there is great difference in yield, size, ear lines and others. It is only by several trials that the superior strains are found.

Cagampang and Lantican (1977) observed that the wise use of an improved and well selected variety may result in tremendous increase in yield. But growing the wrong cultivar may mean crop failure because of disease infection and diverse climatic condition.

Selection of suitable cultivars is an important step in the farm planning process but the availability of large number of variety makes the selection of a variety for a given field is difficult. Also there are many aspects which have to be considered before it is possible to make an opinion of which one of the available cultivar will be the most suited for growing (Boesen *et al.*, 1997).

### Varietal Evaluation of Potato under Organic Production

In the study of Gibson (2002) in La Trinidad, Granola, Igorota and CM 9 produced the highest marketable yield with low bacterial wilt infection, while genotypes IP 84004.7 and 13.1.1 also produced comparable yield with the other genotypes but were highly infected with bacterial wilt. The study recommended Granola, Igorota and CM9, for planting under La Trinidad, Benguet during the dry season planting.

According to Gayomba (2006), genotype 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 at Sinipsip, Buguias. Genotypes 38025.17,



676070, and 5.19.2.2 could be produced in the area since the genotypes were selected by the farmers.

Montes and Tad-awan (2006) in their evaluation of potato varieties for organic production found that CIP genotype IP 84007.67, 676070 and CIP 13.1.1 were resistant to late blight at 60 and 75 DAP in Longlong La Trinidad. For seed tuber production, genotype 380251.17 produced the highest return on cash expense. Further, the farmer-cooperator selected IP84007.67, 676089 and Ganza due to their high yield and resistance to late blight.

Potato accessions CIP 13.1.1, CIP 676089, CIP 380251.17, BSU 5.1.19.2.2 and CIP 676070 produced the highest tuber yield per hill across locations and planting seasons. These accessions also showed resistant to late blight in all production sites (Tad-awan *et al.*, 2007).

It has been found by Daproza (2009) in his study at Balili, La Trinidad that TPS 15 potato progeny had the highest percent survival, while TPS 14 and TPS 11 potato progenies have low percentage survival. Potato progenies TPS 15, TPS 12, TPS 16 were observed to be vigorous and resistant to late blight. The highest yielding progeny was TPS 15 with 4,380 kg/ 15m<sup>2</sup>. TPS 15 produced the highest number of tuber per hill.

In a related study by Sawak (2010) in Buguias, Benguet, Ganza obtained the highest percent survival, exhibited the tallest plant, highest canopy cover and highly vigorous plants at 75 DAP. MLUSA 5, MLUSA 8 and Ganza were rated moderately resistant to frost injury at 60 and 75 DAP. All of the entries were moderately resistant to leaf miner. Ganza produced the heaviest marketable and non-marketable tubers and had highest return on cash expenses (ROCE).



Mendoza (2011) evaluated seven progenies under organic production in La Trinidad, Benguet. The result of the study showed that progeny 303617 had the highest total number of potato tubers, while progeny 306521 produced the heaviest weight, but comparable to progeny 306468 and 303610.



## MATERIALS AND METHODS

### Land Preparation

An area of 195 m<sup>2</sup> was thoroughly prepared and further divided into three blocks. Each block was subdivided into thirteen plots measuring 1m x 5m representing the thirteen treatments.

### Cultural Management Practices

Organic production practices were employed during the conduct of the study. BSU Grower's Compost was incorporated into the soil at the rate of 5kg/m<sup>2</sup> one week before sowing, while Vermi-compost was incorporated at hilling-up with a rate of 5kg/m<sup>2</sup>. Weeding and irrigation were employed in order to maintain the vigorous growth of the plants. Planting of marigold and other crops within the area were done for diversification purpose and to reduce pest occurrence.

### Planting Materials and Treatments

Potato seed tubers were used as planting material. The potato entries were selected from the project "Variety evaluation, on farm trials and seed production of organic vegetable in CAR".

The treatments were as follows:

### CodePotato Entries

E <sub>1</sub>	305185
E <sub>2</sub>	303223
E <sub>3</sub>	304416
E <sub>4</sub>	305182



E <sub>5</sub>	306468
E <sub>6</sub>	306521
E <sub>7</sub>	306522
E <sub>8</sub>	303224
E <sub>9</sub>	307251
E <sub>10</sub>	303203
E <sub>11</sub>	307521
E <sub>12</sub>	303405
E <sub>13</sub>	Phil 5.19.2.2

#### Experimental lay-out and Planting

The experiment was laid-out following the randomized complete block design (RCBD) with three replications. Seed tubers were planted at a distance of 30cm x 30 cm.

#### Data gathered:

##### A. Morphological characters (CIP, 2001)

##### 1. Leaf Characters

a. Leaf Dissection. This describes the degree of leaf dissection expressed as:

- 1 Undissected – entire leaves.
- 2 Pinatilobed – leaves with lobes extending almost to the midribs.
- 3 Scarcely dissected – leaves with terminal and primary lateral leaflets only.
- 4 Weakly dissected – leaves with terminal and primary lateral leaflets and some secondary interjected leaflets on the rachis.





- 5 Medium dissected – leaves with terminal and primary lateral leaflets and interjected leaflets from the second to the fifth order on the rachis.
- 6 Strongly dissected – leaves with terminal and primary lateral leaflet, interjected of the second, third etc. Order on the rachis and one to three interjected leaflets on the petiolules.
- 7 Very strong dissected – leaves with terminal and primary lateral leaflet, intersected leaflets of the second, third, etc. Order on the rachis and more than three interjected leaflets on the petiolules and rachidules.

b. Adaxial leaf pubescence. This represents the degree to which the lower surfaces of the leaves are covered by hairs (trichomes) expressed as:

- 0 Glabrous – when hairs are absent
- 1 Glabrescent – when the pubescence is very sparse
- 2 Pubescence
- 3 Strongly pubescent

c. Type of hairs (trichomes). This describes the type of hair in the lower surface of the leaves expressed as:

- 0 Absent
- 1 Simple – simple trichomes.
- 2 Simple and Glandular – simple trichomes and glandular trichomes bearing a sticky four 0 – lobed head.
- 3 Simple and Glandular – simple trichomes and glandular trichomes with a sticky droplet at the tip.
- 4 Simple and Glandular – simple trichomes and both type of



glandular trichomes present.

