BIBLIOGRAPHY

SAB-IT, JOSHUA D. APRIL 2012. Growth and Yield of Potato Entries Applied with Organic Fertilizers in La Trinidad, Benguet.Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted to determine the best performing potato entry applied with organic fertilizer based on yield and resistance to pest and diseases; determine the kind of organic fertilizer that will produce plants with high yield under La Trinidad, Benguet condition; determine the best combination of organic fertilizer and potato entry that will give the best performance in terms of yield and resistance to pest and diseases; and determine the return on cash expenses (ROCE) on potato production.

Among the four potato entries, Tawid was the most vigorous. Entries Omega, Tawid, and 2.21.6.2 were the most resistant to late blight at 60 DAP. Entries Tawid and 2.21.6.2 were highly resistant to leaf miner. The application of organic fertilizer may have contributed to the resistance of the plants.

Based on marketable yield, entry Tawid produced the highest.Plants applied with Murasaka produced the highest marketable and total yield. Entry Tawid applied with Murasaka registered the highest return on cash expenses.

Based on the results, entry Tawid could be recommended for organic potato production under La Trinidad, Benguet condition. Application of organic fertilizer is possible for potato production under La Trinidad, Benguet condition.

INTRODUCTION

Potato (*Solanum tuberosum L.*) is commonly grown in Benguet. Farmers prefer growing potato not only because of its adaptability to various types of soil but it is also easier to manage than other vegetable crops. It is considered as the world's leading vegetable crop and the most promising substitute for rice (McCollum, 1975).

The problem faced by potato farmers at present is a gradual reduction in yield due to continuous use of the same variety in the same location every year. There is a lack of high yielding and pest resistant varieties. Problems on soil fertility and occurrence of plant diseases that lead to low production are also experienced by most farmers. Thus, application of pure inorganic fertilizer is often practiced to attain maximum yield of potato. However, the continuous application of inorganic fertilizer will destroy the soil structure and pollute the water source (Balaoing, 2012). The application of organic fertilizer may therefore be a good alternative since it will not only reduce inputs of farmers but also improve soil tilth, soil structure, and water holding capacity (Galagal, 2006).

Moreover applying the right organic fertilizer not only contributes to growth performance of the crop and tuber quality but also may help farmers reduce their fertilizer inputs. Organic fertilizers hold nutrients at a higher capacity than chemical fertilizers do, when used properly. It will also bring back the productive capacity of the soil, soundness of the environment and safer food for human consumption. This study could therefore be of great importance to potato farmers. Proper selection of planting materials should also be done for a successful potato production and for increasing productivity and sustainability.

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The objective of the study was to:

1. determine the best performing potato entry applied with organic fertilizer based on yield and resistance to pest and diseases;

2. determine the kind of organic fertilizer that will produce plants with high yield under La Trinidad, Benguet condition;

3. determine the best combination of organic fertilizer and potato entry that will give the best performance in terms of yield and resistance to pest and diseases; and

4. determine the return on cash expenses (ROCE) on potato production.

The study was conducted in Lamtang, La Trinidad, Benguet from November 2011 to February 2012.

REVIEW OF LITERATURE

Varietal Evaluation on Organic Production

Varietal evaluation or crop selection is important for managing crops under organic production. There is need to evaluate the variety under organic production, to know what variety is good for organic production. According to Wang, *et. al.* (2001), the desirable method in organic production is the cultivation of resistant varieties.

HARRDEC (1996) stated that achieving maximum production requires the best variety to be selected in the locality. Series of varietal evaluation must be conducted in order to determine the adapted variety and the performance of newly introduced varieties.

Effects of Organic Fertilizers on
the Growth and Yield Potato

In potato production, application of chicken manure as source of organic matter enhances the tallest average height at harvest. And weakly growth increment of potato plants was significantly affected by fertilizing with chicken manure. Application also at organic fertilizer control bacterial wilt (Bilanggo, 1996).

Poincelot (1980) found out that plants fertilized with different organic manure increases weight of marketable tubers. In 1980, Pandosen reported that as the level of organic fertilizer is raised, the tuber formation and the yield also increased. This is because more absorption of nutrients by the plants led to the development of heavier tubers considering that the other factors were favorable.

Fertilizer serves an important role on the growth and yield of potato plants. The application of 200 kilograms of nitrogen per hectare doubled the yield while the application to farmyard manure alone and more than double yield of potato receiving no potash at all. Kinoshita (1996) pointed out that the lack of nitrogen severely affected tuber yields.

