BIBLIOGRAPHY

FAUSTINO, DELFER P. APRIL 2011. Wet Season Evaluation of Five Potato Entries For Organic Production in La Trinidad, Benguet. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

Five entries of potato were evaluated during the wet season to identify the best entries for organic production; to determine the profitability of growing potato for organic production during wet season; and to record and photo document all the activities employed in potato production under organic production system in La Trinidad, Benguet.

Based on the results, MLUSA #8, and MLUSA #5 are the best entries for organic production during wet season cropping in La Trinidad, Benguet. They produced high yield and return on cash expense among the potato entries evaluated.

All cultural management practices from land preparation to crop management and protection, to harvesting of potato tubers were recorded and photo documented.

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INTRODUCTION

Potato *(Solanum tuberosum L.)* is a herbaceous annual subtropical and temperate crop grown for its edible tubers. *Solanum tuberosum* is mostly used as a vegetable, as a source of starch and for other commercial purposes. This crop becomes the world's most important tuber crop and it is considered as the 4th most important source of food energy after rice, wheat, and maize. Farmers and gardeners grow them worldwide. Growers cultivate thousands of different varieties of potato (Mosley, 2003).

FNRI (2006) stated that potato has high nutritive value. It contains carbohydrates, proteins, minerals and vitamins in moderate amounts. Potatoes are best suited in the highlands like Benguet and Mt. Province because of its cool climate. Thus, it became a major source of income to growers in the Cordillera.

In addition, potatoes in Benguet have been grown under organic production to avoid the use of pesticides. Organic production is the traditional practice utilizing the diverse farming system which avoided the use of synthetic chemical inputs such as fertilizers, pesticides, herbicides, growth stimulants, and others. Organic farming depends on crop rotation, green manuring and others. Pest control is done by applying non-chemical methods such as biological controls, mechanical cultivation, mulches, and other forms of natural control (Kuepper, 2002).

Potato is one of the most planted crops in Benguet and Mt. Province. This crop is more profitable than the other crops in the highlands, because potato can give good yield and higher income to the growers. Aside from the fact that potato is not easily damaged when transported to the market.

Organic potato production need good varieties that are adapted to the environment, resistant against insect pests and diseases, and can produce high yield. Resistant varieties can help growers to minimize the use of inorganic pesticides or other chemicals.

Planting potatoes during the wet season is good because the need for water for growth and development is met. However, during this season plants are easily attacked by pest and diseases. In this case, the result of the study will serve as a guide to the farmers in selecting and growing organic potato varieties for wet season production. Findings can also serve as reference for future research.

The study was conducted:

1. to evaluate potato entries in La Trinidad Benguet for organic production during the wet season;

2. to determine the best organically grown potato entries in terms of growth, yield, resistance to pests and profitability;

3. to determine the return on cash expenses (ROCE) of growing organic potato during the wet season; and

4. to record and photo document all the activities employed in organic production of potato.

The study was conducted at BSU Organic Farm in Balili, La Trinidad, Benguet from August to November 2010.

REVIEW OF LITERATURE

Definition of Organic Farming

Organic farming is defined as a whole system approach that works to optimize the natural fertility resources of the farm. This is done through traditional practices of recycling farm produced like livestock manures, composting, crop rotation, green manuring, and crop residue management (Kuepper and Gegner, 2004).

Organic agriculture is a holistic production management system that promotes and enhances agro-ecosystem health, including biodiversity, biological cycle and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs. By using, where possible, agronomic, biological and mechanical methods, as to opposed using synthetic materials, to fulfil any specific function within the system (PCARRD, 2006). Organic agriculture also looks to local waste products manures from confinement feeding food processing waste and others to supplement soil fertility economically (Potandon, 2003).

Effect of using Organic Fertilizer

Organic fertilizer can improve the conditions of all mineral soils for many reasons. This fertilizer helps sandy soils by increasing their water- and nutrients-holding capacity. It improves clay soils by loosening them and improving their tilt (Pandosen, 1986).

Organic fertilizer also makes the compact soil lighter, holds the soil particles together and helps anchor them against erosion, and it provides microelements in more readily available for the plants.

Organic fertilizers add the nutrients to the soil that plants need to be more productive. These vital nutrients include phosphorus, nitrogen, and potassium. They allow the plant to grow larger, blooming flowers and larger fruits. So the produce are in good quality, allowing the farmer to harvest more and better fruits. Also keep the plants growing healthy and productive longer into the season despite changing weather and soil temperatures. Organic fertilizers break down slowly, which means they need to be applied much less frequently than other types of fertilizers. This means that farmers spend less on feeding their plants. In addition, the application of organic matter effects and improves the physical properties of the soil, decreasing the bulk density of the soil that favours plant growth (Newsome, 2009).