## 2. Stem Character

a. Stem color. This indicates the color of the stems expressed as:

- |   |                           |
|---|---------------------------|
| 1 | Green only                |
| 2 | Red-brown only            |
| 3 | Purple only               |
| 4 | Cream with some red-brown |
| 5 | Cream with purple         |
| 6 | Red-brown with some green |
| 7 | Purple with some green    |
| 8 | Others                    |

## 3. Tuber Characters

a. Predominant tuber skin color. These are the color which covers most of the surface of the tuber expressed as:

- |   |                   |
|---|-------------------|
| 1 | White-cream       |
| 2 | Yellow            |
| 3 | Orange            |
| 4 | Brownish          |
| 5 | Pink              |
| 6 | Red               |
| 7 | Purple            |
| 9 | Dark purple-black |



b. Secondary tuber skin color. These describe the color on the surface of the tuber expressed as:

- |   |                   |
|---|-------------------|
| 0 | Absent            |
| 1 | White-cream       |
| 2 | Yellow            |
| 3 | Orange            |
| 4 | Brownish          |
| 5 | Pink              |
| 6 | Red               |
| 7 | Purplish-black    |
| 8 | Purple            |
| 9 | Dark purple-black |

c. Tuber skin type. This is expressed as:

- |   |                     |
|---|---------------------|
| 1 | Smooth              |
| 2 | Rough               |
| 3 | Partially netted    |
| 4 | Totally netted      |
| 5 | Very heavily netted |
| 6 | Others              |

d. Pre-dominant tuber flesh color. This indicates the flesh color present in most of the tuber expressed as:



- 1 White
- 2 Cream
- 3 Yellow-cream
- 4 Yellow
- 5 Red
- 6 Violet
- 7 Purple
- 8 Others

e. Secondary tuber flesh color. This represents the secondary flesh color in the tuber expressed as:

- 0 Absent
- 1 White
- 2 Cream
- 3 Yellow-cream
- 4 Yellow
- 5 Red
- 6 Violet
- 7 Purple

f. General tuber shape. This indicates the tuber outline expressed as:

- 1 Compressed (oblate) – major axis is the shortest axis.
- 2 Round – an almost circular outline
- 3 Ovate – an outline resembling an egg. The broadest part is within  $\frac{1}{3}$  of the distance from the stolon end.



- 4      Obovate – an outline which is inversely ovate and broadest within  $\frac{1}{3}$  of the distance from the apical end.
- 5      Elliptic – an outline showing the same breadth when measured at equal distance from both the stolon and apical end. The outline is slightly acute at each end.
- 6      Oblong – an almost rectangular outline with the sides nearly parallel but the corners rounded. The length/breadth ratio should not be more than  $\frac{3}{2}$ .
- 7      Long-oblong – an oblong outline with a length/breadth ratio closer to  $\frac{2}{1}$ .
- 8      Elongate – a long rectangular outline with a length/breadth ratio equal to or more than  $\frac{3}{2}$ .

g. Unusual tuber shape. This represent those variants of tuber shape which cannot be described under general tuber shape and expressed as follows:

- 0      Absent
- 1      Flattened – when the length of a transverse section, at any point of the tuber, is more than three times longer than its breadth.
- 2      Clavate – resembling an elongated club, thickened at one end.
- 3      Reniform – shaped like a kidney.
- 4      Fusiform – spindle-shaped, tapering gradually at both ends.
- 5      Falcate – curved or shaped like a sickle or horseshoe.
- 6      Spiral – long and coild.
- 7      Digitate – resembling a hand or a fist.
- 8      Concertina-shaped – resembling a concertina.
- 9      Tuberosed – covered with few or many small lamps and tubers. It includes those shaped, like a pineapple, a cluster of grapes, and raised internodes.



h. Depth of tuber eyes. This indicates the depth of the eye in the tuber expressed

as:

1	Protruding
2	Shallow
3	Medium
4	Deep
5	Very deep

i. Eyes per tuber. This represents the number of eyes expressed as:

1	Few (less than 5)
5	Intermediate
10	Many (more than 20)

## B. Growth Characters

1. Plant survival (%). The number of plants that survived were counted at 30, 60 and 75 days after planting(DAP) and calculated using the formula:

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

2. Plant height. Plant height was measured at 30, 60, and 75 DAP using a meter stick.

3. Canopy cover. Canopy cover was recorded at 30, 60, and 75 DAP using a wooden frame which measures 120 cm x 60 cm and having an equal size of grid of 12 cm x 6 cm grids. Holding the grids over the foliage of four marked plants, grids covered with effective leaves will be counted.



4. Plant vigor. Plants were rated at 30, 60, and 75 DAP based on a rating scale by (CIP, 2001):

<u>Scale</u>	<u>Description</u>	<u>Reaction</u>
5	Plant is strong with robust stems and leaves, light color to dark green in color.	Highly Vigorous
4	Plants are moderately strong with robust stem and leaves were light green.	Moderately Vigorous
3	Better than less vigorous.	Vigorous
2	Plants are weak with few thin stems and leaves pale.	Less Vigorous
1	Plants are weak with few stems and leaves, very pale.	Poor Vigorous

### C. Yield and Yield Components

1. Number and weight of marketable tubers per plot (kg). All the tubers that were of marketable size, not malformed, free from cuts cracks and without more than 10% greening of the total surface was counted and weighed at harvest.