Organic vs. Inorganic Fertilizer

Commercial fertilizers are petroleum-based so they make the soil acidic and hard. As a result, beneficial microbes and the natural fertility of the soil is lost. On the other hand, organic fertilizers improve drainage and aeration of heavy soil. It promotes plant resistance to virus and pest (Landacan, 1993).

Applying large amount of inorganic fertilizer to the soil can result in temporary nitrogen depletion from the soil and the surrounding plants (Garden Line, 2000). Heavy application of inorganic fertilizer can result to an excessive and toxic accumulation of salts which can damage plants.

Organic fertilizers allow you more of a choice in the content and amount of nutrient to meet the needs of your plants where as the nutrients in inorganic fertilizers vary depending on the type of fertilizer (Pataras, 1984).

Benefits of Using Organic Fertilizers

The benefit of organic farming is mostly health related since production has little or no pesticide residue. Some practitioners of organic farming believe that organic food is more nutritious than produced by conventional farming (Hynes, 2006). It improves nutritive value, nitrate content, taste keeping quality and resistance (PCARRD, 2006).

Organic fertilizer maintains, improves soil organic matter. It can also control of weeds combined with soil cultivation. Organic agriculture also contributes to food security by increasing on the yield in low input areas, conserving biodiversity and nature resources on the farm and in the surrounding area (IFOAM, 2005).

Crop fertilized with organic matter were reported by Abadilla (1982) to have greater resistance to pest and diseases. (Donahue, 1977) reported that the fertilizer should be applied as close as possible to the roots without hindrance to germination on growth. It should be supplied when the nutrients are most needed usually at early vegetative stage and at flowering.

Soil for vegetative production should be rich in organic matter (Pataras, 1984). He mentioned that the best way to achieve this condition is through sustained application of compost whereby weeds, manure and other farm wastes are converted to useful soil amendment which when use in farm can improve soil structure making it ideal for vegetable production.

Marcelino (1995) also found that organic fertilizer supplies some amount of the nutrient requirements of the crop and promote favorable soil properties such as granulation, efficient aeration, easy root penetration and more improved water holding capacity of the soil. Organic fertilizers and without fertilization did not significantly affect the period of seedling recovery, days from transplanting to booting, days from transplanting to heading, to ripen, length of panicles and harvest index. Soil may become hard and unproductive not because of the large application of chemical fertilizers but because of small addition of humus (Watts, 1972).

Importance of Organic Fertilizer

Organic fertilizers generally provide many advantages to organic growers, to soil properties and to crop yields. An organic fertilizer provides some essential elements for proper plant growth. It assures farmers of lower stable fertilizer cost and reliable local raw materials. Organic growers realized to look for alternative low-cost of fertilizers that are not harmful and beneficial to the plants.

Kinoshita (1996) reported that application of organic fertilizer in sufficient amount improves soil structure; serve to improve organic fertilizer increase not only the quantity of nutrients elements for plant growth and development but also decreases bulk density of the soil. Organic matters can increase water absorption and lessen water run-off, leaching and erosion.

MATERIALS AND METHODS

An area of 240 m^2 was thoroughly prepared and divided into three blocks containing 16 plots measuring 1m x 5m each to accommodate the 3 replications (Figure 1). This was laid out following split-plot design arranged in Randomized Complete Block Design (RCBD).

Organic fertilizers were assigned to the main plot and potato entries were assigned to the sub-plot.

The double row method of planting was followed with a distance of 30cm between hills and rows (Figure 2). All organic fertilizers were applied and thoroughly mixed with the soil one week before planting. One seed tuber was planted per hill.

Cultural practices like irrigation, hilling-up (Figure 3), and weeding were done as necessary throughout the duration of the study.

The following treatments were:

Main Plot – Fertilizer	Sub – plot Potato Entries/Varieties	Source
F1 = No organic fertilizer (control)	E1 = Raniag (check)	NPRCRTC
F2 = Bio 3-n-1	E2 = Omega	NPRCRTC
F3 = Murasaka	E3 = “Tawid”	NPRCRTC
F4 = Green World	E4 = 2.21.6.2	NPRCRTC

Figure 1. Overview of the production site after land preparation

Figure 2. Planting of potato tubers

Figure 3. Hilling up at 30 DAP

Nutritional Analysis of Organic Fertilizers Used

Murasaka An organic fertilizer that provide microorganism to the soil. It can improve the ability of plants to use available nutrients resulting to higher yields.

Guaranteed Analysis:

Macronutrients:

Nitrogen (N)	2.5%
Phosphorus (P_2O_3)	6.3%
Potassium (K_2O)	3.5%

Bio 3-n-1 Organic fertilizer that is a decent source of nitrogen (2-4%) organic. It also has small amounts of phosphorus and potassium. It is used to increase green leaf growth, adds organic matter that increases humus and can be used as a compost decomposition activator.

