BIBLIOGRAPHY

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ABSTRACT

The study was conducted to: evaluate potato entries from potato rooted stem cuttings under organic production; determine the best potato entry in terms of growth, yield and pest and disease resistance under organic production; determine the profitability of growing potato entries under organic production and to document organic production practices at La Trinidad, Benguet.

All potato entries were adapted for organic production. Among the entries tested, entries 303224, 307521 and Granola Selection 1 produced the highest marketable yield and ROCE for both table and seed production. All potato entries were resistant to late blight infection and highly resistant to leaf miner infestation.

Potato entries 306522, 397521, 306522, 304416, 308468, 305180, 303224, 307251 and Granola Selection 1 are potential entries for organic production in La Trinidad, Benguet.

INTRODUCTION

Potato (*Solanum tuberosum* L.*)* had an important role in our economy and the country's effort to attain self sufficiency in food. It is in fact a high value crop and is widely grown in the Cordillera particularly in Benguet and Mountain Province due to its potential as one of the profitable crop to grow in the region. Potato is not only utilized as food but as health therapy since it contains high nutrition values, good source of carbohydrates, proteins, minerals, vitamins and calcium. It is grown in the region due to the favorable climatic condition and soil type which are the primary factors that favor the growth and development of the crop leading to good yield (Simongo and Gonzales, 2009).

Demand for potatoes is increasing due to the rising number of fast-food chains, hotels, and local potato based snacks food manufacturers. At present, maximum production is not reached due to various factors. One major constraint is poor quality varieties which are low yielding and susceptible to pest (HARRDEC, 1996).

One alternative technology for commercial potato production is the use of potato rooted stem cuttings. Planting potato stem cuttings would greatly reduce the cost in producing, storing and planting tubers. Disease transmission in potato seed tubers will be also be minimized (Gayao and Simongo, 2006).

The major system of potato production is conventional or chemical based is now faced with problems such as soil acidity, human health problems and environmental pollution (Cheng and Bersamina, 1994). Potato was also reported as the most chemically sprayed crop among the vegetables grown in the Philippine highlands (Ganga, 1994).

Due to the problems brought about by the conventional farming alternative system of production such as organic farming should be practiced. According to Briones (1997), organic farming practices the use of organic fertilizers and diverse cropping system without the use of any pesticide.

Factors that contribute to the success of potato production under organic systems are the availability of varieties that are adapted under such condition and alternative planting material are important practices that can be considered in organic production.

The study was conducted to:

1. evaluate potato entries from rooted stem cuttings under organic production in La Trinidad, Benguet;

2. determine the best potato entry in terms of growth, yield and pest and disease resistant under organic production;

3. determine the profitability of growing potato entries under organic production; and

4. document the organic production practices employed in growing potato.

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

REVIEW OF LITERATURE

Importance of Organic Production

Organic production is a holistic system that aims to increase the productivity and fitness of diverse communities within agro ecosystem, including soil organism, plants livestock and people. The development of enterprises that are suitable and harmonious with the environment is the aim of organic production (CGSB, 2006).

Recently, there are many farmers who practice diverse method of farming from conventional to the organic farming because of the unstable price of oil. Oil is the major ingredient for making chemical fertilizer. The farmer realized to look for alternative low cost of fertilizer that are not harmful but beneficial to the environment and plant (Razzaq, 2008). According to PCARRD (2000), organic production is the traditional method used by the farmers to practice the diverse farming which avoided the use of synthetic chemicals.

Organic farming conserves and maintains the ecological balance of the environment. It avoids the contamination of the air, soil, water, and the crop itself. According to Balfour (2000), organic farming preserves and enhances top soil and it increases the chances that future generation can continue growing food.

Organic production is highly recommended in the Cordillera. This production strategy enhances safety and quality, environmental sustainability and gives concern to the health and welfare of the farmer in the future (Briones, 1997).

Evaluation of Potato Varieties under Organic Production in Benguet

It was reported by Gayomba (2006) that CIP 13.1.1 is the best genotype for organic production at Sinipsip, Buguias due to the highest canopy cover, high resistance to late blight and high total yield. CIP 13.1.1 also had the highest ROCE (return on cash expense) for both table potato productions.

Loque (2007) reported that accession CIP 8.20.4 had the highest percentage plant survival; low late blight infection and highest canopy cover at 60 DAP. Accession 380679.3 was observed to be highly resistant to leaf miner. NPV 06 produced the highest tubers with highest dry matter content.