2. Number and weight of non-marketable tubers per plot (kg). This was obtained by counting and weighing all tubers that are malformed, damage by pest and disease and those with more than 10% greening.

3. Total yield per 5m<sup>2</sup>(kg). This is the sum of the weight of marketable and non-marketable tubers per plot.

4. Computed Yield (t/ha). This was computed using the formula:

Total Yield

$$\text{Computed Yield (t/ha)} = \frac{\text{Total Yield (kg)}}{\text{Plot Size (m}^2\text{/1,000)}} \times 10,000$$



D. Cost and Return Analysis. The cost of production, gross sale, net profit, and return on cash expense were determined, Return on cash expense was computed by using the formula:

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

E. Reaction to Pest and Diseases

1. Reaction to leaf miner. The reaction to leaf miner was recorded at 30, 60, 75 DAP using the following rating scale (CIP, 2001):

Scale Description Reaction

1	Leaf infected (1-20%)	Highly Resistant
2	Infected (20-40%)	Moderately Resistant
3	Moderately infected (41-60%)	Susceptible
4	Severely infected (61-80%)	Moderately Susceptible
5	Most serious (81-100%)	Very Susceptible

2. Reaction to late blight. Rating was done at 30, 60, and 75 DAP using a rating scale (CIP, 2001) as follows:

<u>%Blight</u>	<u>Scale</u>	<u>Description</u>
0	1	No blight observed
Traces-<5	2	Blight is present at maximum of 10 lesions per plot.
5-<15	3	Plant look healthy but lesions are easily seen at closer distance. Maximum foliage is one





		affected by lesions or destroyed corresponds to more than 2 leaflets.
15->35	4	Blight easily seen on most plants. About 25% foliage is covered with lesions or destroyed.
35->65	5	Plots look green; however all plants are affected. Lower leaves are dead and about 1/2 of the foliage are destroyed.
65-<85	6	Plots look green with brown flecks about 75% each plant is affected. A left or lower half of the plant is destroyed.
85->95%	7	Plant is either predominant green or brown only top leaves are green.
95-<100	8	Plots colored brown. A few top leaves have green areas. Most stems and lesions are dead.
100	9	All leaves and stems are dead.

Description: 1-highly resistant, 2-3- resistant, 4-5- moderate resistant, 6-7- moderate susceptible, 8-9- susceptible

#### F. Postharvest Characters

1. Dry matter content of tubers. Twenty gram of tubers was weighed and sliced into cubes and oven dried at 80<sup>0</sup>C for 24 hrs. This was recorded and computed using the following formula:

Dry matter content (%) = 100% - % moisture content

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

2. Sugar Content (°Brix). This was taken by extracting the juice of 20 g potato tubers and read on a digital refractometer.

3. Sensory Evaluation. Storage roots harvested were washed and boiled and evaluated by fifteen evaluators composed of faculty members and students. Evaluation was based in



terms of appearance, color, texture, flavor and general acceptability following the 1-5 scale. This was the basis to determine the eating quality.

Rating	Description
1	Dislike very much
2	Dislike moderately
3	Neither like nor dislike
4	Like moderately
5	Like very much

#### G. Agro-climatic Data.

Temperature, relative humidity, rainfall were recorded during the conduct of study.

#### Data Analysis

All quantitative data were analyzed using the Analysis of Variance (ANOVA) for Randomized Complete Block Design (RCBD) with three replications. The significance of difference among the treatment means was tested using the Duncan's Multiple Range Test (DMRT) at 5% level of significance.



## RESULTS AND DISCUSSION

### Meteorological Data

Table 1 shows the monthly mean temperature, relative humidity, rainfall and sunshine duration during the conduct of study. The monthly mean temperature ranged from 13.1 °C to 23 °C. During the month of January, air temperature was the highest. The lowest relative humidity was noted in the month of November with 84.75%, while the highest was noted in the month of December with 86.5%. Very little rainfall was noted (0.15 to 2.19 mm).

The temperature and relative humidity during the conduct of study was favorable. Temperature is important in potato plants because it enhance the accumulation of carbohydrates and dry matter in the tubers. The optimum temperature for potato production was reported to be ranging from 17-22 °C and a relative humidity of 86% (HARRDEC, 1996). The lowest sunshine duration was noted in the month of November at 11.09 min while the highest was observed in the month of January with 360 min.

Table 1. Meteorological data from October 2012 to January 2013

MONTH	TEMPERATURE (°C)	RELATIVE HUMIDITY	RAINFALL (mm)	SUNSHINE DURATION
-------	---------------------	----------------------	------------------	----------------------



	MIN	MAX	(%)		(min)
October	15.1	23.00	85	2.19	11.09
November	13.1	20.9	84.75	1.33	10.97
December	13.2	22.6	86.5	0.15	12.18
January	18.3	23.7	80	0.5	360

### Morphological Characters

#### Leaf Dissection, Adaxial Leaf Pubescence Type of Hair and Stem color of the potato entries

Generally, all the entries had similar characteristic. For the leaf dissection, all the entries were scarcely dissected having terminal and primary lateral leaflet only (Figure 1). In terms of adaxial leaf pubescence, all the entries had strongly pubescence where the upper surface of the leaves is covered with fine short hairs or trichomes only and simple and glandular for the type of hair. For the stem color, all the entries are colored green.

#### Pre-dominant and Secondary tuber skin color Pre-dominant and Secondary tuber flesh color

Table 2 shows the tuber characters of the entries. In terms of pre-dominant tuber skin color, entries 303224 and 303405 presented a white cream and red color. Brownish tubers were observed in entries 305185 and 306522. The rest of the entries displayed white cream color. For the secondary tuber skin color, all the entries displayed a white cream color. In terms of tuber flesh color, all the entries showed a white color except for entry 307251 with yellow color, while absent in terms of secondary flesh color.