Varietal Evaluation for Organic Production

In potato trial conducted under organic production system, Ambales (2009) found that CIP 676089 had the highest tubers and dry matter content at 90 DAP. CIP 13.1.1, CIP 96-06, PHIL 5.19.2.2 and CIP 676089 produced the highest total yield tubers. CIP 13.1.1, CIP 67608, PHIL 5.19.1.1 and CIP 96-06 had moderately resistance to leaf miner at 60 DAP and highly resistant to late blight. CIP 676089 obtained the highest return on cash expenses.

The study of Montes (2006) at Puguis, La Trinidad, Benguet found out that potato genotype CIP 676080 was the best entry under organic production system, As evidenced by highly vigorous and tall plants, high yield, high dry matter content of tubers and resistance to late blight.

Imarga (2009) found that CIP 380241.17, MLUSA 5, MLUSA 8 and Igorota were adapted under organic production at Beckel, La Trinidad, Benguet. Igorota and MLUSA

3 were highly resistant to late blight while the other entries were rated moderately resistant to leaf minner at 75 DAP. MLUSA 5 produced the highest number of marketable tuber while CIP 380241.17 produced heaviest weight of marketable tubers, high yield and highest ROCE.

Laweng (2006) found that Entry 13.1.1 produced the highest canopy cover and the most resistant to late blight. Catani produced the highest marketable yield but was susceptible to late blight.

MATERIALS AND METHODS

A total area of 75 m^2 was cleaned and thoroughly prepared and divided into three blocks representing three replications (Figures 1and 2). Each block had five plots measuring 1m x 5m each. The experiment was laid out following Randomized Complete Block Design (RCBD) with three replications. The sprouted potato tubers (Figure 3) were planted in double row-plot at a distance of 30 cm x 30cm between hills and between rows. Cultural management practices such as irrigation, weeding, pest control and hilling up were uniformly employed to all treatments throughout the experimental duration.

The treatments were:

Code	Entry	Source
E1	MLUSA #8	Mainland USA
E2	MLUSA #5	Mainland USA
E3	MLUSA #3	Mainland USA
E4	Gloria (check variety)	CIP, Lima Peru
E5	Granola (check variety)	CIP, Lima Peru

Figure 1. Clearing of the experimental area

Figure 2. Preparation of the experimental area

Figure 3. Sprouted tubers of entries used in the study as planting materials

Data gathering Gathering of data such as plant height, canopy cover, pest and disease assessment and others was done during the conduct of the study (Figure 4).

Figure 4. Data gathering in the experimental field

Data gathered

1. Agro climatic data. The temperature, relative humidity, rainfall and sunshine duration were taken from Philippines Atmospheric Geophysical and Astronomical Services Administration (PAGASA) Agronomical Meteorological Station based at Benguet State University.

2. Plant survival (%). The number of plants that survived was counted at 30, 45, 60 days after planting (DAP) and percent plant survival was calculated using the following formula.

$$\text{Plant Survival (\%)} = \frac{\text{No of Plant Survived}}{\text{Total Number of Tubers Planted}} \times 100$$

3. Plant height. The height of ten sample was taken at 30, 45, 60 DAP using a meter stick from the base of the plant to the youngest leaf.

4. Canopy cover. This was gathered at 30, 45, 60 DAP using a wooden frame which measure 120 cm x 60 cm having grids of equal size of 12 cm x 6 cm by placing it on top of the canopy.

5. Plant vigor. Plant vigor was rated at 30, 45, and 60 DAP based on a rating scale used by CIP, in 2001.

Scale	Description	Remarks
1	Plants are weak with few stems and leaves, very pale.	poor vigor
2	Plants are weak with few thin stems and leaves, pale.	less vigorous
3	Better than less vigorous	vigorous
4	Plants are moderately strong with robust stem and leaves were light green in color	moderately vigorous
5	Plants are strong with robust stem and leaves, light color to dark green in color.	highly vigorous

6. Reaction to leaf miner. The reaction to leaf miner was recorded at 30, 45 and 60 DAP using the following the rating scale used by (CIP, in 2001).

Scale	Description	Reaction
1	Less than 20% of plants per plot infested	Highly Resistant
2	21-41 % of plants per plot infested	Moderately Resistant
3	41-60% of plant per plot infested	Susceptible
4	61-80% of plant per plot infested	Moderately Susceptible
Scale	Description	Reaction
5	80-100% of plants per plot infested	Very Susceptible

2. Reaction to late blight. Ratings were done at 30, 45, 60 and 75 DAP using a CIP (Henfling, 1987) rating scale as follows:

Blight (%)	Scale	Description
1	1	No blight seen
Trace < 5	2	Late blight present. Maximum of 10 lesions per plant
5-<15	3	Plants look healthy, but lesions are easily seen at closer distance. Maximum foliage are affected by lesions or destroyed corresponds to not more than 20 leaflets.
15-<35	4	Late blight easily seen on most plants. About 25% of foliage is covered with lesions or destroyed.
35-<65	5	Plots look green; however, all the plants are affected. Lower leaves are dead. About half of the foliage is destroyed.
65-<85	6	Plots look green with brown flecks. About 75% of each plant is affected. Leaves of the lower half of the plants are destroyed.
85-<95	7	Plots are neither predominantly green nor brown. Only top leaves are green. Many stems have large lesions.

