BIBLIOGRAPHY

LAGAWAD, CARMELITA P. APRIL 2010. Growth and Yield of Potato Entries Applied with Different Rates of Vermicompost in La Trinidad, Benguet Condition. Benguet State University, La Trinidad, Benguet.

Adviser: Guerzon A. Payangdo, MSc.

ABSTRACT

The study was conducted to identify the best entry and rates of vermicompost on the growth yield of potato; determine the interaction effect between the potato entries and rates of vermicompost and determine the economic benefit of growing potato applied with different rates of vermicompost.

Among the entries used in the study, Gloria had the highest survival rate, was resistant to late blight and produced the most marketable tubers. It also significantly produced the highest total and computed yield and highest ROCE (238%).

Among the rates of vermicompost, application of 13 kg/$5m^2$ produced the plants with the highest survival rate, high vigor and resistance to leaf miner and late blight. Furthermore, the plants applied with 13 kg/$5m^2$ produced the highest yield of marketable tubers. However, the plants had the lowest ROCE (-18.85%) due to high cost of vermicompost.

In terms of yield, producing Gloria applied with 13kg/m^2 of vermicompost might be the best combination to increase marketable yield. However, based on ROCE, Gloria applied with 7 kg/$5m^2$ might be the best combination for a positive ROCE.

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INTRODUCTION

Potato (*Solanum tuberosum L.*) is commercially grown in Benguet, Bukidnon, Pangasinan, Lanao del Norte, Nueva Ecija and North Cotabato. Benguet is a highly profitable potato producer and is among the provinces with wealthier small-scale farmers in the country (Waibel, 1981). Due to the high-end quality of locally grown potatoes, local processors have started to notice the Benguet potatoes (Dati, 2009).

However, potato production in Benguet is mainly conventional which involves the use of synthetic fertilizers, which are readily available in the market. These fertilizers are also believed to have a more effective action to plant growth. However, using these fertilizers may cause problems on soil acidity, soil pollution and gradual depletion of the soil nutrients (TACC, 2009).

The attempt to use vermicompost as an alternative fertilizer in potato production may improve the soil properties and increase yield. The proper application of recommended fertilizer rates may contribute to lower inputs of production.

Vermicompost is one of the organic fertilizers produced through composting with the action of earthworm feeding on a biological waste material and plant residues. The humus in the vermicompost contains toxins, fungi and bacteria, which has the ability to fight off plant diseases and prevent plants from absorbing more nutrients than they need (Hahn, 2007).

Farmers of Benguet are intensive users of chicken dung but due to its fowl odor, it attracts more flies. Vermicompost, on the other hand, is an odorless, clean, organic material containing adequate quantities of NPK and high amount of humus that favors good physical conditions in the soil for plant and beneficial organism (Agro Organics, 2009).

Thus, using vermicompost as an alternative fertilizer to chicken dung and other synthetic fertilizers in potato production must be studied. On the other hand, the first decision in potato production is to use the best variety to plant. Resistant varieties ensure high yield and better quality of produce. Thus, selection of a high yielding potato variety must be continually done.

The objectives of the study are to:

1. identify the best entry and rates of vermicompost on the growth and yield of potato;

2. determine the interaction effect between the potato entries and different rates of vermicompost; and

3. determine the economic benefit of growing potato applied with different rates of vermicompost.

The study was conducted at Longlong, La Trinidad Benguet from April 2009 to July 2009.

REVIEW OF LITERATURE

Temperature and Soil Requirement of Potato

Potato has a wide range of soil adaptation. A fertile soil rich in organic matter is essential for its good growth. Average temperature ranges between 15-18 ^{0}C (PCARRD, 1979) but also grows best at temperature from 17 ^{0}C to 22 ^{0}C with soil temperature of 13 ^{0}C to 18 ^{0}C (NPRCRTC, 1998).

HARRDEC (1996) reported that the recommended temperature for potato ranges from 17º C to 23º C. Furthermore, Simongo 2007 stressed that potato grows best with an average relative humidity of 86 %. Perez (2008) added that due to the presence of moisture and high relative humidity occurrence of late bight is favorable.

For optimum yields, a deep well drained loam soil or sandy loam with a pH of 5.5 to 6.0 is required for potato cultivars. Maximum yields are normally obtained when the average temperature through out the growing season ranges between 15-18 ^{0}C. A cool night temperature appears to be more important than a cool daytime temperature. However, high temperature during the day reduces high yield (PCARRD, 1979). Further results revealed that potato grows well with satisfactory production in a wide variety of soil with a pH ranging form 5.0 to 6.5 (Motes and Criswell, 2000).

Varietal Evaluation in Organic Farming

Singh (1999) stated that the proposed standard variety selection in organic farming is to be adapted locally common in the area, the selected variety must be resistant to pest and diseases so that the crop planted may yield high produce. However, organic farmers need the varieties that are adapted to specific soil fertility conditions. To some production circumstances, varieties that do not perform well in organic system have different yielding ranks. In selecting the right variety, the farmers must also consider the consumers requirements, supermarket requirement and the variety maturity in order to achieve the best production needed.

Vergara (1991) added that new varieties under good condition have greater yield potentials than the old ones. The use of fertilizer and improved farming practices will increase more yield in new varieties than the old ones.

Simongo and Tad-awan (2007) reported that in terms of leaf area index, net assimilation rate and growth rate CIP 380241.17, CIP 13.1.1 and PHIL 5.19.2.2 are the best performers. Further results revealed that the genotypes PHIL 5.19.2.2, CIP 13.1.1 and CIP 380241.17 had the highest total yield of 4.75 kg, 4.21 kg and 4.13 kg, and computed marketable yields of 6.33, 5.46, and 5.92 tons/ha, respectively.

According to NPRCRTC Director Dati (2009) 7,000 farmers planted new potato varieties of Benguet State University for evaluation, aiming to clinch a bound of importing potatoes to their foreign suppliers.