Guaranted Analysis:

Nitrogen (N)	2.5%
Phosphorus (P_2O_3)	3.9%
Potassium (K_2O)	3.0%

Green World is a balanced, stable and complete natural and organic fertilizer, with carefully selected nutrients, minerals and vitamins in the forms that are readily available for plants. It increases activities and population of soil beneficial microorganisms.

Guaranted Analysis:

Nitrogen (N)	3.41%
Phosphorus (P_2O_3)	2.83%
Potassium (K_2O)	1.75%

Data Gathered

A. Meteorological data. The temperature, rainfall, sunshine duration, and relative humidity during the conduct of the study were taken from the Philippines Atmospheric Geophysical and Astronomical Services (PAG-ASA) weather station at Benguet State University.

B. Initial and final soil analysis. Soil samples were taken from the experimental area before and right after harvest. The nitrogen, phosphorus, potassium, soil pH, and organic matter content of the soil were analyzed at the Department of Agriculture, Soils Laboratory, Pacdal, Baguio City.

C. Vegetative Characters

1. Initial plant height (cm). Initial plant height was measured from ten sample plants ten days after emergence from the base to the tip of the longest shoots.

2. Final height (cm). Ten sample plants per plot were measured from the base to the tip of the plant one week before harvest.

3. Plant vigor. This was taken one month after planting using the CIP scale.

Scale	Description	Remarks
5	Plants are strong with robust stems and leaves, leaves are light to dark in color	Highly vigorous
4	Plants are moderately strong with robust stem and leaves are light green color	Moderately vigorous
3	Better then 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	Poorly vigorous

4. Canopy cover. This was gathered at 30, 45 and 60 days after planting (DAP) using a wooden frame measuring 120cm x 60cm having equally sized 12cm x 6cm grids. Holding the grid over the foliage of four representative previously marked plants, grids covered with effective leaves were counted.

5. Plant survival. The number of plants that survived was counted at 30 days after planting (DAP) and computed using the formula:

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

D. Reaction to Leafminer and Late Blight. This was noted through visual observation.

1. Leaf miner. The reaction was recorded at 30 and 45 DAP using the following rating scale (CIP, 2001):

Scale	Description	Remarks
1	Least infected (1-20%)	Highly resistant
2	Infected (21-40%)	Moderately resistant
3	Moderately infected (41-60%)	Susceptible
4	Severely infected (61-80%)	Moderately susceptible
5	Most serious (81-100%)	Very susceptible

2. Late blight. This was gathered at 30, 45 and 60 DAP, using the CIP scale (Henfling, 1987). Percent late blight infection was based on ten sample plants.

Blight (%)	CIP scale	Description
0	1	No late blight to be observable
Trace <5	2	Late blight present. Maximum 10 lesions per plant
5-<15	3	Plant look healthy but lesions are easily seen at closer distance. Maximum foliage area affected by lesions or destroyed corresponds to more than 20 leaf lets.
15-<35	4	Late blight easily seen on most plant. About 25% of foliage is covered with lesions or destroyed.
35-<65	5	Plants look green: however all plants are affected. Lower leaves are dead. About half the foliage area is destroyed.
65-<85	6	Plants look green with brown flecks. About 75% of each plant is affected. Leaves of the lower half of the plant are destroyed.
85-<95	7	Plants neither predominantly green nor brown. Only top leaves are green. Many stems have large lesions.
95-<100	8	Plants are 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.

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

E. Yield and yield components

1. Number and weight of marketable tubers per plot (kg). All tubers that have marketable size, not malformed, free from cuts, cracks and without more than 10% greening of the total surface were 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 were malformed, attacked by pest, diseases, cuts and those with more than 10% greening.

3. Total yield per plot (kg). This is the sum of the weight of marketable and non-marketable tubers.

4. Computed yield/ha. This was computed using the formula:

$$\text{Computed Yield (ton/ha)} = \frac{\text{Total yield}}{10m^2} \text{x}10,000$$

5. Return on cash expenses (ROCE). This was computed by dividing the net profit over the total cost of production multiplied by 100.

$$\text{ROCE} = \frac{\text{Net Profit}}{\text{Total Cost of Production}} \text{ x } 100$$

Data Analysis

All quantitative data were analyzed using the Analysis of Variance (ANOVA) for split plot design with 3 replications. The significant differences among treatments were tested using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Soil Chemical Properties

The final analysis of the soil taken from the experimental area is shown in Table 1. The initial pH of the soil was 5.37 with organic matter content of 2.0%, while the nitrogen, phosphorus and potassium contents of the soil were 0.12%, 124 ppm, and 308 ppm, respectively.