Ongican (2008) found that CIP 38025.17, CIP 676089, CIP 13.1.1 and PHIL 5.19.2.2 are adapted under organic production at Loo, Buguias, Benguet. This entries were observed to be vigorous 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. CIP 13.1.1 produced the highest number of small- sized tubers and marketable tubers while CIP 38025.17 obtained the highest ROCE.

It was reported by Ambales (2009) that PHIL 5.19.22 and CIP 676089 had the highest canopy cover in La Trinidad. CIP 676089 had the highest tubers yield and dry matter content at 90 DAP. CIP 96.06 produced the heaviest weight of marketable tubers. CIP 13.1.1, CIP 676089, PHIL 5.19.1.1 and CIP 96-06 had moderate resistance to leaf miner at 60 DAP and highly resistant to late. CIP 67609 obtained the highest return on cash expense.

Daproza (2009) evaluated seven progenies under screen house and field condition at La Trinidad. The results showed that TPS 15 progeny had the highest percent survival

while TPS 14 and TPS 11 had the least. Potato progenies TPS 15, TPS 12, and TPS 16 were observed to be vigorous to be vigorous and resistant to blight. The highest yielding progeny was TPS 15 with 4,380/15 m^2. Uniformity for tuber qualities, length of stolons and tubers were significantly different among potato progenies. TPS 16 had the most uniform fresh color. TPS 15 produced the highest number of tuber per hill.

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

Delfin (2012) evaluated agronomic characters of potato progenies under organic production in La Trinidad. Result showed that progenies 307125 and 307256 significantly registered the tallest plants and heights of 185.33 and 178.33 cm at 75 DAP. Progenies 30751, 306522 and 307249 had the widest canopy cover. Progeny 30725 had the highest number of tuberlets of 82.33 per 5 m^2 followed by progeny 306522. Based on yield, progeny 30725 produced the highest number of tuberlets.

The Use of Rooted Stem Cuttings

The cost production of seed production is considerably high; the cost of rooted stem cuttings as planting materials has been estimated to be 60% less than the seed tuber (Torio, 1980).

Demonteverde (1992) emphasized that the use of rooted stem cuttings has a great potential for the multiplication of pathogen tested materials either *in-vitro* or in protected greenhouse. This method promotes fast introduction of new cultivars, reduces field

exposure during the early stage of seed production and ensure higher quality. It also serves as promising tool for germplasm evaluation. Several on farm trials showed that the use of rooted stem cuttings of certain clones has been efficient, profitable and low cost method of potato production.

According to Horton (1987) to obtain high yield in potato, the use of clean seeds is an important factor. Furthermore in certain parts of Asia, seed tuber accounts for 40-50% of total variable cost of production. But the investment can be reduced to one half by using cheaper alternative ways of producing clean planting materials.

Escobar and Zaag(1995) confirmed that the use of rooted stem cuttings in developing countries like Asia is a very promising tool for low cost production and prevent possible occurrence of tuber-borne diseases. It has a great potential for seed and table potato production where the seed quality is a major determining growth and yield of the crop.

Zamora (1986) reported that the rooted stem cuttings yields more planting materials at the shortest possible time than the traditional seed piece method. In the most instances planting material produced from stem cutting is cheaper.

MATERIALS AND METHODS

Land Preparation and Experimental Design

An area of 150 m^2 was thoroughly prepared and divided into three blocks. Each block was composed of 10 plots measuring 1m x 5m which represents the ten potato entries. The experiment was laid-out following the randomized complete block design (RCBD) with three replications.

Treatments

The potato entries served as treatments as follows:

Treatment	Entry	Characteristics
T1	306468	Highly resistant to moderately resistant to late blight, high yield
T2	306521	Highly resistant to moderately resistant to late blight, high yield
T3	306522	Highly resistant to moderately resistant to late blight, high yield
T4	307251	Highly resistant to moderately resistant to late blight, high yield
T5	304416	Highly resistant to moderately resistant to late blight, high yield
T6	305180	Highly resistant to moderately resistant to late blight, high yield
T7	303223	Highly resistant to moderately resistant to late blight, high yield
T8	303224	Highly resistant to moderately resistant to late blight, high yield
T9	307521	Highly resistant to moderately resistant to late blight, high yield
T10	Granola Selection 1	Highly resistant to moderately resistant to late blight, high yield

Planting Materials and Planting

The original planting materials (seeds) were obtained from the International Potato Center (CIP) Lima, Peru through the PCARRD funded project "Variety Evaluation, On-Farm Trials and Seed Production of Organic Vegetables in CAR". Granola Selection 1 was produced through True Potato Seed (TPS) the planting materials was further multiplied using the rapid multiplication technique to produce rooted stem cuttings. Rooted stem cuttings were planted in single row at 30 cm between hills.