The tuber skin color can be used as a selection index for gourmet potato in which yellow and white cream color is acceptable for potato chipping (Ludwig, 1985).



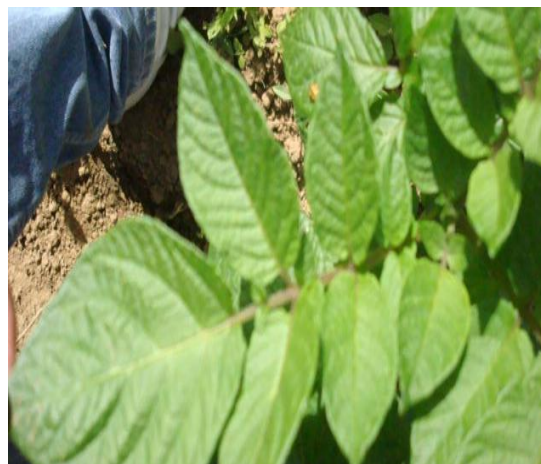
306522



304416



305185



303223



303224



306521

Figure 1. Leaves of some potato entries

Table 2. Pre-dominant skin color, secondary skin color, pre-dominant flesh color and secondary flesh color of the thirteen potato entries evaluated for organic production.

ENTRY	PRE-DOMINANT SKIN COLOR	SECONDARY SKIN COLOR	PRE-DOMINANT FLESH COLOR
305185	Brownish	White-cream	White
303223	White-cream	White-cream	White
304416	White-cream	White-cream	White
305182	White-cream	White-cream	White
306468	White-cream	White-cream	White
306521	White-cream	White-cream	White
306522	Brownish	White-cream	White
303224	White-cream and Red	White-cream	White
307251	White-cream	White-cream	Yellow
303203	White-cream	White-cream	White
307521	White-cream	White-cream	White
303405	White-cream and Red	White-cream	White
Phil 5.19.2.2	White-cream	White- cream	White

Tuber skin, Tuber shape, Depth of eye and Eyes per Tuber

In terms of tuber skin type, entries 303223, 304416, 306521, 306522 and 307251 exhibited a rough skin, while the rest of the entries had smooth skin texture. In terms of shape, entries 305185 and 303224 exhibited oblong and round shape, Phil 5.19.2.2 had an obovate and oblong shape. The rest of the entries had oblong shape. There were no un-usual tuber shapes (Table 3 and Fig. 2).

For the depth of tuber eyes, protruding and shallow eyes were observed in entries 306521 and Phil 5.19.2.2, while entries 304416 and 305182 had protruding eyes. The rest of the



entries were shallow. In terms of the number of eyes, all the entries were observed to be intermediate, ranging from 6 to 20 eyes per tuber.

In relation to potato processing, shallow eyes, round or elongate shape, smooth skin and freedom from defect are among the external characteristics of potatoes preferred by the processor. These characteristics are important for lesser trimming (Ludwig, 1985).

Table 3. Tuber skin type, tuber shape, depth of tuber eye and number of eyes per tuber of the thirteen potato entries

ENTRY	TUBER SKIN	TUBER SHAPE	DEEP OF EYE	EYES PER TUBER
305185	Smooth	Round and Oblong	Shallow	Intermediate
303223	Rough	Oblong	Shallow	Intermediate
304416	Rough	Oblong	Protruding	Intermediate
305182	Smooth	Oblong	Protruding	Intermediate
306468	Smooth	Oblong	Shallow	Intermediate
306521	Rough	Oblong	Protruding	Intermediate
306522	Rough	Oblong	Shallow	Intermediate
303224	Smooth	Round and Oblong	Shallow	Intermediate
307251	Rough	Oblong	Shallow	Intermediate
303203	Smooth	Oblong	Shallow	Intermediate
307521	Smooth	Oblong	Shallow	Intermediate
303405	Smooth	Oblong	Shallow	Intermediate
Phil	Smooth	Obovate and Oblong	Protruding	Intermediate
5.19.2.2		Oblong		







Figure 2. Tubers of some potato entries

## Growth Characters

Plant Survival. The percent survival of the thirteen potato entries was not significant at 30, 60 and 75 DAP. At 60 DAP, all entries had decrease in their plant survival due to late blight infection. Among the entries, high percentage plant survival was observed on entry 304416 with 81.89% which is comparable to entries 305185 and 30652, while the lowest was observed on entry 303224 with 44.02%.

At 75 DAP, entry 305185 exhibited a high plant survival of 76.00% which is not significantly different with entry 306522 with 72.73%.

Potato entries 305185, 304416 and 306522 with more than 50% survival may be due to its resistant to late blight.

Table 4. Plant survival of the thirteen potato entries evaluated for organic production at 30, 60 and 75 DAP

ENTRY	PLANT SURVIVAL (%)		
	30 DAP	60 DAP	75 DAP
305185	100.00	80.95 <sup>ab</sup>	76.00 <sup>a</sup>
303223	100.00	46.53 <sup>c</sup>	43.40 <sup>b</sup>
304416	100.00	81.89 <sup>a</sup>	66.64 <sup>ab</sup>
305182	96.38	52.80 <sup>bc</sup>	52.91 <sup>ab</sup>
306468	97.81	59.35 <sup>abc</sup>	57.20 <sup>ab</sup>
306521	98.78	58.09 <sup>abc</sup>	55.71 <sup>ab</sup>
306522	100.00	76.06 <sup>ab</sup>	72.73 <sup>a</sup>
303224	100.00	44.02 <sup>c</sup>	44.02 <sup>b</sup>
307251	100.00	53.40 <sup>bc</sup>	53.40 <sup>ab</sup>
303203	98.89	61.62 <sup>abc</sup>	55.72 <sup>ab</sup>
307521	95.39	59.54 <sup>abc</sup>	57.06 <sup>ab</sup>
303405	97.92	63.29 <sup>abc</sup>	55.00 <sup>ab</sup>
Phil 5.19.2.2	95.02	68.95 <sup>abc</sup>	64.07 <sup>ab</sup>
CV%	2.27	22.80	21.18

Means with the same letter are not significantly different at 5% level by DMRT.