The soil applied with Murasaka, Bio 3-n-1, and Green World had an increased pH, while that of the control remained. The organic matter content of the soil applied with organic fertilizer had increased which is apparently a direct effect of the applied organic materials. The phosphorus and potassium content of plots applied with organic fertilizer had increased, while the soil not applied with fertilizer decreased in phosphorus and potassium.

Table 1. Soil analysis before and after planting

	pH	ORGANIC MATTER (%)	NITROGEN (%)	PHOSPHORUS (ppm)	POTASSIUM (ppm)
Before planting	5.37	2.0	0.10	124	308
After planting					
No organic fertilizer	5.37	2.0	0.10	118	300
Bio 3-n-1	5.80	2.5	0.13	126	373
Murasaka	5.96	2.5	0.13	135	375
Green World	5.84	2.5	0.13	130	375

Meteorological Data During the Study Period

Table 2 shows the temperature, relative humidity, sunlight duration, and rainfall. Temperature ranged from 22-24˚C, which could be considered within the temperature range of 17-22ºC (HARRDEC, 1996) in which potato grows best. Relative humidity was 85 to 87 % which was favorable for potato plant growth. Potato grows best in areas with an average relative humidity of 86% (HARRDEC, 1996). Sunlight duration ranged from 1169 to 10554 minutes, and rainfall ranged from 2.20 to 6.40mm daily, both of which also favor the growth of potato.

Table 2. Agro climatic data during the study period (November 2011 to February 2012)

MONTH	AVERAGE TEMPERATURE (ºC)	RELATIVE HUMIDITY (%)	SUNLIGHT DURATION (min)	RAINFALL AMOUNT (mm)
November	24	87	1169	2.20
December	23	87	7578	6.40
January	22	85	10554	3.20
February	22	86	8492	3.40
MEAN	23	86	6948	4.00

Source: PAG-ASA Weather Station at BSU

Plant Height

Effect of fertilizer. Table 3 shows the plant height of potato entries at 30 and 60 DAP as affected by organic fertilizer. In both instance, potato applied with Murasaka had the tallest plants indicating that Murasaka is suitable as an organic fertilizer for potato.

Effect of potato entry. Entry Tawid produced the tallest plants among the entries at 30 and 60 DAP (Table 3) while Omega was the shortest at 30 and 60 DAP. The differences in height among the entries could be due mainly to their genotypic variation.

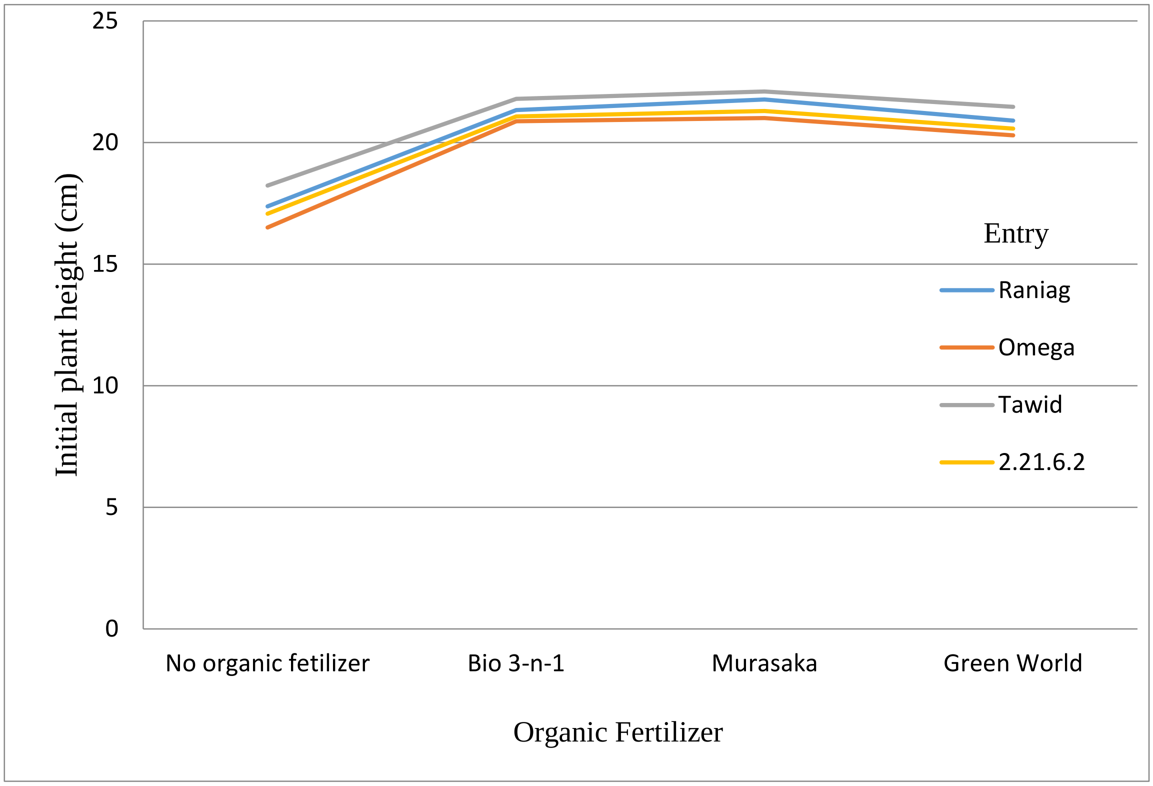
Table 3. Plant height of four potato entries as affected by organic fertilizers.