Organic Production Practices

The treatments were equally applied with BSU Grower's Compost and Vermi-compost (1:1) at the rate of 5 kg/ 5 m^2 incorporated into the soil one week before transplanting. Hilling-up, weeding and irrigation were employed in order to maintain the vigorous growth of the plant. Yellow traps were established around the experimental area in order to control the occurrence of leaf miner. Planting of marigold and other crops within the area was done for diversification purposes and to reduce pest occurrence.

The data gathered were:

1. Plant survival (%). These were the number of plants that survived at 30 days after planting (DAP).

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

2. Plant vigor. This was gathered at 30, 45 and 60 DAP using the CIP rating scale (CIP, 2004).

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

3. Canopy cover. This was gathered at 30, 45, and 60 DAP using a wooden frame measuring 120cm x 60cm and having equal sized 12cm x 6cm grids.

4. Initial height (cm). Plants were measured using ten sample plants selected at random per plot at 30 DAP from the base to the tip of the longest shoots.

5. Final Height (cm). The plants used in measuring the initial height were used. Plants were measured from the base up to the tip of the tallest shoot, one week before harvesting.

6. Reaction to leaf miner and late blight

a. Leaf miner. The reaction was recorded at 45, 60, and 75 DAP using the following rating scale (CIP, 2001).

Scale	Description	Reaction
1	Less than 20% of plants per plot infested	Highly resistant

2	21-40% of the plants per plot infested	Moderately resistant
3	41-60% of the plant per plot infested	Susceptible
4	61-80% of the plant per plot infested	Moderately susceptible
5	81-100% of the plant per plot infested	Very susceptible

b. Late blight. This was gathered at 45, 60 and 75 DAP using the CIP scale (Henfling, 1982).

Blight (%)	CIP Scale	Description Symptom
	1	No late blight observed
Traces-<	2	Late blight present, maximum 10 lesions per plant.
5-<13	3	Plants look healthy but lesion are easily seen at closer distance maximum foliage are affected by lesions destroyed corresponds to 20 leaflets.
15-<35	4	Late blight easily seen on most plants. About 25% of foliage is covered with lesion or destroyed.
35-<65	5	Plot looks green; however, all plants are affected lower leaves are dead. About half foliage are destroyed.
65-<85	6	Plot looks green with brown flecks. About 75% of each plant is affected. Leaves of the lower-half of the plant are destroyed.

85-<95	7	Plot neither predominantly green nor brown. Only top leaves are green. Many stems have large lesions.
95-<100	8	Plot is brown colored. A few top leaves still have green areas. Most stems have lesion are of 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

7. Yield and yield components

a. Number and weight of marketable tubers per plot. All tubers free from insects and diseases damage and with less than 10% greening of total surface area was considered.

b. Number and weight of non- marketable tubers/plot (kg). This were the tubers which are malformed, damaged by pest and diseases and marble are with 10% greening and weighing less than 20g were considered as non-marketable.

c. Total yield per plot (kg). This was the weight of marketable and non marketable tubers per plot.

d. Computed yield per hectare. This was computed using the formula:

$$\text{Yield (tons/ha)} = \frac{\text{Total yield/Plot}}{5\ m^2 \times 1000} \times 10,000$$

8. Return on cash expense. This was the return on cash expenses of potato table and seed production that was determined using the formula:

$$\text{ROCE} = \frac{\text{Gross income - Production cost}}{\text{Production cost}} \times 100$$

9. Tuber Dry Matter Content (DMC %). Tubers were weighed and slice into cubes and oven dried at 80 °C for 60 hours. DMC was computed using the formula:

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

10. Sugar Content. Sap juice was extracted from 20 grams of potato tubers and sugar content was taken using a digital refractometer.

11. Meteorological Data. All climatic data such as temperature, relative humidity and rainfall was taken from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAG-ASA) based at Benguet State University (BSU).

12. Soil Chemical Properties. Soil samples were taken before planting and after harvesting. The soil pH, organic matter, nitrogen, phosphorus and potassium were analyzed at the Department of Agriculture, Regional Field Unit, La Union.