95-<100	8	Plot is black colored. A few top leaves still have green area. Most stems have lesions or are dead.
100	9	All leaves and stems are dead.

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

8. Weight of marketable tubers per plot (kg/m^2). This was taken by weighing all the marketable tubers per plot at harvest.

9. Weight of non-marketable tubers per plot (kg/m^2). This was taken by weighing all the non-marketable per plot at harvest. These are tubers obtained by counting and weighing all tubers that are malformed, damaged by pest and diseases and those with more than 10% greening marketable tubers.

10. Total yield per plot (kg/m^2). This was the sum of the weight of marketable and non-marketable tubers per plot.

11. Computed yield (tons/ha). This was computed on a hectare basis using the formula:

Computed Yield (T/ha) = Total Yield per Plot (kg/5m^2) x 2

where: 2 is the factor used to convert yield per plot in kg/5m^2 into tons per hectare assuming one hectare effective area.

12. Return on cash expense. This was computed using the following formula:

$$\text{ROCE (\%)} = \frac{\text{Net Income}}{\text{Total Cost of Production}} \text{ X } 100$$

13. Dry matter content of tubers. Twenty gram (20g) (Figure 5) tubers were weighed and sliced into cubes and oven dried at 80^{o}C for 24 hours. This was recorded and computed using the following formula:

Dry Matter Content = 100%-% moisture content

$$\text{where: Moisture Content (\%)} = \frac{\text{Fresh Weight} - \text{Oven Dry Weight}}{\text{Fresh Weight}} \text{ X100}$$

14. Sugar content (^{0}Brix). This was taken by extracting the juice from potato tubers and measuring sugar content using a digital refractometer.

Figure 5. Cubed potato tubers for dry matter analysis

15. Documentation of cultural practices. All cultural management practices on organic production that were employed in this study such as fertilizer application, crop protection, hilling-up, harvesting and others were recorded and photo documented.

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 differences among the treatment means was tested using the Duncan's Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Agro-climatic Data

The monthly temperature, relative humidity, amount of rainfall, and sunshine duration throughout the conduct of the study are shown in Table 1. The maximum temperature was recorded in October 2010, while the minimum temperature was observed in November 2010.

The relative humidity was higher in September and then decreased during the month of October to November. The monthly rainfall ranged from 6.3 to 8.2 mm. Highest amount of rainfall was gathered in October. The longer sunshine duration was observed during the month of September and November which was 237.4 min. and the shortest sunshine duration was recorded in October. According to (HARRDEC, 1996) potato grow best in areas with a temperature ranging from 17^{o}C to 22^{o}C and average relative humidity of 86^{o}C. Yield was highest when average daytime temperature are about 21^{o}C. Temperature is important because it affects the accumulation of carbohydrates and dry matter in the tubers.

Table 1. Temperature, relative humidity, rainfall, and sunshine duration for September to November 2010

MONTHS	TEMPERATURE		RELATIVE HUMIDITY (%)	RAINFALL (mm)	SUNSHINE DURATION (min)
	Max. ^{o}C	Min. ^{o}C			
September	24.95	15.82	57	6.30	237.40
October	25.22	15.40	55	8.20	196.40
November	24.80	15.20	55	6.30	237.40

Source: BSU, La Trinidad, Benguet, PAGASA office

Plant Survival

Figure 6 shows the plant survival of the different potato entries at 30, 45, and 60 DAP. Statistical analysis revealed no significant differences among the five potato entries tested. At 30 DAP, the percent survival ranged from 97-100% among the five entries of potatoes evaluated. At 45 DAP, it ranged from 90-97% and at 60 DAP, there was 87-95 % percent survival. There was decreasing percent survival from 30 to 60 DAP due to the infestation of leaf miner and late blight and prevalence of typhoon at 62 days after planting.

Plant Height

It is shown in Figure 7 that the plant height of potato entries at 30, 45, and 60 DAP differed significantly among the five potato entries tested. Gloria had the tallest plants while Granola exhibited the shortest plants at 30, 45, and 60 DAP.