## Plant Height

Table 5 shows the heights of the potato entries at 30, 60 and 75 DAP. At 30 DAP. No significant differences were observed.

At 60 and 75 DAP, significant differences were observed. At 60 DAP, entry 307521 had the tallest plants with 63.67 cm, but comparable with entries 304416 and 306522, while the shortest plant were observed in Phil 5.19.2.2 with 49.40 cm.

At 75 DAP, the tallest plants were observed in entry 306522 with 65.40 cm, while the shortest plant were observed in Phil 5.19.2.2 with 52.67 cm.

Increasing height and variability are observed among the potato entries. According to Smith (1968) as cited by Gayodan (1999), larger and longer stems were found to have greater assimilation rate per unit plant and leads to higher yield.

Table 5. Plant height of the thirteen potato entries evaluated for organic production at 30, 60 and 75 DAP

ENTRY	PLANT HEIGHT(CM)		
	30 DAP	60DAP	75DAP
305185	38.53 <sup>ab</sup>	52.87 <sup>bc</sup>	55.00 <sup>bc</sup>
303223	38.73 <sup>ab</sup>	49.93 <sup>c</sup>	54.53 <sup>c</sup>
304416	37.67 <sup>ab</sup>	60.40 <sup>ab</sup>	62.73 <sup>ab</sup>
305182	34.33 <sup>b</sup>	50.13 <sup>c</sup>	53.93 <sup>c</sup>
306468	38.87 <sup>ab</sup>	49.73 <sup>c</sup>	54.33 <sup>c</sup>
306521	39.07 <sup>ab</sup>	53.20 <sup>bc</sup>	54.67 <sup>c</sup>
306522	37.80 <sup>ab</sup>	60.60 <sup>ab</sup>	65.40 <sup>a</sup>
303224	39.80 <sup>ab</sup>	56.47 <sup>abc</sup>	59.67 <sup>abc</sup>
307251	42.13 <sup>a</sup>	53.93 <sup>bc</sup>	54.87 <sup>bc</sup>
303203	42.07 <sup>a</sup>	55.13 <sup>abc</sup>	58.40 <sup>abc</sup>
307521	40.47 <sup>ab</sup>	63.67 <sup>a</sup>	64.80 <sup>ab</sup>
303405	40.60 <sup>ab</sup>	52.27 <sup>bc</sup>	53.73 <sup>c</sup>
Phil 5.19.2.2	40.60 <sup>ab</sup>	49.40 <sup>c</sup>	52.67 <sup>c</sup>
CV (%)	9.74	8.73	8.87

Means with the same letter are not significantly different at 5% level by DMRT.



## Canopy Cover

Table 6 shows, significant differences on the canopy cover of the thirteen potato entries at 30, 60 and 75 DAP. Wide canopy was observed in entry 306522 with 73.11, but not significantly different with entries 305185, 306521, 303224 and 303405 at 30 DAP. Lowest canopy cover was observed from entry 307521 with 44.33.

Entries 304416 and 306522 had the widest canopy cover at 60 DAP of about 81.00 and 84.78, respectively, but comparable with entry 305185 with 71.33. Lowest canopy was observed in Phil 5.19.2.2 with 36.11.

At 75 DAP, wide canopy was still observed on entries 304416 and 306522 with 39.22 and 40.55, respectively, but comparable with entry 305185. Narrowest canopy was still observed in Phil 5.19.2.2 with 17.44.

Potato entries 305185, 304416 and 306522 exhibited the widest canopy in all dates. This might be due to their resistance to late blight, high plant survival and plant vigor.

Table 6. Canopy cover of the thirteen potato entries evaluated for organic production at 30, 60 and 75 DAP



ENTRY	CANOPY COVER		
	30 DAP	60DAP	75DAP
305185	70.22 <sup>a</sup>	71.33 <sup>ab</sup>	37.11 <sup>ab</sup>
303223	55.55 <sup>ab</sup>	49.77 <sup>bc</sup>	26.33 <sup>abc</sup>
304416	56.55 <sup>ab</sup>	81.00 <sup>a</sup>	39.22 <sup>a</sup>
305182	58.00 <sup>ab</sup>	47.33 <sup>bc</sup>	23.78 <sup>bc</sup>
306468	59.00 <sup>ab</sup>	64.44 <sup>abc</sup>	28.44 <sup>abc</sup>
306521	66.55 <sup>a</sup>	68.22 <sup>ab</sup>	28.67 <sup>abc</sup>
306522	73.11 <sup>a</sup>	84.78 <sup>a</sup>	40.55 <sup>a</sup>
303224	67.77 <sup>a</sup>	45.44 <sup>bc</sup>	19.55 <sup>c</sup>
307251	56.77 <sup>ab</sup>	42.66 <sup>bc</sup>	17.11 <sup>c</sup>
303203	59.78 <sup>ab</sup>	45.55 <sup>bc</sup>	19.09 <sup>c</sup>
307521	44.33 <sup>b</sup>	56.66 <sup>abc</sup>	24.33 <sup>b<sup>bc</sup></sup>
303405	62.11 <sup>a</sup>	44.77 <sup>bc</sup>	18.44 <sup>c</sup>
Phil 5.19.2.2	59.44 <sup>ab</sup>	36.11 <sup>c</sup>	17.44 <sup>c</sup>
CV (%)	14.14	26.79	28.09

Means with the same letter are not significantly different at 5% level by DMRT.