Vermicompost

Vermicompost is one of the organic fertilizers produced through composting with the action of earthworm. It can be produced in about four to five weeks provided optimum conditions for earthworm growth and development are met. Earthworms are useful soil dwellers that feed on organic materials and in return will produce humus (vermicompost) through their excrete or waste product (Lagman, 2003).

Benefits and Use of Vermicompost

Bhawan (2002) claimed that vermicompost is known as "farmer's gold". It acts as barrier to prevent extreme pH levels from making it impossible for plants to absorb nutrients. Made from eco-friendly technology using organic waste producing vermicompost that is available in particle forms (granules) which can be applied at any stage of the crop. It also improves the quality of produce, reduces cost of cultivation and offers additional value in the farm of organic agriculture. The reports of Alam (2005) showed that upon increasing the rate of the vermicompost the dry matter increases.

A potential environmental benefit of vermitechnology includes reduction of noxious qualities of organic wastes, elimination / reduction of harmful microorganisms; conversion of agro-wastes into high value fertilizer and production of food and feed from food discards Vermicompost envisages the soil fertility for years together with out affecting the food quality. The NPK content of vermicompost is higher than the farmyard wastes (Tripathi *et al.*, 2005). In addition, Singh (2001) stated that vermicompost has a good physical and chemical property, which supply the nutrients required for plant growth and development.

Betayan (2009) reported that increasing the rate of vermicompost from 5-30 tons/ha had improved the growth of potato (var. Igorota) and enhanced the initial and final heights of the plant. The plants applied with 30 tons/ha were the tallest at 75 days after emergence. This was attributed to the ability of vermicompost to provide the essential physical and chemical conditions for growth and development and the added nutrients supplied by the vermicompost.

The ideal physical and chemical properties of the soil as a growing media are obtained from vermicompost. Application of vermicompost increases the water holding capacity and decreases the bulk density of a media (Patnaik, 2009). Lumagto (2004) stressed those organic fertilizers like vermicompost can improve the soil physical, chemical and biological property that favors the growth of the plant. Ansari (2005) agreed that vermicompost as an organic input can grow vegetable crops successfully.

Chemical Compositions of Vermicompost

According to Nagavallemma *et. al*, (2004) vermicast from recycled waste contain nutrient element such as N (1.61%), P (1.02%), K (0.73%), Ca (7.61%), Mg (0.568%), Na (0.158%), Zn (0.11%), Fe (1.33%) and Mn (0.2038%). Rajendran (2008) also claimed that earthworm casting (vermicompost) in the home garden often contains 0.50% of Nitrogen, with 0.57 % Phosphorous and 3.14% Potassium.

The chemical properties of soil such as N, P, K, OM and pH are significantly increased by the addition of vermicompost. Therefore, the application of vermicompost increased the yield, (Lagman, 2003).

As reported by Krisma (2002) that nitrogen is crucial for several physiological and biochemical reactions during vegetative and reproductive stages of the plant, this implies that the nitrogen content of the vermicompost is not totally used after the potato had been planted. He further concluded that the vital process like the photosynthesis and respiration are dependent on the potassium concentration in plant cells. According to HARRDEC (1996), phosphorous is needed by the crop during its early development and tuberization to increase the number of tubers produced per plant.

MATERIALS AND METHODS

An area of 180 m^2 was thoroughly prepared and divided into three blocks consisting of 36 plots measuring 1 m x 5 m. The treatments were laid out in 3 x 4 factorial design arranged in Randomized Complete Block Design with three replications.

The different rates of vermicompost were applied basally by thoroughly mixing with the soil before planting. Potato seed tubers were planted at a depth of 7 cm at a distance of 30 cm x 30 cm between hills and rows.

The following treatments were:

Factor A: Entry	Factor B: Rate of Vermicompost (VC)
E_1 – Gloria	T_1- 0 kg/ 5m
E_2 – PHIL 5.19.2.2	T_2-7 kg/5m
E_3 – CIP 380241.17	T_3-10 kg/ 5m
	T_4-13 kg/5m

Other cultural management practices necessary for potato production such as irrigation, weeding, insect pest and disease control were uniformly employed in the experiment throughout the duration of the study.

Data Gathered

1. Meteorological data. Temperature (º C), Relative Humidity (%), Rainfall (mm), and Sunshine Duration (kj) was taken at the BSU-PAGASA Office.

2. Percentage survival. This was taken by counting the number of plants that survived two weeks after planting using the following formula:

$$\% \text{ Survival} = \frac{\text{Total Number of Plants Survived}}{\text{Total Number of Tubers Planted per Plot}} \times 100$$

3. Initial plant height (cm). Initial plant height was taken by measuring ten sample plants from base to the tip of the longest shoots 7 days after emergence.

4. Canopy cover (%). This was gathered at 30, 45, 60 and 75 days after planting with the use of a wooden frame at 120 cm x 60 cm with equal sized foliage grids.

5. Plant vigor. This was recorded at 30 and 45 days after planting using the CIP (2001) rating scale.

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

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

7. Leaf miner infestation. This was observed at 30, 45, and 60 DAP using the following scale (CIP, 2001):

Scale	Description	Remarks
1	Less infested (1-20%)	Highly Resistant
2	Infested (20-40%)	Moderately resistance

3	Moderately infested (41-60%)	Intermediate
4	Severely infested (61-80%)	Moderate susceptibility
5	Most serious	Susceptible

8. Late blight infection. This was observed at 30, 45, and 60 days after planting using the CIP rating scale (Henfling, 1987).

Late Blight (%)	CIP scale	Description of corresponding symptoms
0	1	No late blight observed.
Trace-<5	2	Late blight present. Maximum 10 lesions per plant.
5-<25	3	Plants look healthy, but lesions are easily seen at a closer distance. Maximum foliage area is affected by lesions or destroyed. It corresponds to no more than 20 leaflets.
15-<35	4	Late blight is easily seen on most plants. About 25% of foliage is covered with lesions or destroyed.
35-<65	5	Treatments look green; however all plants are affected leaves are dead. About half the foliage area is destroyed.
65-<85	6	Treatments 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	Treatments are neither predominantly green nor brown Only top leaves are green. Many have large lesions.
95-, 100	8	Treatments are brown-colored. A few top leaves still have green areas. Most stems have lesions or are dead.
100	9	All leaves and stems are dead.