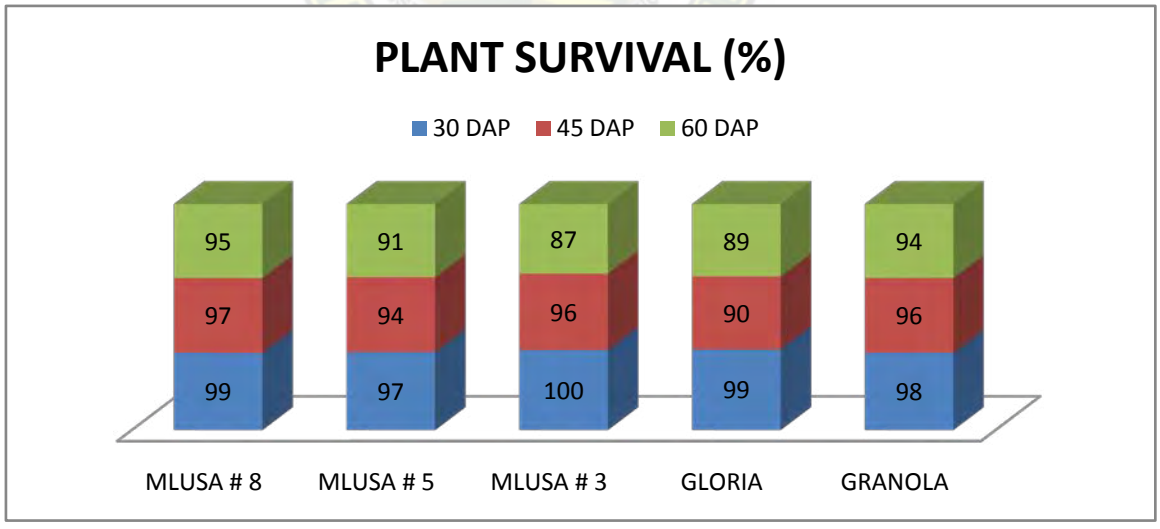

Figure 6. Plant survival of five potato entries at 30, 45, and 60 DAP under organic production system during wet season

Canopy Cover

The canopy cover of the five potato entries showed no significant differences at 30, 45 and 60 DAP (Figure 8). It ranged from 8.33 cm – 11.33 cm at 30 DAP. At 45 DAP it ranged from 16.33 cm – 26.00 cm and at 60 DAP, it ranged from 29.33 cm – 41.00 cm. There was increasing canopy cover from 30 to 60 DAP that could be due to the high vigor of the plants.

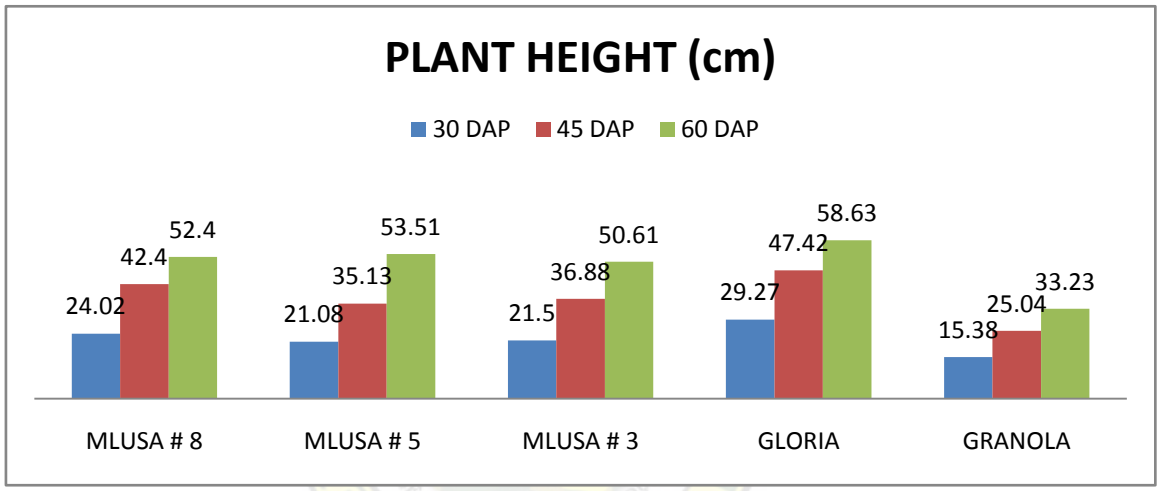

Figure 7 . Plant height of five entries of potato at 30, 45, and 60 DAP under organic production system during wet season