TREATMENT	PLANT HEIGHT (cm)	
	30 DAP	60 DAP
Fertilizer (F)		
No organic fertilizer	17.29 c	27.35 c
Bio 3-n-1	21.27 ab	30.10 ab
Murasaka	21.54 a	30.47 a
Green World	20.81 b	29.68 b
Variety (V)		
Raniag	20.34 b	29.32 b
Omega	19.67 d	28.53 c
“Tawid”	20.90 a	30.40 a
2.21.6.2	20.00 c	29.35 b
F x V	*	ns
CV A %	2.7	1.05
CV B %	0.81	1.09

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

Interaction effect. Significant interaction was observed between the organic fertilizer and entries on the initial plant height. Entry Tawid applied with Murasaka and Bio3-n-1 were the tallest (Figure 4). The interaction between the fertilizer and potato entries did not significantly affect through the final height of the plant. This result indicates that the effect of the organic fertilizers used are remarkable during the earlier growth stage of potato thus, they should be applied also early.

Figure 4. Initial height of four potato entries as affected by different organic fertilizer



Plant Vigor

Effect of fertilizer. It was observed that at 30 and 45 DAP potatoes applied with Bio 3-n-1, Murasaka, and Green World were highly vigorous (Table 4). Potato without fertilizer was moderately vigorous until 45 DAP. The high vigor exhibited by the potato plants are clearly due to the release of nutrients from the organic fertilizers. This effect may not be sustained in the long run due to the relatively low proportion of nutrients held by such fertilizers.

Table 4. Plant vigor at 30 DAP and 45 DAP of four potato entries as affected by organic fertilizer

TREATMENT	PLANT VIGOR	
	30 DAP	45 DAP
Fertilizer (F)		
No Organic Fertilizer	Moderately vigorous	Moderately vigorous
Bio 3-n-1	Highly vigorous	Highly vigorous
Murasaka	Highly vigorous	Highly vigorous
Green World	Highly vigorous	Highly vigorous
Variety (V)		
Raniag	Highly vigorous	Moderately vigorous
Omega	Moderately vigorous	Highly vigorous
"Tawid"	Highly vigorous	Highly vigorous
2.21.6.2	Moderately vigorous	Highly vigorous

Effect of potato entries. Entries Raniag and Tawid were found to be highly vigorous, while Omega and 2.21.6.2 were moderately vigorous at 30 DAP. At 45 DAP entries Omega, Tawid, and 2.21.6.2 were highly vigorous while Raniag was moderately vigorous. This may be explained by the absence of late blight infection at that stage.

Plant Survival

All potato entries had 100% survival percentage showing that the planting materials used were of good quality.

Canopy Cover at 30, 45, and 60 DAP

Effect of fertilizer. As shown in Table 5, the differences in canopy cover at 30, 45, and 60 days after planting were significant. Plants applied with organic fertilizer have wider canopy cover which could be attributed to the observed high vigor of plants. The nutrient content of the organic fertilizers seem to enhance better vegetative growth condition in the potato plants.

Effect of potato entries. Significant differences were also observed on the canopy cover of different potato entries. Canopy cover of the potato entries consistently increased until 60 DAP. Entry Tawid obtained the highest canopy cover at 60 DAP indicating its better resistance to late blight compared to other. Omega obtained the lowest canopy cover at 30 DAP but it gradually exhibited better cover until 60 DAP.

Interaction effect. There was no significant interaction between fertilizer and potato entries on canopy cover at 30, 45, and 60 DAP.