Descriptions: 1= highly resistant; 2-3 = resistant; 45 = moderately resistant; 6-7 =moderately susceptible; 8-9 = susceptible

9. Number and weight of marketable tubers per 5m^2 (kg). This was the counted and weighed tubers from extra large to marble sized, not malformed, and free from natural cracks and with no more than 10% greening of the total surface at harvest.

10. Number and weight of non-marketable tubers per $5m^2$ (kg). This was obtained by counting and weighing all tubers that has natural cracks, malformed and damaged by pest and diseases.

11. Total yield per $5m^2$ (kg). This was the recorded weight of both marketable and non-marketable tubers.

12. Tuber dry matter content (%). The dry matter content of the tubers was determined by slicing 4 medium tubers into 100g and replicated three times and then oven dried at 80°C for 72 hours.

Dry matter content was computed using the formula:

% DMC= 100 - % moisture content

Where:

$$\% \text{ MC} = \frac{\text{Fresh Weight-Oven Dried Weight}}{\text{Fresh Weight}} \times 100$$

13. Computed yield (tons/ha). This was obtained by using the following formula:

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

14. Return on cash expense. This was obtained through the following formula:

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

Data Analysis

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

RESULTS AND DISCUSSION

Meteorological Data

Table 1 shows the meteorological data from April to July at Longlong, La Trinidad, Benguet. During the conduct of the study, minimum and maximum temperature ranges from 23.08º C to 25. 4 ºC. The lowest relative humidity was noted in the month of April at 84 % while the highest was recorded in July at 92%. A little rainfall of 11.6 mm was recorded in the month of April while a heavy rainfall was noted in the months of June and July (25.6mm). Sunshine duration in the month of July and June was low ranging from 183 to 184.6 kj as compared to the month of April and May with sunsgine duration of 271kj to 276 kj.

The recommended temperature for potato ranges from 17º C to 23º C (HARRDEC, 1996). Simongo (2007) added that potato grows best with an average relative humidity of 86 %. Furthermore, Escalante and Farrera (2004) reported that amount of rainfall ranging from 10.0mm-18.0mm favors the infection of late blight to potato plants. Therefore, temperature and rainfall during the conduct of the study was unfavorable for potato production.

Table 1. Temperature, relative humidity, rainfall, sunshine duration from April to July 2009.

MONTH	TEMP (ºC)	RH (%)	RAINFALL (mm)	SUNSHINE DURATION (Kj)
APRIL	24.70	84.00	13.00	271.00
MAY	25.40	88.00	11.60	276.50
JUNE	24.80	88.00	25.60	184.60
JULY	23.08	92.00	25.30	183.00

Source: BSU PAG-ASA (2009)

Plant Survival

Effect of the entry. Results showed a significant difference on the percent survival of the different entries. Entry Gloria obtained the highest percent survival of 80 % followed by CIP 380241.17 (68 %) while PHIL 5.19.2.2 had the lowest percent of survival (Table 2). This shows that entry Gloria has a potential ability to withstand the erratic rainfall pattern during the conduct of the study. The differences between the entries may be due to their resistance and adaptability to the condition of the area.

Effect of the rates of vermicompost. Plants applied with 13 kg/5m^2 vermicompost had a percent survival of 83 %, which was significantly higher than the plants applied with 10 and 7 kg/5m^2 of vermicompost. The higher survival of the plants could be attributed to the sufficient nutrient content that supported the plants growth. This conforms to the statement that vermicompost as an organic input for vegetable crops results in successful growth (Ansari, 2008).

Interaction effect. Highly significant interaction was noted on the interaction between potato entries and different rates of vermicompost (Fig.1).

Entry PHIL 5.19.2.2 registered the highest survival rate when applied with 13kg/5m^2 of vermicompopst. For most of the entries, raising the rates of applied vermicompost led to increased survival rate.

Plant Vigor

Effect of the entry. Table 2 shows that all the potato entries used were highly vigorous at 30 days after planting. This could be the effect of the vermicompost, which provided sufficient nutrients to the potato plant. However, at 45 DAP plants were observed to be vigorous in spite of the slight infestation of leaf miner and late blight infection

Effect of the rates of vermicompost. Application of different rates of vermicompost did not significantly affect the plant vigor. However results revealed that application of 13 kg of vermicompost resulted to highly vigorous plants at 45 DAP.

Interaction effect. No significant interaction was noted on plant vigor at 30 and 45 DAP between the different potato entries and rates of vermicompost applied.

Table 2. Plant survival and vigor at 30 and 45 DAP of three potato entries applied with different rates of vemicompost

TREATMENT	SURVIVAL (%)	PLANT VIGOR 45 (DAP)
Factor (A)		
Gloria	80[a]	Vigorous
PHIL 5.19.2.2	62[c]	Vigorous
CIP 380241.17	68[b]	Vigorous
Factor (B)		
0 kg/5m^2	58[d]	Vigorous
7 kg/5m^2	63[c]	Vigorous
10 kg/5m^2	76[b]	Vigorous
13 kg/5m^2	83[a]	Highly vigorous
A x B	**	
CV (%)	10.72	

For each column, treatment means with different letter are significantly different at 5% probability levels (DMRT)