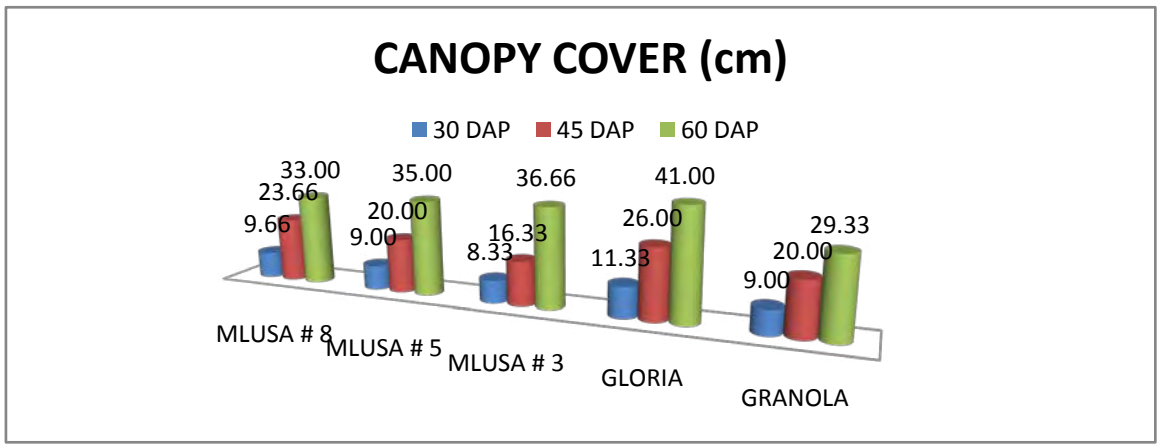

Figure 8. Canopy cover of five entries of potato at 30, 45, 60 DAP under organic production system during wet season

Plant Vigor, Reaction to Leaf Miner and Late Blight

Table 2 shows the plant vigor, reaction to leaf miner, and late blight of five potato entries at 60 DAP. All the entries were highly vigorous. This could be due to the highest percentage of plant survival and large canopy cover of the plants.

MLUSA #5 was rated susceptible while MLUSA #8 and Granola were moderately resistant and MLUSA #3 and Gloria were rated highly resistant to leaf miner (Table 2). At 60 DAP, all the entries were moderately resistant to late blight except Gloria that was rated resistant (Table 2). The resistance of the entries could be due to their genotypic characteristics that can tolerate late blight incidence.

According to Tosay (2008) on his personal interview with Perez that high relative humidity increases the late blight incidence because of the presence of moisture that favors the occurrence of late blight. Further, the crop is horizontally resistant to late blight, there may be an infection but not enough to affect the yield.

Table 2. Plant vigor, reaction to leaf miner and late blight at 60 DAP of five potato entries under organic production system during wet season

ENTRY	REACTION TO	
	LEAF MINER	LATE BLIGHT
MLUSA # 8	Moderately Resistant	Moderately Resistant
MLUSA # 5	Susceptible	Moderately Resistant
MLUSA # 3	Highly Resistant	Moderately Resistant
GLORIA	Highly Resistant	Resistant
GRANOLA	Moderately Resistant	Moderately Resistant

Weight of Marketable and Non-Marketable Tubers

Table 3 shows the total weight of marketable and non-marketable tubers per plot of five potato entries evaluated. No significant differences on marketable and non-marketable tubers per plot were observed among the five entries evaluated. The weight of marketable tubers ranged from 1.06 to 1.60 kg/5m^2. The weight of non-marketable ranged from 0.18 to 0.48 kg/5m^2.

Total Yield Per 5m^2 and Computed Yield Per Hectare

Table 4 also shows no significant differences on the total yield per plot and computed yield per hectare among the five potato entries evaluated. MLUSA # 8 numerically produced the highest yield of 2.08 kg/5m^2 followed by MLUSA # 5. Granola gave the lowest yield of 1.36 kg/5m^2. MLUSA #8 numerically produced the highest computed yield per hectare of 4.16 T/ha while Granola gave the lowest yield of 2.73 T/ha.

Table 3. Weight of marketable and non-marketable tubers of five potato entries under organic production

ENTRY	WEIGHT	
	MARKETABLE TUBERS (Kg)	NON-MARKETABLE TUBERS (Kg)
MLUSA # 8	1.60	0.48
MLUSA # 5	1.56	0.38
MLUSA # 3	1.08	0.30
GLORIA	1.60	0.18
GRANOLA	1.06	0.30
CV (%)	28.63	43.65

Dry Matter and Sugar Content

Table 5 shows the dry matter content (DMC) and sugar content of the five potato entries grown during wet season under organic production system. No significant differences were observed among the potato entries evaluated.

Dry matter contents of tubers ranged from 15.66 to 17.83 %, an indication that the potato entries tested are not suitable for processing. Based on early reports, potato for French fries should contain 20 to 24 % dry matter content (APA, 1991). Harvesting potato tubers earlier (at 60 DAP) had lower dry matter content than the DMC during usual harvesting period of 110 DAP.

Table 4. Total yield and computed yield of five potato entries under organic production

ENTRY	TOTAL YIELD (kg/5 m^2)	COMPUTED YIELD (T/ha)
MLUSA # 8	2.08	4.16
MLUSA # 5	1.95	3.90
MLUSA # 3	1.38	2.75
GLORIA	1.78	3.56
GRANOLA	1.36	2.73
CV (%)	25.21	25.21

Means followed by common letters are not significantly different at 5 % level of DMRT

Table 5. Dry matter and sugar content of five potato entries under organic production system during wet season

ENTRY	DRY MATTER CONTENT (%)	SUGAR CONTENT (^{o}Brix)
MLUSA # 8	17.00[b]	1.93
MLUSA # 5	17.00[b]	2.13
MLUSA # 3	17.80[a]	2.10
GLORIA	15.66[c]	2.16
GRANOLA	17.83[a]	2.10
CV (%)	3.91	4.50

Means followed by common letters are not significantly different at 5 % level of DMRT

The sugar content of potato ranged from 1.93 to 2.16 ^{o}Brix. Results obtained in this study indicated that MLUSA #8 could be good entry for chips production. According to Ludwig in 1985, the sugar content of potatoes for chipping should be below 2 %. Potatoes with low sugar content resulted in lighter colored chips.