13. Organic Production Practices. All practices from planting to harvesting were documented.

Analysis of data

All quantitative data were analyzed using the analysis of variance (ANOVA for RCBD) with three replications, the significance of differences among the treatment means was tested using the Duncan's Multiple Range test (DMRT), at 5% level of significance.

RESULTS AND DISCUSSION

Meteorological Data during the Study Period

Table 1 shows the meteorological data from December 2012 to February 2013 at La Trinidad, Benguet. During the conduct of the study, temperature ranged from 11.8 °C to 23.7 °C. The highest relative humidity was recorded in the month of December while the lowest relative humidity was recorded on the month of February with 86.5% and 68%, respectively. The highest rainfall was recorded in February (0.29 mm) while the lowest reading was in January with a rainfall amount of 0.5 mm.

The best temperature for potato production ranged from 17°C to 22°C and with an average relative humidity of 86% (Simongo, 2007). Thus, the conditions during the conduct of the study were favorable for the growth and development of the potato entries.

Table 1. Meteorological data during the study period

MONTH	TEMPERATURE		RELATIVE HUMIDITY (%)	RAINFALL AMOUNT (mm)	SUNSHINE DURATION (min)
	MAX	MIN			
December	22.60	13.20	86.5	0.15	12.18
January	23.70	18.13	80.00	0.50	360.00
February	17.50	11. 80	68.00	0.29	330.20

Source: BSU PAGASA Office, La Trinidad, Benguet

Soil Chemical Properties

Soil pH. The pH of the soil before and after harvest was 6.60 which favored the growth of potato entries since the optimum pH for potato production ranged from 5.6 – 6.5 (NPRCRTC, N.D)

Soil Organic Matter. Organic Matter before planting was 3.00 % and after harvest organic matter decreased to 2.50 %. The decrease in organic matter maybe attributed for the potato for its growth and development. Parnes (1986) stated that organic matter is the principal source of nitrogen, phosphorus and sulfur nutrients which organisms require. A typical agricultural soil may control 1.5% organic matter in the soil top 15 cm of the soil surface (Alam, 2001). Further, the greater the amount of organic matter in the soil, the better physical properties of the soil.

Nitrogen (%). Nitrogen content of the soil before planting was 0.15% and after harvest nitrogen decrease to 0.125%. Potatoes require optimal levels of essential nutrients throughout the growing season. Nutrient uptake rates are often slow early in the season, increase rapidly during the tuber bulking phase and then slow as the plant matures. Potato plants take up nutrients in the range of several hundred pounds per acre to less than a tenth of a pound per acre (Hopkins, 2012).

Phosphorus (ppm). The initial and final phosphorus content of the soil recorded was at 430 to 240 ppm which showed a slightly decrease in the phosphorus content of the soil at harvest. Maximum potato yield occurs when sufficient P is available during early vegetative development and the entire period of tuber growth. Total plant phosphorus uptake increases rapidly during tuber initiation, levels off to a constant rate during tuber bulking, and ceases with plant maturation (Tindall, 1991).

Potassium (ppm). There was a decreased observed in the potassium content of the soil from 401.00 to 278.00 ppm. This could be attributed as potassium increase the dry matter content and helps prevent black spot damage and blue discoloration after cooking. It also improves the storage quality of potato (Motavalli, 2005).

Table 2. Chemical properties of the soil taken before and after harvesting

SAMPLING TIME	pH	ORGANIC MATTER (%)	NITROGEN (ppm)	PHOSPHORUS (ppm)	POTASSIUM (ppm)
Before planting	6.60	3.00	0.15	430.00	401.00
After planting	6.50	2.50	0.125	240.00	248.00

Analyzed by: DA, Regional field Unit 1, San Fernando City, La Union (February 2012)

Percentage Plant Survival

The percentage plant survival at 30 DAP is shown in Table 3. There was no significant difference observed among the ten entries evaluated. Granola obtained the highest percentage of plant survival, but comparable with other entries evaluated. Entry 307521 obtained the lowest plant survival with a mean of 46.67%.

The low percent plant survival observed can be attributed to cutworm infestation and occurrence of thrips during the conduct of the study.

Plant Vigor

Plant vigor of the potato entries is shown in Table 4. Plant vigor shows the performance of the different potato entries based on the stand of the plants. At 30 DAP, potato entry 304416 and 305180 obtained the lowest plant vigor with the mean of 4.67, however there were no significant differences observed among the other entries.

At 45 days after planting, entry 306468 and Granola Selection 1 were highly vigorous. At 60 days after planting, entry 306522 and Granola Selection 1 were rated vigorous.