Table 5. Canopy cover at 30, 45, and 60 DAP of four potato entries as affected by organic fertilizers

TREATMENT	CANOPY COVER		
	30 DAP	45 DAP	60 DAP
Fertilizer (F)			
No Organic Fertilizer	28.52 [b]	38.24 [c]	43.80 [b]
Bio 3-n-1	39.12 [a]	46.88 [a]	50.40 [a]
Murasaka	40.08 [a]	47.92 [a]	51.48 [a]
Green World	38.32 [a]	45.60 [b]	49.88 [a]
Variety (V)			
Raniag	36.72 [b]	45.12 [b]	47.64 [b]
Omega	33.56 [c]	42.28 [d]	46.52 [b]
"Tawid"	40.60 [a]	47.40 [a]	52.28 [a]
2.21.6.2	35.12 [b]	43.88 [c]	49.08 [b]
F x V	ns	ns	ns
CV A %	3.71	1.47	2.31
CV B %	1.43	1.24	1.57

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

Late Blight Incidence

Effect of fertilizer. Plants at 30 DAP were observed to have high resistance to late blight (Table 6). Plants applied with Bio 3-n-1, Murasaka, and Green World were resistant to late blight infection at 45 and 60 DAP while the unfertilized plants were observed to be moderately resistant at 45 and 60 DAP.

Effect of entries. Table 6 shows the reaction of four potato entries applied with organic fertilizers to late blight. The four potato entries were highly resistant to late blight at 30 DAP. Entries Omega, Tawid, and 2.21.6.2 were resistant to late blight infection at 45 and 60 DAP while Raniag was observed to be moderately resistant at 45 to 60 DAP. These reactions are primarily due to desirable genetic attributes of the entries used.

Table 6. Reaction to late blight at 30, 45, and 60 DAP of four potato entries applied with organic fertilizers

TREATMENT	REACTION TO LATE BLIGHT		
	30 DAP	45 DAP	60 DAP
Fertilizer (F)			
No Organic Fertilizer	Highly resistant	Moderately resistant	Moderately resistant
Bio 3-n-1	Highly resistant	Resistant	Resistant
Murasaka	Highly resistant	Resistant	Resistant
Green World	Highly resistant	Resistant	Resistant
Variety (V)			
Raniag	Highly resistant	Moderately resistant	Moderately susceptible
Omega	Highly resistant	Resistant	Resistant
“Tawid”	Highly resistant	Resistant	Resistant
2.21.6.2	Highly resistant	Resistant	Resistant

Leaf Miner Incidence

Effect of fertilizer. It was observed that plants applied with organic fertilizers, together with the unfertilized plants were not attacked by leaf miner at 30 DAP. However, at 45 to 60 DAP plants applied with Murasaka, Bio 3-n-1, and Green World were slightly attacked by insect pest. The plants with no organic fertilizer became moderately resistant because its resistance had weakened due to lack of nutrients.

Table 7. Leaf miner incidence at 30, 45, and 60 DAP of four potato entries as affected by organic fertilizer

TREATMENT	REACTION TO LEAF MINER		
	30 DAP	45 DAP	60 DAP
Fertilizer (F)			
No Organic Fertilizer	Highly resistant	Moderately resistant	Moderately resistant
Bio 3-n-1	Highly resistant	Resistant	Resistant
Murasaka	Highly resistant	Resistant	Resistant
Green World	Highly resistant	Resistant	Resistant
Variety (V)			
Raniag	Highly resistant	Resistant	Moderately resistant
Omega	Highly resistant	Moderately resistant	Moderately resistant
Tawid	Highly resistant	Highly resistant	Highly resistant
2.21.6.2	Highly resistant	Highly resistant	Highly resistant

Effect of entries. It was observed that most of the potato entries were highly resistant to leaf miner at 30 DAP. Entries Tawid and 2.21.6.2 were consistently highly resistant to leaf miner at 30, 45, and 60 DAP. On the other hand, Raniag become resistant at 45 DAP then moderately resistant at 60 DAP, while Omega only moderately resistant at 45 to 60 DAP. Tawid and entry 2.21.6.2 are good materials for planting by farmers when leafminer is a problem. Omega could be an alternative choice since it also showed moderate resistance to the same insect pest.

Number of Marketable and
Non-marketable Tuber

Effect of fertilizer. The number of marketable and non-marketable tubers is presented in Table 8. All the organic fertilizer treatments enhanced more number of marketable tubers but at the same time they also produced greater number of non-marketable tubers. All the organic fertilizers used have good potential for organic potato production. The abundance of non-marketable tubers is probably a consequence of the insufficient amount of the fertilizers applied.

Effect of entries. Table 8 shows that entry Tawid produced the highest marketable and non-marketable tubers, while Raniag registered both the lowest number of marketable and non-marketable tubers. Tawid is exhibiting a remarkable genetic characteristic that could result to a satisfactory tuber yield in organic potato production.