Return on Cash Expense (ROCE)

The return on cash expenses in producting the five potato entries during the wet season evaluation for organic production is shown on Table 6. Potato entry MLUSA #8 had the highest ROCE of 20.93% followed by MLUSA #3 (13.37%) and Gloria (3.48%) while Granola and MLUSA #3 had negative ROCE. These results indicate that the entries with the highest yield could also result in highest profit.

Table 6. Return on cash expense on growing five potato entries under organic production system during wet season

ENTYR	TOTAL WEIGHT OF TUBERS ($kg/5m^2$)	COST OF PRODUCTION (PhP)	GROSS INCOME (PhP)	NET PROFIT (PhP)	ROCE (%)
MLUSA # 8	2.08	172	208.00	36	20.93
MLUSA # 5	1.95	172	195.00	23	13.37
MLUSA # 3	1.38	172	138.00	-34	-19.76
GLORIA	1.78	172	178.00	6	3.48
GRANOLA	1.36	172	136.00	-36	-20.93

Tubers were sold at 100 Php per kilogram

Documentation of Cultural Practices on Producing Potato Entries During Wet Season Evaluation for Organic Production

Land clearing. The area was cleaned by cutting the weeds with the use of a sickle (Figure 9). Weeds were removed from the area with a hoe. They were polled at one side of the area for decomposition (Figure 10).

Figure 9. Clearing of the area

Figure 10. Removing weeds from the experimental area

Land preparation and application of compost fertilizer. Land preparation was done by digging plots to raise the beds. BSU compost as organic fertilizer was broadcasted on the plots 15 days before planting at a rate of 5kg per $5m^2$ (Figures 11 and 12).

Figure 11. Land preparation

Figure 12. Application and mixing of compost fertilizer in the plot

Planting. Planting of tubers was done at a distance of 30 cm x 30 cm between hills and between rows in a plot $1m^2$ x $5m^2$ (Figure 13).


Figure13. Lay-outing and planting of potato tubers

Irrigation. Irrigation water was obtained from Balili river using watering cans. Irrigation of the crops where done twice a week or when necessary (Figure 14).

Figure 14. Irrigating potato plant using watering cans

Hilling-up. Hilling-up was done once at 30 DAP using a grab hoe (Figure 15). This was done to cover the base of the plant to avoid greening of tubers. The overview of the plants after hilling-up at 30, 45, and 60 DAP is shown in Figures 16 to 18.

Figure 15. Hilling-up of potato plants

Figure 16. Overview of five potato entries at 30 days after planting

Figure 17. Overview of potato plants at 45 DAP

Figure 18. Overview of potato plants at 60 DAP

Crop protection. Crop protection against late blight is done by spraying of virtuoso, a bio fungicide at a rate of seven tablespoons mixed with 16 liters of water

(Figure 19). Spraying was done once a week to prevent the incidence of late blight especially during the conduct of the study that weather was un-prevalent.

Figure 19. Spraying of virtuoso to potato at 45 DAP

Harvesting. Harvesting of potato tubers was done using a pointed stick for digging (Figures 20 and 21). Harvesting was done at 70 days after planting.

Figure 20. Harvesting using a pointed stick for digging

Figure 21. Harvested potato tubers

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted from September to November 2010. Five entries of potato were evaluated for their growth and development during wet season under organic production system, to and identify the best potato entries for organic production during wet season; to determine the profitability of growing potato for organic production during wet season; and to record and photo document all the activities employed in organic production of potato in La Trinidad, Benguet.

Among the five potato entries evaluated, significant differences were observed on the plant height. No significant differences were observed on the plant survival, canopy

cover, weight of marketable and non-marketable tubers, total yield and computed yield and dry matter and sugar contents among the five potato entries studied.

The five potato entries had statistically similar and decreasing plant survival from 30 DAP to 45 DAP to 60 DAP. MLUSA # 8 had the highest plant survive. Gloria produced significantly tallest plants which was comparable to MLUSA #5 and MLUSA #8. Gloria had also the largest canopy cover followed by MLUSA #3 and was comparable to MLUSA #5. All the entries were highly vigorous at 60 DAP.

All the entries were resistant to leafminer except for MLUSA # 5 that was rated susceptible to leaf miner at 60 DAP. Gloria was resistant to late blight while all of the other entries were moderately resistant.