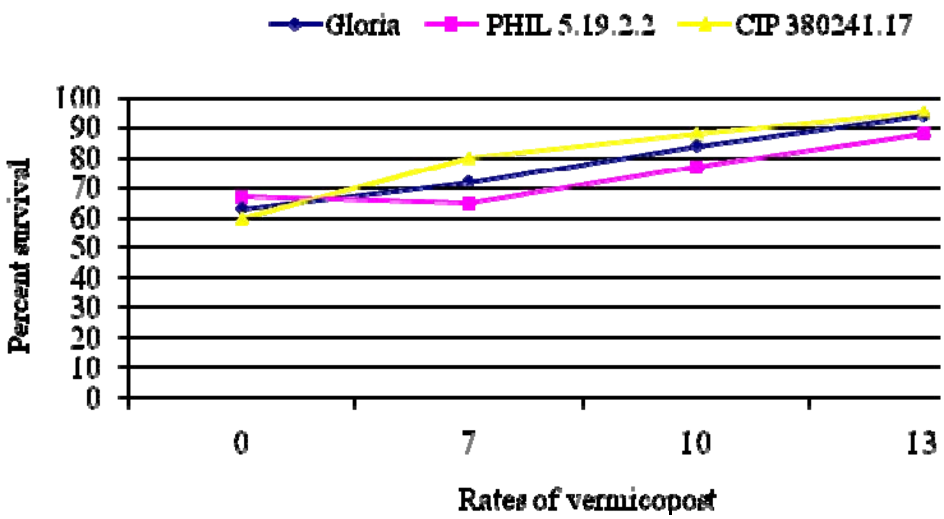

Figure 1. Interaction effect on percent survival of the three potato entries applied with different rates of vermicompost (kg/5m^2)

Initial and Final Height

Effect of the entry. The different potato entries did not show significant differences on the initial height at 30 DAP. Numerically, entry PHIL 5.19.2.2 was the tallest. This coincides with the result that entry PHIL 5.19.2.2 produced the tallest plant in two locations at Benguet (Lem-ew, 2007).

Statistically, entry CIP 380241.17 significantly obtained the tallest final height at 75 DAP.

Effect of the rates of vermicompost. The data presented in table 3 shows the influence of different rates of vermicompost on the heights of the potato plants. The plots applied with 13kg of vermicompost significantly produced the tallest plants.

These observations show that the organic matter N, P, K contents of the vermicompost as well as the pH value can support the vegetative growth of the potato entries tested for evaluation.

Interaction effect. Significant interaction between the two factors was observed on the final height at 75 DAP (Fig.2). Entry CIP 380241.17 applied with 13 kg/5m^2 vermicompost was the tallest plants. Application of 13 kg/5m^2 vermicompost may have improved the physical, chemical and biological properties of the soil that favored the growth of the plants (Lumagto, 2004).

Table 3. Initial and final height at 30 and 45 DAP of the three potato entries applied with different rates of vermicompost (cm)

TREATMENT	PLANT HEIGHT	
	30 (DAP)	75 (DAP)
Factor (A)		
Gloria	4.52	85.52^c
PHIL 5.19.2.2	5.33	91.65^b
CIP 380241.17	4.97	93.41^a
Factor (B)		
0 kg/5m^2	4.63	76.58^d
7 kg/5m^2	4.67	94.20^b
10 kg/5m^2	4.97	93.99^c
13 kg/5m^2	5.47	96.01^a
A x B	ns	*
CV (%)	9.77	6.33

For each column, treatment means with different letter are significantly different at 5% probability levels (DMRT)

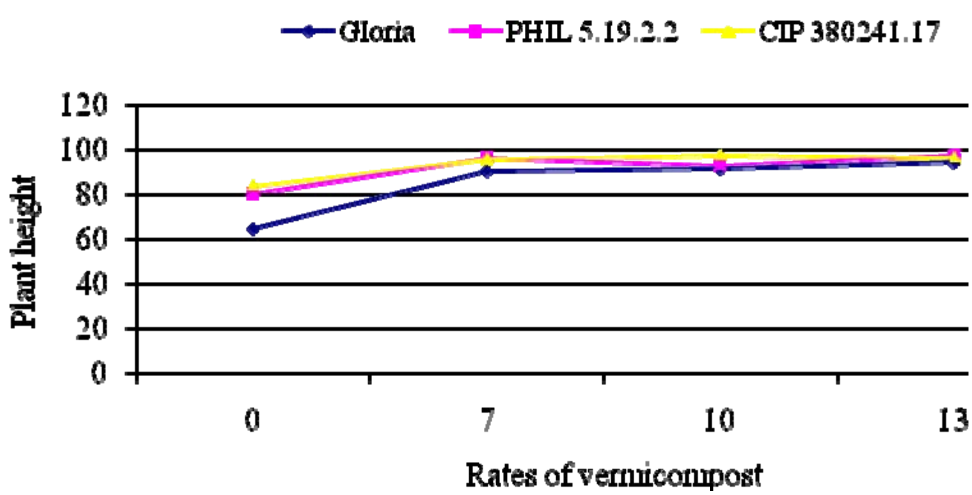

Figure 2. Interaction effect on final plant height at 75 DAP of potato entries applied with different rates of vermicompost (kg/5m^2)

Leaf Miner Infestation

Effect of the entry. Table 4 shows the incidence of leaf miner infestation on the different potato entries. There was no leaf miner observed at 30 days after planting, all entries were highly resistant. However, during 45 to 60 DAP there were slight variations observed which may be attributed to the varietal nature of the crop and weather condition during the study period. PHIL 5.19.2.2 remained highly resistant until 60 DAP.

Effect of the rates of vermicompost. Different rates of vermicompost did not significantly affect the leaf miner infestation at 45 DAP. After 60 DAP, plants applied with 0 to 10 kg vermicompost were moderately resistant as compared to the plants applied with 13 kg which were highly resistant. The plants recovery may be the effect of higher rate of vermicompost applied that contributed to the health and resistance of the crop.

Interaction effect. No significant interaction existed between the two factors on the leaf miner infestation at 45 and 60 days after planting.