### Plant Vigor

Table 7 shows, the plant vigor of the thirteen potato entries at 30, 60 and 75 DAP. All entries at 30 DAP were rated highly vigorous. At 60 DAP, entry 304416 and 306522 were rated moderately vigorous, while the entries 305182, 305185, 306468, 306521, 307521 and Phil 5.19.2.2 were rated vigorous. Other entries were rated less vigorous.

At 75 DAP most of the entries were rated either less vigorous or poor except for the entries 304416, 306522 and 305185 which were rated vigorous.

Table 7. Plant vigor rating of the thirteen potato entries evaluated for organic production at 30, 60 and 75 DAP



ENTRY	PLANT VIGOR		
	30 DAP	60 DAP	75DAP
305185	Highly vigorous	Vigorous	Vigorous
303223	Highly vigorous	Less vigorous	Less vigorous
304416	Highly vigorous	Moderately vigorous	Vigorous
305182	Highly vigorous	Vigorous	Less vigorous
306468	Highly vigorous	Vigorous	Less vigorous
306521	Highly vigorous	Vigorous	Poor vigorous
306522	Highly vigorous	Moderately vigorous	Vigorous
303224	Highly vigorous	Less vigorous	Less vigorous
307251	Highly vigorous	Less vigorous	Less vigorous
303203	Highly vigorous	Less vigorous	Less vigorous
307521	Highly vigorous	Vigorous	Less vigorous
303405	Highly vigorous	Less vigorous	Less vigorous
Phil 5.19.2.2	Highly vigorous	Vigorous	Poor vigorous

### Yield and Yield Components

#### Number of Marketable and Non-marketable Tubers

Table 8 shows no significant differences on the number of marketable and non-marketable tubers per plot. However, entries 303223 and 303224 produced the most numbers of marketable tubers of 138 and 137, respectively, while entry 303405 had the least number of marketable tubers of 73. For the non-marketable tubers entry 303203 had the lowest number of non-marketable tuber of 4.67.

#### Weight of Marketable and Non-marketable tubers



Highly significant differences were observed on the marketable and non-marketable yield (Table 8). Entry 305185 obtained the heaviest marketable tuber of 4.43 kg which is comparable with entry 306522. Lightest marketable tubers were obtained from entry 303405. In terms of non-marketable weight, entries 303223 and Phil 5.19.2.2 had the lowest non-marketable weight of 0.11 and 0.11 kg, respectively.

Table 8. Number and weight of marketable tubers, number of non-marketable and weight of non-marketable tubers evaluated under organic production at 30, 60 and 75 DAP

ENTRY	MARKETABLE		NON-MARKETABLE	
	NUMBER	WEIGHT (Kg/5m <sup>2</sup> )	NUMBER	WEIGHT (Kg/5m <sup>2</sup> )
305185	101.7 <sup>ab</sup>	4.43 <sup>a</sup>	6.33 <sup>abc</sup>	0.22 <sup>bcd</sup>
303223	138.00 <sup>a</sup>	3.58 <sup>abcd</sup>	4.67 <sup>a</sup>	0.11 <sup>a</sup>
304416	99.33 <sup>ab</sup>	3.76 <sup>abc</sup>	7.33 <sup>abc</sup>	0.20 <sup>bcd</sup>
305182	97.33 <sup>ab</sup>	1.65 <sup>ef</sup>	8.67 <sup>abc</sup>	0.16 <sup>cd</sup>
306468	96.33 <sup>ab</sup>	2.44 <sup>cdef</sup>	6.67 <sup>abc</sup>	0.23 <sup>bcd</sup>
306521	112.00 <sup>ab</sup>	3.59 <sup>abc</sup>	5.67 <sup>abc</sup>	0.21 <sup>bcd</sup>
306522	75.33 <sup>b</sup>	4.22 <sup>ab</sup>	7.00 <sup>abc</sup>	0.35 <sup>d</sup>
303224	137.00 <sup>a</sup>	3.03 <sup>abcde</sup>	9.33 <sup>ab</sup>	0.29 <sup>ab</sup>
307251	109.3 <sup>ab</sup>	2.87 <sup>bcdef</sup>	8.67 <sup>abc</sup>	0.28 <sup>abc</sup>
303203	78.33 <sup>b</sup>	1.92 <sup>def</sup>	9.67 <sup>c</sup>	0.32 <sup>ab</sup>
307521	119.3 <sup>ab</sup>	2.32 <sup>cdef</sup>	8.33 <sup>abc</sup>	0.20 <sup>bcd</sup>
303405	73.00 <sup>b</sup>	1.52 <sup>f</sup>	7.67 <sup>abc</sup>	0.20 <sup>bcd</sup>
Phil 5.19.2.2	117.3 <sup>ab</sup>	2.45 <sup>cdef</sup>	5.33 <sup>bc</sup>	0.11 <sup>a</sup>
CV (%)	23.76	25.67	28.46	28.78

Means with the same letter are not significantly different at 5% level by DMRT

#### Total and Computed yield



Table 9 shows highly significant differences on the total yield and computed yield of the thirteen potato entries. Entry 305185 significantly had the highest total yield of 4.65 kg/m<sup>2</sup> and computed yield of 9.30 t/ha, but comparable with entry 306522. Second in rank were entries 304416 and 306521.

The high yield of the entries 305185, 304416 and 306522 may be attributed to their resistance to late blight, high canopy cover and vigor.