Among the potato entries, MLUSA # 8, and MLUSA # 5 produced numerically high total yield plot and computed yield per hectare that consequently recorded the highest return on cash expense among the potato entries grown under organic production system during wet season.

Granola and MLUSA #3 recorded the higher dry matter content at 60 DAP. Gloria and MLUSA #5 had the highest sugar content which MLUSA #8 recorded that least sugar content.

All the cultural management practices from land preparation, to crop management and protection, to harvesting of potato tubers under organic production system in La Trinidad Benguet during wet season cropping were fully recorded and photo documented.

Conclusion

Based on the results of this study, MLUSA # 8 and MLUSA # 5 are the best entries for organic production during wet season cropping in La Trinidad, Benguet. Both

entries produced high yield and gave positive ROCE. Both also showed resistance to leaf miner and late blight.

Recommendation

MLUSA # 8 and MLUSA # 5 are the entries recommended for organic production during wet season at La Trinidad, Benguet condition.

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APPENDICES

Appendix Table 1. Plant survival at 30 DAP

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	97	100	100	297	99
MLUSA # 5	94	97	100	291	97
MLUSA # 3	100	100	100	300	100
GLORIA	100	97	100	297	99
GRANOLA	97	97	100	294	98

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	15.60	7.800	3.06^{ns}		
Treatment	4	15.60	3.900	1.53^{ns}	3.84	4.46
Error	8	20.40	2.550			
TOTAL	14	51.60				

^{ns}- not significant

CV (%) = 1.62

Appendix Table 2. Plant survival at 45 DAP

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	94	100	97	291	97
MLUSA # 5	94	97	91	282	94
MLUSA # 3	94	94	100	288	96
GLORIA	100	85	85	270	90
GRANOLA	97	94	97	288	96

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	10.80	5.400	0.21^{ns}		
Treatment	4	93.60	23.400	0.91^{ns}	3.84	4.46
Error	8	205.20				
TOTAL	14	309.60				

^{ns}- not significant

CV (%) = 5.35

Appendix Table 3. Plant survival at 60 DAP

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	94	94	97	285	95
MLUSA # 5	88	94	91	273	91
MLUSA # 3	88	85	88	261	87
GLORIA	97	85	85	267	889
GRANOLA	94	91	97	282	94

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	15.60	7.80	0.49^{ns}		
Treatment	4	134.40	33.60	2.09^{ns}	3.84	4.46
Error	8	128.40	16.05			
TOTAL	14	278.40				

^{ns}- not significant

CV (%) = 4.39

Appendix Table 4. Plant height at 30 DAP

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	26.80	23.71	21.55	72.05	24.02
MLUSA # 5	22.80	20.70	19.74	63.24	21.08
MLUSA # 3	21.37	22.59	20.55	64.51	21.50
GLORIA	34.95	26.23	28.73	89.91	29.97
GRANOLA	18.94	14.80	12.40	46.14	15.38

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	52.53	26.267	6.86**		
Treatment	4	335.27	83.817	21.90**	3.84	4.46
Error	8	30.61	3.827			
TOTAL	14	418.41				

** - highly significant

CV (%) = 8.74

Appendix Table 5. Plant height at 45 DAP

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	46.40	42.06	38.74	127.20	42.40
MLUSA # 5	36.20	35.70	33.50	105.40	35.13
MLUSA # 3	40.78	35.73	34.14	110.65	36.88
GLORIA	54.00	40.42	47.86	142.28	47.43
GRANOLA	32.43	21.63	21.06	75.12	25.04

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	157.70	78.848	8.46**		
Treatment	4	851.12	212.779	22.83**	3.84	4.46
Error	8	74.55	9.319			
TOTAL	14	1083.37				

**- highly significant

CV (%) = 8.18

Appendix Table 6. Plant height at 60 DAP

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	61.15	50.31	45.74	157.20	52.40
MLUSA # 5	57.50	51.15	51.88	160.53	53.51
MLUSA # 3	65.90	40.70	45.25	151.85	50.62
GLORIA	65.93	54.88	55.10	175.91	58.64
GRANOLA	45.35	28.98	25.36	99.69	33.23

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	675.79	337.897	19.16**		
Treatment	4	1121.31	280.327	15.90**	3.84	4.46
Error	8	141.07	17.633			
TOTAL	14	1938.17				

**- highly significant

CV (%) = 8.45

Appendix Table 7. Canopy cover at 30 DAP

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	9	12	8	29	9.66
MLUSA # 5	10	8	9	27	9.00
MLUSA # 3	8	8	9	25	8.33
GLORIA	12	10	12	34	11.33
GRANOLA	5	11	11	27	9.00

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	3.33	1.667	0.38^{ns}		
Treatment	4	15.73	3.933	0.91^{ns}	3.84	4.46
Error	8	34.67	4.333			
TOTAL	14	53.73				