Table 4. Reaction of the three potato entries to leaf miner infestation at 30, 45, and 60 DAP applied with different rates of vermicompost

TREATMENT	LEAF MINER INFESTATION	
	45 (DAP)	60 (DAP)
Factor (A)		
Gloria	Highly resistant	Moderately resistant
PHIL 5.19.2.2	Highly resistant	Highly resistant
CIP 380241.17	Moderately resistant	Moderately resistant
Factor (B)		
0kg/5m^2	Moderately resistant	Moderately resistant
7 kg/5m^2	Highly resistant	Moderately resistant
10 kg/5m^2	Highly resistant	Moderately resistant
13 kg/5m^2	Moderately resistant	Highly resistant

Late Blight Infection

Effect of the entry. Potato entries showed no significance at 30 days after planting. However slight differences were noted at 45 and 60 DAP. The slight difference could be attributed to the heavy rainfall observed during the study period, which enhanced the occurrence of late blight. A 10.0- 18.0mm amount of rainfall favors the late blight infection of potatoes (Escalante and Farrera, 2004).

Furthermore, high relative humidity favors the occurrence of late blight (Perez, 2008). Both Gloria and PHIL 5.19.2.2 remained resistant at 60 DAP.

Effect of the rates of vermicompost. The different rates of vermicompost did not show any significant differences on the late blight infection at 30, 45 and 60 days after planting (Table 5).

Interaction effect. The interaction between potato entries and rates of vermicompost with respect to late blight infection was not significant.

Table 5. Reaction of three potato entries to late blight infection at 30, 45 and 60 DAP applied with different rates of vermicompost

TREATMENT	LATE BLIGHT INFECTION		
	30 (DAP)	45 (DAP)	60 (DAP)
Factor (A)			
Gloria	Highly resistant	Highly resistant	Resistant
PHIL 5.19.2.2	Highly resistant	Resistant	Resistant
CIP 380241.17	Resistant	Resistant	Moderately resistant
Factor (B)			
0 kg/5m^2	Resistant	Resistant	Resistant
7 kg/5m^2	Resistant	Resistant	Resistant
10 kg/5m^2	Highly resistant	Resistant	Resistant
13 kg/5m^2	Highly resistant	Highly resistant	Resistant

Canopy Cover

Effect of the entry. The canopy cover of the three potato entries at 30 days after planting had no significant differences (Table 6). This may be because the potato plants are still on their vegetative stage and are not yet fully developed to obtain wider leaf cover. At 45, 60 and 75 DAP the canopy cover was significantly affected by different potato entries used. The canopy cover was progressively increasing up to 60 days but a slight decrease was observed at 75 days. The heavy rainfall during the period of the study might have affected the decrease in the canopy cover. PHIL 5.19.2.2 had the widest canopy cover at 75 DAP.

Effect of the rates vermicompost. At 30 days after planting (DAP), the canopy cover ranging from 16 to 18 % was not significant. Significant differences were observed at 45, 60 and 75 DAP. The narrowest canopy was recorded in plants without vermicompost while the widest canopy was obtained by the application of 13 kg/5m^2 vermicompost. This may be attributed by the higher level of nutrients incorporated in the soil. This was supported by the findings of Beukema and Vander Zaag (1979) that the development of haulm which includes foliage growth is highly affected by climatic and soil conditions.

Interaction effect. Significant interaction between the two factors was noted on the canopy cover at 45, 60 and 75 days after planting (Fig.3). Entry PHIL 5.19.2.2 and CIP 380241.17 significantly registered the widest canopy cover when applied with increasing rates of vermicompost (0-13 kg). The peak of the leaf area is chiefly influenced by variety, fertilizer and planting date (Amer and Harfield, 2004).

Table 6. Canopy cover at 30, 45, 60 and 75 DAP of the three potato entries applied with different rates of vermicompost

TREATMENT	CANOPY COVER			
	30 (DAP)	45 (DAP)	60 (DAP)	75 (DAP)
Factor (A)				
Gloria	18	36[a]	48[c]	39[b]
PHIL 5.19.2.2	17	39[b]	65[a]	48[a]
CIP 380241.17	16	35[a]	62[b]	42[ab]
Factor (B)				
0 kg/5m^2	17	31[b]	48[d]	36[b]
7 kg/5m^2	16	37[ab]	55[c]	43[ab]
10 kg/5m^2	16	37[ab]	61[b]	42[ab]
13 kg/5m^2	18	41[a]	69[a]	49[a]
A x B	ns	*	**	*
CV (%)	18.4	13.52	13.07	20.76

For each column, treatment means with different letter are significantly different at 5% probability levels (DMRT)

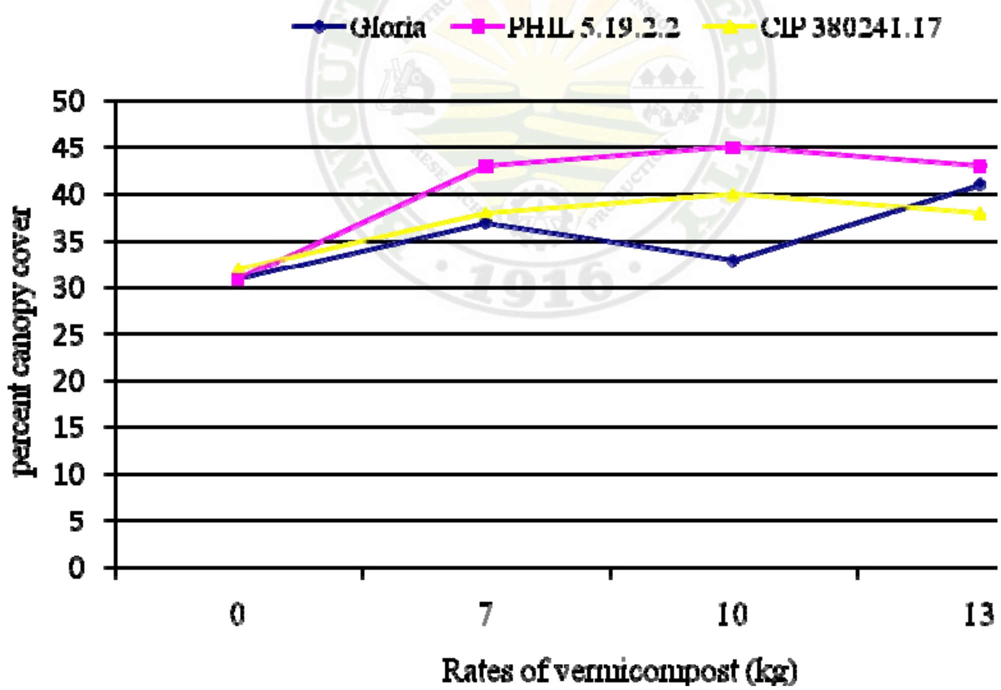

Figure 3a. Interaction effect on percent canopy cover at 45 DAP of three potato entries applied with different rates of vermicompost (kg/5m^2)