Table 9. Total and computed yield of the potato entries evaluated under organic production at 30, 60 and 75 DAP

ENTRY	TOTAL YIELD (kg/m <sup>2</sup> )	COMPUTED YIELD (t/ha)
305185	4.65 <sup>a</sup>	9.30 <sup>a</sup>
303223	3.50 <sup>abcd</sup>	7.00 <sup>abcd</sup>
304416	3.97 <sup>abc</sup>	7.94 <sup>abc</sup>
305182	1.82 <sup>ef</sup>	3.65 <sup>ef</sup>
306468	2.67 <sup>cdef</sup>	5.34 <sup>cdef</sup>
306521	3.80 <sup>abc</sup>	7.60 <sup>abc</sup>
306522	4.58 <sup>ab</sup>	9.16 <sup>ab</sup>
303224	3.33 <sup>abcde</sup>	6.66 <sup>abcde</sup>
307251	3.15 <sup>abcdef</sup>	6.31 <sup>abcdef</sup>
303203	2.24 <sup>def</sup>	4.49 <sup>def</sup>
307521	2.53 <sup>cdef</sup>	5.06 <sup>cdef</sup>
303405	1.72 <sup>f</sup>	3.44 <sup>f</sup>
Phil 5.19.2.2	2.57 <sup>cdef</sup>	5.14 <sup>cdef</sup>
CV (%)	23.81	23.81

### Return on Cash Expenses (ROCE)





Cash expense of potato entries is shown in Table 10. Higher return on cash expense was obtained from the entries 305185, 306522 and 304416.

Table 10. Cost and return analysis of the potato entries for organic production

ENTRIES	COST OF PRODUCTION (Php)	MARKETABLE TUBERS (Kg/5m <sup>2</sup> )	GROSS SALE (Php)	NET INCOME (Php)	ROCE
305185	413	13.29	797.40	384.40	93.08
303223	413	10.14	608.40	187.00	45.27
304416	413	11.28	676.80	263.00	63.68
305182	413	4.95	292.00	-121.00	-32.44
306468	413	7.32	439.20	26.20	6.34
306521	413	10.77	646.20	233.20	43.63
306522	413	12.66	759.60	346.60	83.92
303224	413	9.09	545.40	132.40	32.05
307251	413	8.61	516.60	103.60	25.08
303203	413	5.76	345.60	-674.00	-63.19
307521	413	6.96	417.60	4.60	1.11
303405	413	4.56	273.60	-139.40	-33.75
Phil 5.19.2.2	413	7.33	441.10	28.10	6.80

\* Total cost of production includes material inputs and labor cost.

\* Selling price of potato tuber was 60 pesos per kilo.

### Reaction to Leaf Miner and Late Blight



Leaf Miner Incidence. Leaf miner incidence with in the area was not observed. This could be due to the planting of marigold which acted as insect repellent and the maintenance of plant diversity in the experimental area.

Late Blight Infection. Table 11 shows the reaction to late blight of the thirteen potato entries at 30, 60 and 75 DAPS. It was observed that all the entries were highly resistant at 30 DAP. However, an increase in late blight were rated as moderately susceptible except for the entries 305185, 304416 and 306522 which rated were moderately resistant.

The sudden increase in late blight infection at 60 DAP could be due to high relative humidity caused by sudden rain showers in November and December.

Table 11. Late blight rating of the potato entries evaluated for organic production at 30, 60 and 75 DAP

ENTRY	REACTION TO LATE BLIGHT		
	30 DAP	60 DAP	75 DAP
305185	Highly resistant	Moderately resistant	Moderately resistant
303223	Highly resistant	Moderately susceptible	Moderately susceptible
304416	Highly resistant	Moderately resistant	Moderately resistant
305182	Highly resistant	Moderately susceptible	Moderately susceptible
306468	Highly resistant	Moderately susceptible	Moderately susceptible
306521	Highly resistant	Moderately susceptible	Moderately susceptible
306522	Highly resistant	Moderately resistant	Moderately resistant
303224	Highly resistant	Moderately susceptible	Moderately susceptible
307251	Highly resistant	Moderately susceptible	Moderately susceptible
303203	Highly resistant	Moderately susceptible	Moderately susceptible
307521	Highly resistant	Moderately susceptible	Moderately susceptible
303405	Highly resistant	Moderately susceptible	Moderately susceptible
Phil 5.19.2.2	Highly resistant	Moderately susceptible	Moderately susceptible

### Postharvest Characters



Sugar content. Table 12 shows significant difference on the sugar content of the potato entries. Entry 303223 produced tuber with highest sugar content of 3.83<sup>0</sup> Brix which is comparable with entry 307521 with 3.70<sup>0</sup> Brix.

Sugar content is apparently important in potato chips processing, low sugar content emphasizes good quality for potato chipping and prevents darkening on chips (Table 12).

Dry matter content. Dry matter content of the potato entries ranges from 15.00to 25.00%. Entry 307521 had significant the highest dry matter content of 25.00% but comparable with entry 303203 with 23.33%, while entry 306521 had the lowest dry matter content of 15.00% (Table 12).

The percent dry matter indicates the solid matter that comprises the tuber which is very important composition of the potato. Based on the findings of NPRCRTC(2003), dry matter content is variable depending on the planting season, fertilization and maturity among other factors. In this study, the high dry matter content of the potato entries could be due to the favorable dry season planting from October to January.