^{ns}- not significant

CV (%) = 21.99

Appendix Table 8. Canopy cover at 45 DAP

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	23	25	23	71	23.66
MLUSA # 5	22	17	21	60	20.00
MLUSA # 3	10	19	20	49	16.33
GLORIA	28	23	27	79	26.00
GRANOLA	18	22	20	60	20.00

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	10.00	5.000	0.45^{ns}		
Treatment	4	167.07	41.767	3.74^{ns}	3.84	4.46
Error	8	89.33	11.167			
TOTAL	14	266.40				

^{ns}- not significant

CV (%) = 15.76

Appendix Table 9. Canopy cover at 60 DAP

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	32	37	30	99	33.00
MLUSA # 5	30	43	32	75	25.00
MLUSA # 3	33	40	37	110	36.66
GLORIA	45	48	30	132	44.00
GRANOLA	25	33	30	88	29.33

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	206.40	103.200	5.13^{**}		
Treatment	4	224.67	56.167	2.79_{ns}	3.84	4.46
Error	8	160.93	20.117			
TOTAL	14	592.00				

** - highly significant
ns - not significant

CV (%) = 12.81

Appendix Table 10. Weight of marketable tubers (kg/5 sqm)

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	1.65	1.65	1.50	4.80	1.60
MLUSA # 5	1.35	0.85	2.50	4.70	1.56
MLUSA # 3	1.00	0.75	1.50	3.25	1.08
GLORIA	2.00	1.15	1.65	4.80	1.60
GRANOLA	0.95	1.00	1.25	3.20	1.06

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.90	0.450	2.87^{ns}		
Treatment	4	0.95	0.238	1.52^{ns}	3.84	4.46
Error	8	1.25	0.157			
TOTAL	14	3.11				

^{ns}- not significant

CV (%) = 28.63

Appendix Table 11. Weight of non-marketable tubers

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	0.60	0.60	0.25	1.45	0.48
MLUSA # 5	0.55	0.30	0.30	1.15	0.38
MLUSA # 3	0.40	0.20	0.30	0.90	0.30
GLORIA	0.15	0.15	0.25	0.55	0.18
GRANOLA	0.20	0.25	0.45	0.90	0.30

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.02	0.010	0.46^{ns}		
Treatment	4	0.15	0.037	1.80^{ns}	3.84	4.46
Error	8	0.17	0.021			
TOTAL	14	0.33				

^{ns}- not significant

CV (%) = 43.65

Appendix Table 12. Total yield per plot

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	2.25	2.25	1.75	6.25	2.08
MLUSA # 5	1.90	1.15	2.80	5.85	1.95
MLUSA # 3	1.40	0.95	1.80	4.15	1.38
GLORIA	2.15	1.30	1.90	5.35	1.78
GRANOLA	1.15	1.25	1.70	4.10	1.36

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.95	0.477	2.56^{ns}		
Treatment	4	1.28	0.320	1.72^{ns}	3.84	4.46
Error	8	1.49	0.187			
TOTAL	14	3.73				

^{ns}- not significant

CV (%) = 25.21

Appendix Table 13. Computed yield per hectare

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	4.5	4.5	3.5	12.5	4.1
MLUSA # 5	3.8	2.3	5.6	11.7	3.9
MLUSA # 3	2.8	1.9	3.6	8.3	2.7
GLORIA	4.3	2.6	3.8	10.7	3.5
GRANOLA	2.3	2.5	3.4	8.2	2.7

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	3.82	1.909	2.56^{ns}		
Treatment	4	5.12	1.281	1.72^{ns}	3.84	4.46
Error	8	5.97	0.746			
TOTAL	14	14.91				

^{ns}- not significant

CV (%) = 25.21

Appendix Table 14. Dry matter content

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	17	16.5	17.5	51	17.00
MLUSA # 5	17.5	16.5	17	51	17.00
MLUSA # 3	16.5	18.5	18.5	53.5	17.8
GLORIA	15	16	16	47	15.66
GRANOLA	18	17.5	18	53.5	17.83

ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.933	0.467	1.047^{ns}		
Treatment	4	09.433	2.358	5.290^{**}	3.84	4.46
Error	8	3.567	0.446			
TOTAL	14	13.933				

^{ns}- not significant
** - highly signinficant

CV (%) = 3.91

Appendix Table 15. Sugar content

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
MLUSA # 8	2.00	1.90	1.90	5.80	1.90
MLUSA # 5	2.10	2.30	2.00	6.40	2.13
MLUSA # 3	2.10	2.30	1.90	6.30	2.10
GLORIA	2.30	2.20	2.00	6.50	2.16
GRANOLA	2.10	2.20	2.00	6.60	2.16

ANALYSIS OF VARIANCE TABLE

OURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.13	0.065	7.32**		
Treatment	4	0.10	0.024	2.75ns	3.84	4.46
Error	8	0.07	0.009			
TOTAL	14	0.30				

** - highly significant
ns - not significant

CV (%) = 4.50