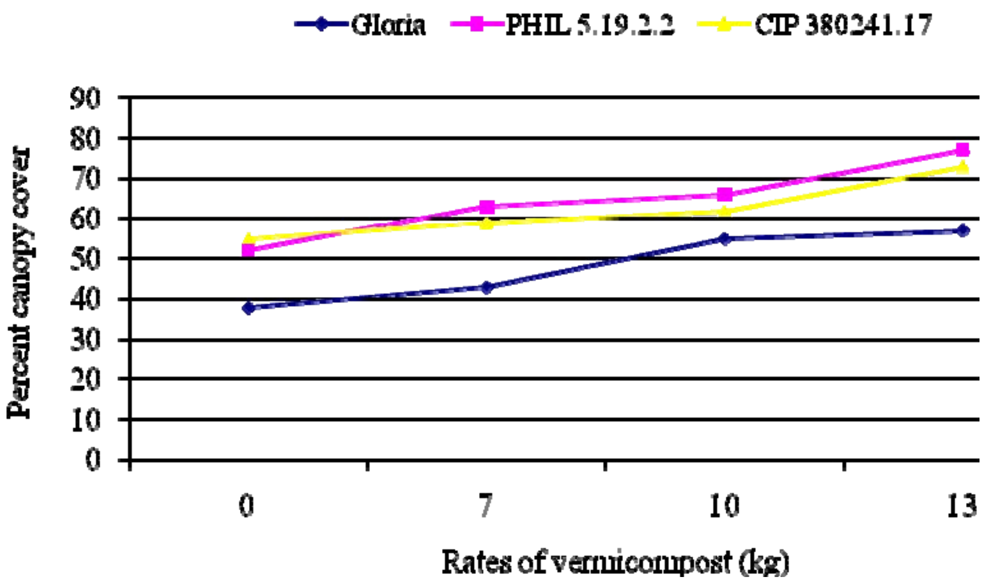

Figure 3b. Interaction effect on percent canopy cover at 60 DAP of three potato entries applied with different rates of vermicompost (kg/5m^2)

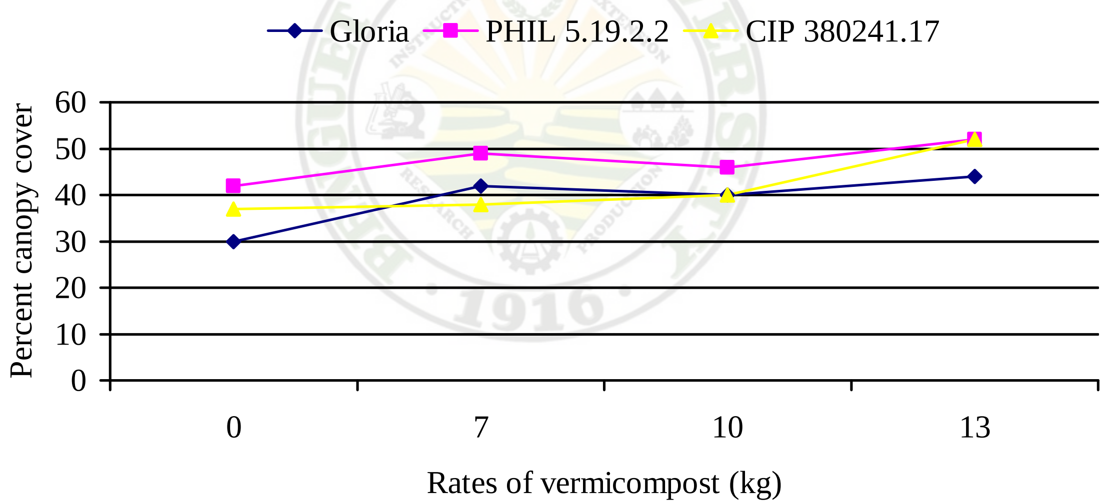

Figure 3c. Interaction effect on canopy cover at 75 DAP of potato entries applied with different rates of vermicompost (kg/5m^2)

Number of Marketable and
Non-marketable Tubers

Effect of the entry. Table 7 shows significant differences among the different tuber sizes from the different entries studied. Gloria produced the most marketable tubers from medium to marble sized followed by entry PHIL 5.19.2.2 while the least tubers were produced by entry CIP 380241.17. No significant differences were observed on the number of extra large and large tubers. As to the number of non-marketable tubers, PHIL 5.19.2.2 significantly gave the least tubers followed by CIP 380241.17 but comparable to Gloria, which obtained the highest non-marketable tubers.

Effect of the rates of vermicompost. Statistical analysis showed significant differences among the rates of vermicompost applied. It was noted that plants treated with 13 kg/5m^2 produced the highest total number of marketable tubers followed by the plants applied with 10 and 7 kg/5m^2 vermicompost.

On the number of non-marketable tubers, 7 kg/5m^2 and 13 kg/5m^2 significantly produced lesser f tubers. This implies that the application of vermicompost ranging from 7 to 13 kg/5m^2 could increase the number of tubers.

Interaction effect. A significant interaction existed on the number of marketable and non-marketable tubers as affected by the entries and application of different rates of vermicompost (Fig.4).