Interaction effect. The interaction between the potato entry and organic fertilizer were not significant on the number of marketable and non-marketable tubers.

Table 8. Number of marketable and non-marketable tuber of four potato entries as affected by organic fertilizers

TREATMENT	NUMBER OF TUBER (per $5m^2$)	
	MARKETABLE	NON-MARKETABLE
Fertilizer (F)		
No Organic Fertilizer	143.83[b]	5.42 [a]
Bio 3-n-1	223.42[a]	6.75 [b]
Murasaka	223.92[a]	7.00 [b]
Green World	222.50[a]	6.75 [b]
Variety (V)		
Raniag	189.00[d]	5.67 [a]
Omega	201.00[c]	5.67 [a]
Tawid	216.58[a]	7.83 [b]
2.21.6.2	207.08[b]	6.75 [ab]
F x V	ns	ns
CV A %	0.58	4.98
CV B %	1.47	11.790

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

Weight of Marketable and
Non-marketable Tubers

Effect of Fertilizer. Plants applied with organic fertilizers produced almost twice as heavy marketable and non-marketable tubers than the control, further showing their effectiveness as organic fertilizers for potato production.

Effect of potato entries. Significant differences were obtained on marketable and non-marketable tubers. Tawid produced the heaviest tubers, while Raniag obtained the lowest tuber yield. Tawid also had the heaviest marketable tubers but this could be considered as a yield potential.

Interaction effect. There was no significant interaction between the potato entries and organic fertilizers on marketable and non-marketable tubers of potato.

Table 9. Weight of marketable and non-marketable tubers of four potato entries as affected by organic fertilizer

	WEIGHT OT TUBER (kg/5m^2)	
TREATMENT	MARKETABLE	NON-MARKETABLE
Fertilizer (F)		
No Organic Fertilizer	4.55[b]	0.44 [a]
Bio 3-n-1	848[a]	0.81 [b]
Murasaka	8.70[a]	0.82 [b]
Green World	8.37[a]	0.79 [b]
Variety (V)		
Raniag	6.41[d]	0.60 [a]
Omega	7.21[c]	0.63 [a]
“Tawid”	8.59 [a]	0.88 [b]
2.21.6.2	7.89 [b]	0.74 [ab]
F x V	ns	ns
CV A %	4.56	34.54
CV B %	3.61	17.84

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

Total and Computed Yield

Effect of fertilizer. Plants applied with Murasaka significantly produced the highest total yield of 9.52 $kg/5m^2$ and computed yield of 19.03 tons/ha. While plants without fertilizer produced lower total and computed yield (Table 11). Tuberization appears to be a trait that is positively influenced by the organic fertilizers used resulting from their balanced nutrient composition for potato plant growth and productivity.

Table 11. Total yield and computed yield of four potato entries as affected by organic fertilizer fertilizers

TREATMENT	TOTAL YIELD ($kg/5m^2$)	COMPUTED YIELD (t/ha)
Fertilizer (F)		
No Organic Fertilizer	4.99 ^{b}	9.98 ^{b}
Bio 3-n-1	9.29 ^{a}	18.58 ^{a}
Murasaka	9.52 ^{a}	19.03 ^{a}
Green World	9.16 ^{a}	18.32 ^{a}
Variety (V)		
Raniag	7.01 ^{d}	14.02 ^{d}
Omega	7.84 ^{c}	15.68 ^{c}
Tawid	9.48 ^{a}	18.95 ^{a}
2.21.6.2	8.63 ^{b}	17.27 ^{b}
F x V	ns	ns
CV A %	4.57	4.5
CV B %	3.70	3.70

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

Effect of potato entries. There were significant differences observed on the total and computed yield of the four potato entries. Entry Tawid produced the highest total yield of 9.48 kg/plot and computed yield of 18.95 t/ha while Raniag obtained the lowest total yield of 7.01 kg/5m^2 and computed yield of 14.02 t/ha. This is indicative of the good potential of planting Tawid for high yield.

Interaction effect. There was no significant interaction between the potato entries and organic fertilizers on total and computed yield.

Return on Cash Expenses (ROCE)

Effect of fertilizer. Table 12 shows the return on cash expenses of the potato entries applied with different organic fertilizers. Plants applied with Murasaka obtained the highest ROCE of 656.52%. While plants without organic fertilizer had the lowest ROCE of 378.95% due to low yield and weaker resistance to late blight and leaf miner attack.

Effect of potato entries. Results showed that entry Tawid obtained the highest ROCE of 684.03% followed by 2.21.6.2 with 620.15%. The high ROCE of all entries applied with organic fertilizers reveal the high profitability of organic potato production.