Table 3. Plant survival, Plant vigor at 35, 45 and 60 days after planting of potato entries grown from rooted stem cuttings under organic production

ENTRY	PLANT SURVIVAL (%)	PLANT VIGOR		
		30 DAP	45 DAP	60 DAP
306522	50.00	5.00	4.67^{ab}	3.67^{a}
307251	51. 67	5.00	4.33^{ab}	3.33^{ab}
306521	50.00	5.00	4.00^{b}	3.00^{ab}
303223	60.00	5.00	4.33^{ab}	3.00^{ab}
304416	50.00	4.67	4.67^{ab}	2.67^{ab}
306468	60.00	5.00	5.00^{a}	3.33^{ab}
305180	50.00	4.67	4.33^{ab}	2.33^{b}
303224	50.00	5.00	4.00^{b}	3.33^{ab}
307521	46.67	5.00	4.67^{ab}	2.67^{ab}
Granola Selection	66.67	5.00	5.00^{a}	3.67^{a}
CV (%)	23.12	4.93	10.21	10.21

For each column, treatment means with different letters are significantly different at 5% probability level (DMRT).

Legend:
5 - Highly vigorous
4 - Moderately vigorous
3 – Vigorous
2 - Less vigorous
1 – Poorly vigorous

Plant Height

The potato entries showed no significant differences on the height at 30 and 75 days after planting (DAP) as shown in Table 4. From 30 DAP entries 306522 and 303223 registered the tallest plants with 26 cm and 25 cm, respectively. Potato entries 306468 and 304416 had the shortest plants with a mean of 21 cm and 21 cm, respectively.

At 75 DAP all the ten entries did not significantly differ in height with means ranging from 26cm to 33 cm. Entry 306521 exhibited the tallest plants while 303223 registered the shortest plants.

Table 4. Plant height at 30 DAP and 75 DAP of potato entries grown from rooted stem cuttings under organic production

ENTRY	PLANT HEIGHT (cm)	
	30 DAP	75 DAP
306522	23	33
307251	22	28
306521	26	33
303223	22	26
304416	21	29
306468	21	32
305180	22	29
303224	25	31
307521	23	27
Granola Selection 1	22	29
CV (%)	13.43	11.56

Canopy Cover

No significant differences were observed on the canopy cover of the different potato entries at 35 to 60 DAP (Table 5). Canopy cover increased from 35 to 45 DAP except for entry 303224. Entries 303223 and 304416 consistently had the widest canopy

The increase in canopy cover might be an indication of resistance to late blight infection. It was observed that entries with high canopy covers were resistant to late blight.

Table 5. Canopy cover of potato entries grown from rooted stem cuttings under organic production

ENTRY	CANOPY COVER		
	35 DAP	45 DAP	60 DAP
306522	19.33	24.67	29.33
307251	18.67	19.67	24.00
306521	17.33	19.33	23.33
303223	17.33	24.00	20.00
304416	22.00	22.67	24.67
306468	15.33	17.00	23.33
305180	15.67	17.33	23.33
303224	24.00	22.67	27.00
307521	16.67	18.00	32.33
Granola Selection 1	14.67	17.00	23.33
CV (%)	28.55	29.4	28.9

Leaf Miner Incidence

There was no observed leaf miner incidence within the area. This could be due to the planting of marigold which acted as insect repellant, the use of yellow traps and maintenance of plant diversity in the experimental area (Table 6).

Late Blight Infection

At 45 DAP no late blight incidence was observed since all entries were rated highly resistant except for entries 306521 and 303223 which were rated as moderately resistant. At 60 days after planting late blight occurrence was increased, Granola, 305180, 306468, 304416, 303223, 307251,303224 and 307521 was rated as resistant. At 75 DAP most entries were rated as resistant while entry 304416 were moderately susceptible to late blight.

Increase in late blight infection observed from 45 to 75 DAP could be due to the scattered rain showers during the study period which favored the growth of the pathogen.

Number and Weight of Marketable Tubers per plot

Table 7 shows the number and weight of marketable tubers per plot. There are significant differences on the number of tubers among the entries. Granola Selection 1 produced the highest number of tubers but comparable with entries 307521, 303224, 306468, 304416, 303223, 306521, 307251 and 306521. It was observed that the entries with high canopy cover also produced most tubers (Fig. 1).

No significant differences were observed among the potato entries on the weight of marketable tubers. Numerically, however, entry 303224 obtained the highest weight of marketable tubers with 4.51 kg followed by entry 307521 (4.04 kg).