Statistically, results indicated that Gloria applied with 13 kg vermicompost gave the most marketable medium, small and marble sized tubers. This may imply that increasing the recommended rate (10kg/5m^2) to 13 kg/5m^2 may also increase the production of tubers.

Table 7. Number of marketable and non-marketable tubers of three potato entries applied with different rates of vermicompost

TREATMENT	MARKETABLE TUBERS ($kg/5m^2$) XL	L	M	S	MS	TOTAL	NON-MARKETABLE TUBERS ($kg/5m^2$)
Factor (A)							
Gloria	5	13	21^a	9^a	14^a	62^a	7^c
PHIL 5.19.2.2	4	10	16^b	8^b	12^b	50^b	5^a
CIP 380241.17	11	12	5^c	4^c	9^c	41^c	6^b
Factor (B)							
0 $kg/5m^2$	5^d	7	13^d	6^{bc}	9^d	40^d	8^c
7 $kg/5m^2$	7^c	10	15^c	5^c	11^{bc}	48^c	5^{ab}
10 $kg/5m^2$	9^b	10	17^b	6^{bc}	10^{cd}	52^b	6^b
13 $kg/5m^2$	11^a	13	24^a	8^a	13^a	96^a	4^a
Ax B	ns	ns	**	*	*	*	*
CV (%)	15.1	16.8	8.45	6.28	28.14	14.96	38.39

For each column, treatment means with different letter are significantly different at 5% probability levels (DMRT)

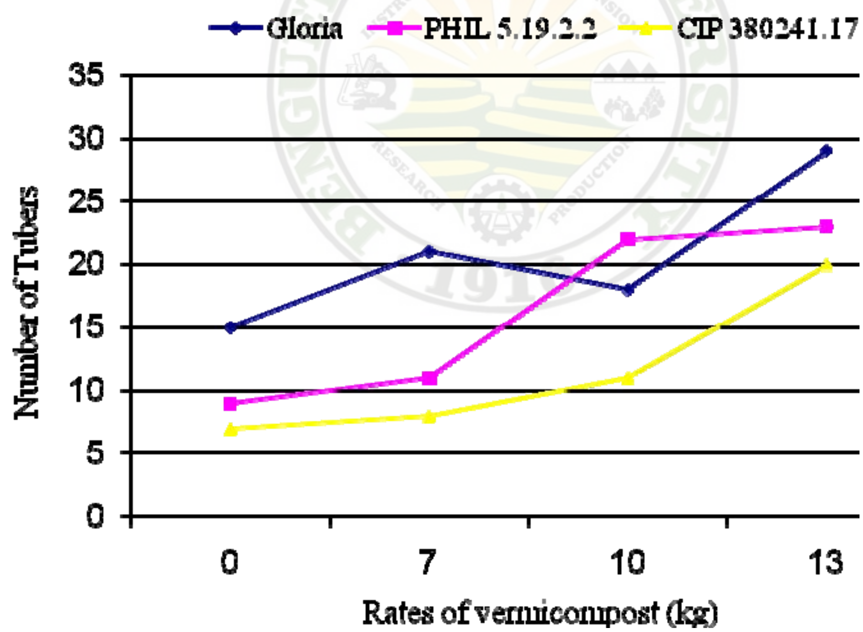

Figure 4a. Interaction effect on the number of marketable medium (M) tubers of potato entries and rates of vermicompost ($kg/5m^2$)

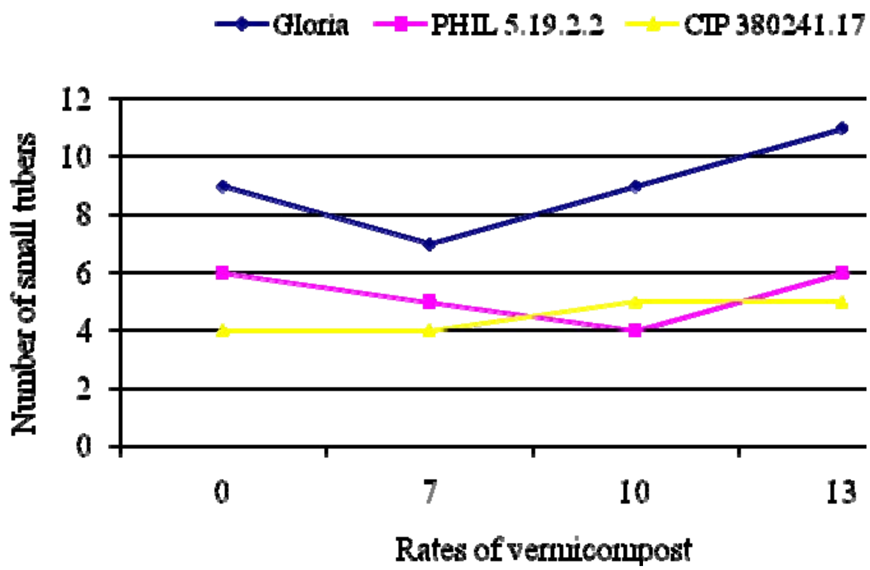

Figure 4b. Interaction effect on the number of marketable small (S) tubers of potato entries and rates of vermicompost (kg/5m^2)