Table 12. Sugar content and dry matter content of the thirteen potato entries under organic production

ENTRY	SUGAR CONTENT	DRY MATTER CONTENT
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	( <sup>0</sup> Brix)	(%)
305185	3.47 <sup>cd</sup>	21.67 <sup>ab</sup>
303223	3.83 <sup>a</sup>	18.33 <sup>bc</sup>
304416	3.50 <sup>cd</sup>	18.33 <sup>bc</sup>
305182	3.33 <sup>def</sup>	16.67 <sup>cd</sup>
306468	3.60 <sup>bc</sup>	18.33 <sup>bc</sup>
306521	3.40 <sup>de</sup>	18.33 <sup>bc</sup>
306522	3.40 <sup>de</sup>	15.00 <sup>d</sup>
303224	3.23 <sup>ef</sup>	16.67 <sup>cd</sup>
307251	3.43 <sup>cd</sup>	16.67 <sup>cd</sup>
303203	3.50 <sup>cd</sup>	23.33 <sup>ab</sup>
307521	3.70 <sup>ab</sup>	25.00 <sup>a</sup>
303405	3.37 <sup>def</sup>	16.67 <sup>cd</sup>
Phil n5.19.2.2	3.20 <sup>f</sup>	21.67 <sup>ab</sup>
CV (%)	2.87	1.02

Mean with the same letter are not significantly different at 5% level by DMRT

#### Sensory Evaluation of the Thirteen Potato Entries for Organic Production

As shown in Table 13, entries 303203, 304416 and 307251 were rated liked moderately while the rest of the entries were rated neither liked nor disliked in terms of appearance. For color, entries 303203, 303223 and 304416 were liked moderately, while the rest were rated neither liked nor disliked.

In terms of texture, entries 306521 and 307521 rated liked moderately, while the other entries were rated neither liked nor disliked. For the flavor, entries 303223, 303405 and 304416 are liked moderately, while the rest of the entries are neither liked nor dislike. In terms of general acceptability, entries 303223, 303405, 304416 and 307521 were liked moderately, while the other entries rated as neither like nor dislike.



The entries that were rated liked moderately were acceptable as to their sensory characteristics by the evaluators.

Table 13. Sensory evaluation of the thirteen potato entries evaluated for organic production at 30,60 and 75 DAP

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ENTRY	APPEARANCE	COLOR	TEXTURE	FLAVOR	GENERAL ACCEPTABILITY
305185	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked
303223	Neither liked nor disliked	Liked moderately	Neither liked nor disliked	Liked moderately	Liked moderately
304416	Liked moderately	Liked moderately	Neither liked nor disliked	Liked moderately	Liked moderately
305182	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked
306468	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked
306521	Neither liked nor disliked	Neither liked nor disliked	Liked moderately	Neither liked nor disliked	Neither like nor dislike
306522	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked	Neither like nor dislike
303224	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked	Neither like nor dislike	Neither like nor dislike
307251	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked	Neither like nor dislike	Neither like nor dislike
303203	Liked moderately	Liked moderately	Neither liked nor disliked	Neither like nor dislike	Neither like nor dislike
307521	Liked moderately	Neither liked nor disliked	Liked moderately	Neither like nor dislike	Like moderately
303405	Neither liked nor dislike	Neither liked nor disliked	Neither liked nor disliked	Like moderately	Like moderately
Phil 5.19.2.2	Neither liked nor dislike	Neither liked nor dislike	Neither liked nor disliked	Neither like nor dislike	Neither like nor dislike

## SUMMARY, CONCLUSIONS AND RECOMMENDATIONS



## Summary

The study was conducted to: morphologically characterize the different potato entries; determine the best performing entries under organic production; and determine the profitability of using the different potato entries under organic production.

For the leaf dissection, all the entries were scarcely dissected, with strongly pubescence of leaves and green stems. As to skin of the tubers, entries 305185 and 306522 had brownish skin color, entries 303224 and 303405 had a white-cream and red color, while the rest of the entries had white-cream in color. For the pre-dominant tuber flesh color, all entries colored white except for entry 307251 with yellow color while no secondary flesh color was observed.

There were no significant differences observed on the plant survival of the thirteen potato entries, however, entries 305185, 304416 and 306522 exhibited high percentage survival in all dates. All the entries had increase in their height in all the dates. Entry 306522 registered the tallest plants among the entries. As to canopy cover, at 60 and 75 DAP, significant differences were observed where entries 304416 and 306522 had the widest canopy covers

In terms of plant vigor, all the entries are highly vigorous at 30 DAP. Entries 304416 and 306522 were moderately vigorous while entries 305185, 305182, 306468, 306521, 307521 and Phil 5.19.2.2 were vigorous at 60 DAP. At 75 DAP, entries 304416, 306522 and 305185 were vigorous.

There was no occurrence of leaf miner during the conduct of the study. For late blight infection, all the entries were highly resistant at 30 DAP. At 60 and 75 DAP, entries



305185, 304416 and 306522 were moderately resistant while the rest of the entries were moderately susceptible to late blight.

Based on yield, entry 305185 produced the highest marketable yield which is comparable with entry 306522. Lowest yield was observed from entry 303405.

For the sugar content and dry matter content, entry 303223 had the highest sugar content. Entry 307521 had the highest dry matter content which is comparable with entry 303203.

The most profitable entries for organic production based on ROCE were 305185, 304416 and 306522.

For the sensory characteristic, evaluators rated the potato entries as liked moderately and liked nor disliked in terms of appearance, color, texture, and flavor. For the general acceptability entries 303223, 304416, 307521 and 303405 were moderately accepted by the evaluators while the other entries were rated neither like nor dislike.

### Conclusions

The different potato entries varied only in their tuber skin color. Other characters such as stem and leaf characters, tuber flesh color are the same for all the potato entries. All the entries produced yield under organic production system. Entries 305185, 304416 and 306522 are the most resistance to late blight infection. Entries 305185, 304416 and 306522 are the highest yielders under organic production. Entries 303223, 304416, 307521 and 303405 were moderately liked by the evaluators. Entries 305185, 3054416 and 306522 were the most profitable under organic production systems.

### Recommendations





Based on the result of the study, potato entries 305185, 304416 and 306522 are recommended for organic production in La Trinidad, Benguet. It is further recommended that another study will be conducted during the wet season since the study was conducted during the dry season to verify the results and determine the stability of the entries.



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