Table 12a. Return on Cash Expenses (ROCE) of four potato entries as affected by different organic fertilizers.

TREATMENT	MARETA-BLE YIELD (kg/15m²)	GROSS SALE (PhP)	TOTAL EXPENSES (PhP)	NET INCOME (PhP)	ROCE (%)
ORGANIC FERTILIZER (A)					
No organic fertilizer	54.6	5460	1140	4320	378.95
Bio 3-n-1	101.8	10180	1380	8800	637.68
Murasaka	104.4	10440	1380	9060	656.52
Green World	100.4	10040	1360	8680	638.24
ENTRY (B)					
Raniag	76.9	7690	1315	6375	484.79
Omega	86.5	8650	1315	7335	557.79
Tawid	103.1	10310	1315	8995	684.03
2.21.6.2	94.7	9470	1315	8155	620.15

Total cost of production includes cost of planting materials, fertilizer, labor cost for land preparation, weeding and other activities.
*Potato tuber was sold at P100.00 per kg. (palaspasan) Based in organic price.

Table 12b. Return on Cash Expenses (ROCE) of four potato entries as affected by different organic fertilizers.

TREATMENT	MARKETA-BLE YIELD ($15m^2$)	GROSS SALE (PhP)	TOTAL EXPENSES (PhP)	NET INCOME (PhP)	ROCE (%)
No Organic Fertilizer					
Raniag	10.4	1040	285	755	264.91
Omega	12.6	1260	285	975	342.11
Tawid	16.8	1680	285	1395	489.47
2.21.6.2	14.8	1480	285	1195	419.30
MEAN					378.95
BIO 3-N-1					
Raniag	22.1	2210	345	1865	540.58
Omega	24.7	2470	345	2125	615.94
Tawid	28.8	2880	345	2535	734.78
2.21.6.2	26.2	2620	345	2275	659.42
MEAN					637.68
MURASAKA					
Raniag	23.2	2320	345	1975	572.46
Omega	24.8	2480	345	2135	618.84
Tawid	29.2	2920	345	2575	746.38
2.21.6.2	27.2	2720	345	2375	688.41
MEAN					656.52
GREEN WORLD					
Raniag	21.2	2120	340	1780	523.53
Omega	24.4	2440	340	2100	617.65
Tawid	28.3	2830	340	2490	732.35
2.21.6.2	26.5	2650	340	2310	679.41
MEAN					638.24

Total cost of production includes cost of planting materials, fertilizer, labor cost for land preparation, weeding and other activities.

*Potato tuber was sold at P100.00 per kg. (palaspasan) Based in organic price.

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

Growth and yield of four potato entries applied with different organic fertilizer were assessed at Lamtang, La Trinidad, Benguet from November 2011 to February 2012. The objectives were to: determine the best performing potato entry applied with organic fertilizer based on yield and resistance to pest and diseases; determine the kind of organic fertilizer that will produced plants with high yield under La Trinidad, Benguet condition; determine the best combination of organic fertilizer and potato entry that will give the best performance in terms of yield and resistant to pest and diseases; and determine the return on cash expenses (ROCE) on potato production.

Among the four potato entries, Tawid was the most vigorous. Entries Omega, Tawid, and 2.21.6.2 were the most resistant to late blight at 60 DAP. While Entries Tawid and 2.21.6.2 were highly resistant to leaf miner. Plants applied with different organic fertilizers were highly vigorous and were resistant to leaf miner infestation and late blight incidence.

There were no significant interaction effect between the four potato entries and different organic fertilizers on all the parameters measured. However, numerically, the best combination based on marketable and total yield is entry Tawid applied with Murasaka.

In terms of yield, entry Tawid produced the highest total yield and obtained the highest ROCE. Plants applied with Murasaka registered the highest ROCE for tuber production.

Conclusion

Entries Tawid and 2.21.6.2 were the best potato entries in terms of yield and resistance to pest and diseases. Plants applied with Murasaka produced the highest yield in potato under Lamtang, La Trinidad, Benguet condition. Entry Tawid applied with Murasaka was the best combination in terms of resistance to late blight and leafminer, high yield and high ROCE for tuber production. The use of organic fertilizer on different potato entries was profitable when sold as tubers.

Recommendation

Based on the results of the study, entries Tawid and 2.21.6.2 are recommended for planting materials due to their resistance to late blight and leaf miner and high yield. Murasaka could be recommended for organic potato production. Entry Tawid applied with Murasaka could be further explored for possible organic potato production under Lamtang, La Trinidad, Benguet condition.

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