Low marketable yield could be due to low percentage of plant survival and high incidence of late blight.

Table 6. Reaction of potato entries to late blight at 45, 60 and 75 DAP under organic production

ENTRY	REACTION TO LATE BLIGHT		
	45 DAP	60 DAP	75 DAP
306522	Highly resistant	Moderately resistant	Resistant
307251	Highly resistant	Moderately resistant	Resistant
306521	Moderately resistant	Moderately resistant	Resistant
303223	Highly resistant	Moderately resistant	Resistant
304416	Highly resistant	Moderately resistant	Moderately susceptible
306468	Highly resistant	Moderately resistant	Resistant
305180	Highly resistant	Moderately resistant	Resistant
303224	Highly resistant	Resistant	Resistant
307521	Highly resistant	Resistant	Resistant
Granola Selection 1	Highly resistant	Moderately resistant	Resistant


303223
306522
305180


307521
307251
306521


GRANOLA
303224
306468


304416

Figure 1. Tubers of the potato entries grown from rooted stem cuttings under organic production

Table 7. Number and weight of marketable tubers of potato entries grown from rooted stem cuttings under organic production

ENTRY	MARKETABLE TUBER	
	NUMBER	WEIGHT (kg/5m^2)
306522	44.67^{ab}	2.90
307251	53.00^{ab}	3.35
306521	41.67^{ab}	3.28
303223	61.00^{ab}	2.70
304416	55.33^{ab}	3.71
306468	68.00^{ab}	3.70
305180	33.00^{b}	3.65
303224	61.67^{ab}	4.51
307521	50.00^{ab}	4.04
Granola Selection 1	71.33^{a}	3.64
CV (%)	27.73	30.48

For each column, treatment means with different letters are significantly different at 5% probability level (DMRT).

Number and Weight of Non-marketable Tubers per plot

Result showed that there are significant differences on the number and weight of non-marketable are shown in Table 8. Lowest number of non-marketable tubers was recorded from entries 307521, 303223, 307521, and 305180.

Significant differences can be observed on the weight of non-marketable tubers. The lowest weight was recorded from entry 306522 followed by 306522 but comparable with the other entries. Entry 307251 was noted to have the highest weight of non-marketable tubers. Most of the tubers with high number of non-marketable were damaged by insect pests.

Table 8. Number and weight of non- marketable of potato entries grown from rooted stem cuttings under organic production

ENTRY	NON-MARKETABLE TUBER	
	NUMBER	WEIGHT (kg/5m^2)
306522	1^{a}	0.02^{a}
307251	3^{ab}	0.13^{b}
306521	4^{b}	0.09^{ab}
303223	1^{a}	0.07^{ab}
304416	1^{a}	0.04^{ab}
306468	2^{ab}	0.04^{ab}
305180	1^{a}	0.09^{ab}
303224	2^{ab}	0.05^{ab}
307521	2^{ab}	0.04^{ab}
Granola	2^{ab}	0.08^{ab}
CV (%)	64.94	66.47

For each column, treatment means with different letters are significantly different at 5% probability level (DMRT).

Total and Computed Yield

No significant differences were observed among the potato entries on the total and computed yield. Entry 303224 produced the highest total yield 0f (4.56 kg/ $5m^2$) and computed yield of 9.12 t/ha. Among the potato entries, 307521 registered as the second highest yielder.

Table 9. Total yield and computed yield of potato entries grown from rooted stem cuttings under organic production

ENTRY	TOTAL YIELD ($kg/5m^2$)	COMPUTED YIELD (/ha)
306522	2.92	5.84
307251	3.49	6.97
306521	3.37	6.74
303223	2.77	5.54
304416	3.76	7.51
306468	3.74	7.49
305180	3.74	7.47
303224	4.56	9.12
307521	4.08	8.17
Granola Selection 1	3.72	7.45
CV (%)	30.48	30.49

Dry Matter Content of Potato Tubers

Table 10 presents significant differences on the tuber dry matter content of the different potato entries evaluated. Entry 307521 significantly obtained the highest dry matter content of tubers (23.33%) followed by 303223, 304416, 303223 and Granola Selection 1 with a

mean of 21. 68% respectively. Low percent dry matter content was noted on entries 305180 and 306522.

Dry matter content ranged from 18 to 21%. Rastovski and Vanes (1981) cited that dry matter content is an important factor in processing potatoes and depends on the varietal characteristics. Thus, most of the entries might be ideal for processing except for entries 305180 and 306522.

Sugar Content

The sugar content of the potato entries are shown in Table 10. Results show significant differences on the potato entries. High sugar content of 3.63 was recorded on 303223 but comparable with entries 306522, 306521, 306468, 305180 and Granola Selection 1. Low sugar content was recorded in entry 304416.

Very low sugar content is apparently important to prevent darkening of chips. Quality wise, sugar content should below 2%. Potato of low sugar content result in lighter color chips (Ludwig, 1985). For processing potatoes, low sugar content is preferred for lighter colored fries and chips and lesser browning as reported by processors.

Table 10. Dry matter and sugar content of potato entries grown from rooted stem cuttings under organic production

ENTRY	DRY MATTER CONTENT (%)	SUGAR CONTENT (°Brix)
306522	16.67^{bc}	3.53^{ab}
307251	20.00^{abc}	3.36^{bcd}
306521	20.00^{abc}	3.50^{abc}
303223	21.67^{ab}	3.63^{a}
304416	21.67^{ab}	3.26^{d}
306468	20.00^{abc}	3.43^{abc}
305180	15.00^{c}	3.50^{abc}
303224	21.67^{ab}	3.30^{cd}
307521	23.67^{a}	3.40^{bcd}
Granola Selection 1	21.67^{ab}	3.50^{abc}
CV (%)	13.35	3.10

For each column, treatment means with different letters are significantly different at 5% probability level (DMRT).

Sensory Evaluation on Boiled Potato Tubers

Appearance and Color. Entries 306468, Granola, 306521, 304416, 307521, 303223, 303224, 305180 and 307521 were liked moderately while entry 306522 was neither liked nor disliked.

Texture. Granola Selection 1, 306468,306521,307521,303223,303224,305180 and 307251 were liked moderately while entry 304416 and 306522 was neither liked nor disliked.

Flavor. Granola, 306468, 306521,303223,303224,305180 and 307251 had a moderately perceptive taste while 304416 and 307521 were neither liked nor disliked.

General Acceptability. Among the ten potato entries evaluated, Granola Selection 1, 306468, 306521, 304416, 307521, 303223, 303224, 305180, 307251 were liked moderately because of their appearance, color, texture, and flavor.

Table 11. Sensory evaluation of potato grown from rooted stem cuttings under organic production

ENTRY	APPEARANCE	COLOR	TEXTURE	FLAVOR	GENERAL ACCEPTABILITY
306522	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked	Liked moderately	Neither liked nor disliked
307251	Liked moderately	Liked moderately	Liked moderately	Liked moderately	Liked moderately
306521	Liked moderately	Liked moderately	Liked moderately	Liked moderately	Liked moderately
303223	Liked moderately	Liked moderately	Liked moderately	Neither liked nor disliked	Liked moderately
304416	Liked moderately	Liked moderately	Liked moderately	Neither liked nor disliked	Liked moderately
306468	Neither liked nor disliked	Neither liked nor disliked	Neither liked nor disliked	Liked moderately	Neither liked nor disliked
305180	Liked moderately	Liked moderately	Liked moderately	Liked moderately	Liked moderately
303224	Liked moderately	Liked moderately	Liked moderately	Liked moderately	Liked moderately
307521	Liked moderately	Liked moderately	Liked moderately	Liked moderately	Liked moderately
Granola Selection 1	Liked moderately	Liked moderately	Liked moderately	Liked moderately	Liked moderately

Return on Cash Expense (ROCE)

Potato table production. In Table 12, the cost and return expense of growing table potato grown from rooted stem cuttings under organic production is shown. High ROCE was recorded in all the entries ranging from 5. 45% to 64%. Entry 303224 with the highest weight of marketable yield obtained the highest ROCE followed by entries 307521 and

Granola Selection 1. Among the potato entries evaluated, entry 303223 having the lowest marketable yield was observed to have negative ROCE.

Table 12. Cost and return analysis of table potato under organic production

ENTRY	COST OF PRODUCTION (PhP)	MARKETABLE YIELD (kg/ $5m^2$)	GROSS INCOME (PhP)	NET INCOME (PhP)	ROCE (%)
306522	165.00	2.90	174.00	9.00	5.45
307251	165.00	2.35	201.00	36.00	21.81
306521	165.00	3.28	196.8	31.80	19.27
303223	165.00	2.70	162.00	-3.00	-1.81
304416	165.00	3.71	222.60	57.60	34.90
306468	165.00	3.70	222.00	57.00	34.54
305180	165.00	3.65	219.00	54.00	32.72
303224	165.00	4.51	270.16	105.60	64.00
307521	165.00	4.04	242.40	77.40	46.90
Granola Selection 1	165.00	3.64	218.40	53.40	32.36

= Standard price of organic potato table was PhP 60.00/kilo
= Total cost of production includes planting materials, labor and organic fertilizers used

Potato seed production. Table 13 showed the cost and return expense of seed potato under organic production. Granola Selection 1 obtained the highest ROCE due its high number of marketable tubers. This was followed by entry 306468. No return on cash expense was observed on entry 305180.

Table 13. Cost and return analysis of growing seedpotato under organic production

ENTRY	COST OF PRODUCTION (PhP)	NO. OF MARKETABLE TUBERS ($5m^2$)	GROSS INCOME (PhP)	NET INCOME (PhP)	ROCE (%)
306522	165.00	44	223.00	58.00	35.15
307251	165.00	53	265.00	100.00	60.61
306521	165.00	41	208.00	43.00	26.60
303223	165.00	61	305.00	140.00	84.85
304416	165.00	55	266.00	101.00	61.60
306468	165.00	68	340.00	175.00	106.61
305180	165.00	33	165.00	0.00	0.00
303224	165.00	61	308.00	143.00	86.67
307521	165.00	50	250.00	85.00	51.51
Granola Selection 1	165.00	71	356.00	191.00	116.15

= Standard price of potato seed was PhP 5.00/tuber
= Total cost of production includes planting materials, labor and fertilizers used

Documentation of Cultural Practices on
Organic Potato Production at La Trinidad, Benguet

Figure 2. Land preparation with the use of grab hoe

Figure 3. Application of BSU growers compost (5 kg/5m^2)

Figure 4. Planting of potato stem cuttings with a distance of 30 cm between hills

Figure 5. Hilling up at 30 days after planting using grab hoe

Figure 6. Yellow traps made up of yellow plastics applied with grease installed at the end of each crop and planting of marigold within the area for protection against insect pest

Figure 7. Harvesting of the potato tubers using pointed stick.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The study was conducted to: evaluate potato entries from rooted stem cuttings under organic production; determine the best potato entry in terms of growth, yield and pest and disease resistant under organic production; determine the profitability of growing potato entries and document the organic production practices employed in growing potato at La Trinidad, Benguet.

All entries were observed to be highly vigorous and vigorous at 30 DAP and 45 DAP except for entry 304416 which was observed to be less vigorous at 60 DAP.

All entries did not vary in terms of height at 30 DAP and 74 DAP. Entries 306521 and 306522 had the tallest plants while 307521 registered the shortest plants.

No significant differences were observed on the canopy cover of potato entries at 35 and 40 DAP. At 60 DAP; entry 307521 had the widest canopy while entries 306521, 306468, 305180 and Granola Selection 1 had the narrowest canopy cover.

In terms of late blight infection, all entries were highly resistant to moderately resistant except for entries 303224 and 307521 that were observed as resistant at 45 DAP and 60 DAP. At 75 DAP all the entries were resistant to late blight infection except for entry 304416 which was observed to be moderately susceptible.

No significant difference was observed among the potato entries on the number of tubers. Granola Selection 1 produced the highest number of tubers and entries 303224 and 307521 produced the highest weight of tubers. No significant difference was observed on the total and computed yield among the potato entries. Numerically, entries 306522,

307251, 306521, 304416, 306468, 303224, 307521 and Granola Selection 1 produced the highest total and computed yield for both table potato and seed production.

For dry matter content, entry 307521 obtained the highest followed by entries, 303223, 304416, 303224 and Granola Selection 1. Lowest sugar content was noted on entry 304416. Most of the entries were liked moderately based on sensory evaluation.

Conclusions

Based on the results, all entries are adapted for organic production. Entries 306522, 307251, 303223, 306468, 304416, 306521, 303224, 307521 and Granola Selection 1 are potential entries having the highest marketable yield and positive ROCE for both table potato and seed tuber production. All entries are resistant to late blight infection and highly resistant to leaf miner infestation under organic production system.

Recommendations

Based on the conditions and results of the study, entries 306522,307251, 306521, 304416, 306468, 305180,303224, 307521 and Granola Selection 1 are recommended for organic production in La Trinidad, Benguet. Since tubers produced are generation 1 (G1), this can be planted in the next planting season to determine the stability of the entries for table potato and seed tuber under organic production systems.

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