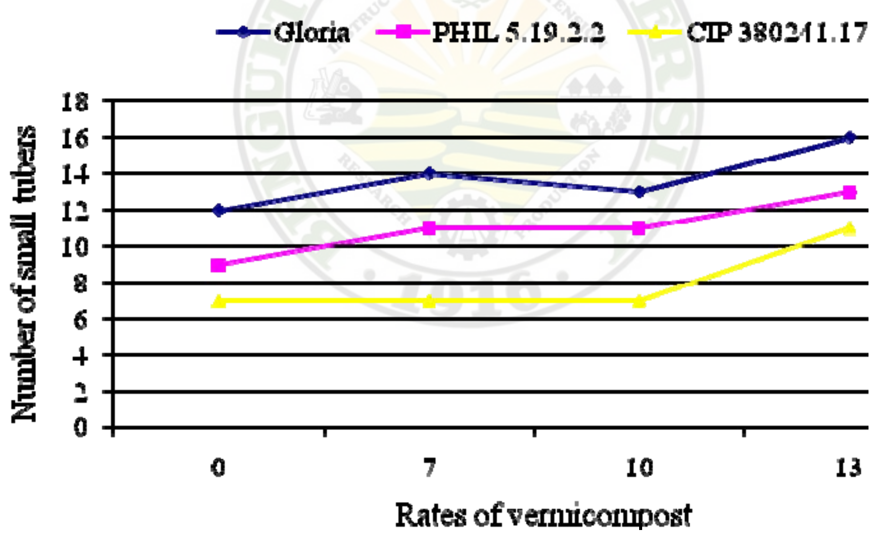

Figure 4c. Interaction effect on the number of marketable marble sized (MS) tubers of potato entries and different rates of vermicompost (kg/5m^2)

Weight of Marketable and
Non-marketable tubers

Effect of the entry. Table 8 showed that entry Gloria had significantly produced the heaviest weight of marketable medium tubers but comparable to PHIL 5.19.2.2. The high marketable medium tubers of Gloria might be attributed to the numerous tubers produced and the resistance of the entry to late blight and leaf miner.

As to the weight of non-marketable tubers, CIP 380241.17 significantly produced the lowest weight followed by Gloria and PHIL 5.19.2.2. The low weight of the CIP 380241.17 may be due to the fewer tubers rotten. As an effect of wet season planting, some of the tubers were rotten and not fully matured during harvesting, thus affecting the yield.

Effect of the rates of vermicompost. The plants applied with 13 kg/5m^2 of vermicompost significantly had the heaviest weight of medium-sized tubers (Table 8). This indicates that higher-level of vermicompost is good for potato production. On the non-marketable tubers, plants applied with 10 kg/5m^2 vermicompost produced the lowest non-marketable tubers.

Interaction effect. Table 8 indicates that significant interaction existed on the weight of marketable medium-sized tubers and non-marketable tubers (Fig.5). Entry Gloria significantly produced the heaviest weight of medium sized tubers when applied with 13 kg/5m^2 of vermicompost. It was noted that upon raising the rates of vermicompost applied the weight of marketable tubers increases.

As to the weight of non-marketable tubers, entry CIP 380241.17 applied with 10 kg/5m^2 vermicompost gave the lowest weight of tubers.

Table 8. Weight of marketable and non-marketable tubers of three potato entries applied with different rates of vermicompost

TREATMENT	MARKETABLE TUBERS (kg/5m^2)						NON-MARKETABLE
	XL	L	M	S	MS	TOTAL	TUBERS (kg/5m^2)
Factor (A)							
Gloria	1.90	2.20	2.90^a	0.98	0.50	9	0.73^b
PHIL 5.19.2.2	0.75	1.18	1.6 0^{ab}	0.64	0.30	4	0.89^c
CIP 380241.17	1.05	1.00	1.20^c	0.40	0.27	6	0.67^a
Factor (B)							
0 kg/5m^2	0.90	0.70	1.00^d	0.50	0.60	4	0.76^b
7 kg/5m^2	2.00	1.20	1.56^c	1.03	0.64	6	0.71^{ab}
10 kg/5m^2	1.21	1.42	2.00^{ab}	1.80	1.00	7	0.69^a
13 kg/5m^2	1.05	2.29	2.40^a	1.70	1.00	9	0.90^c
A x B	ns	ns	*	ns	ns	ns	*
CV (%)	14.90	18.4	20.80	7.74	24.90	14.25	21.10

For each column, treatment means with different letter are significantly different at 5% probability levels (DMRT)

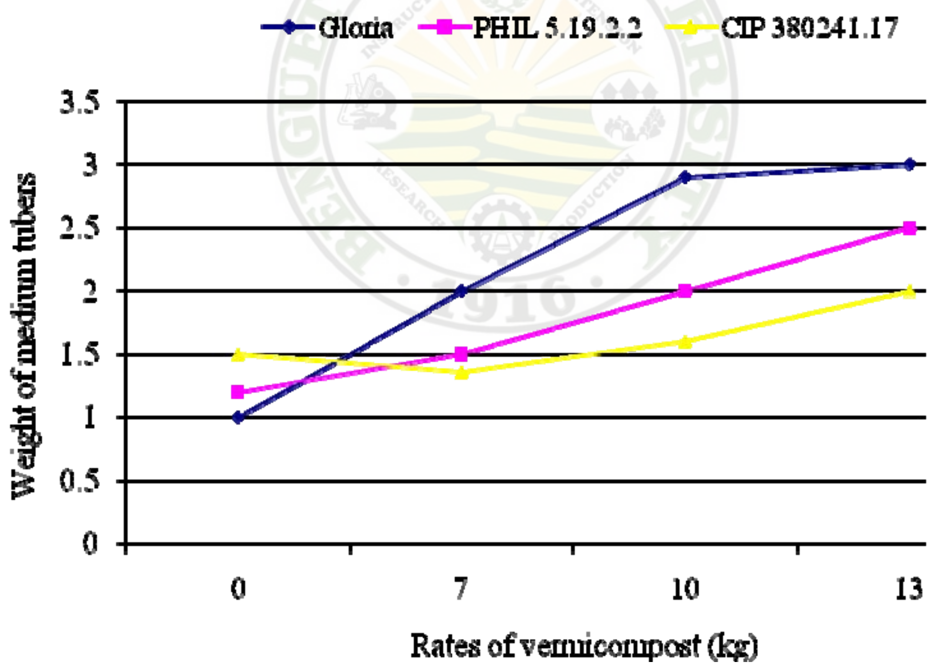

Figure 5a. Interaction effect on the weight of medium tubers of potato entries applied with different rates of vermicompost (kg/5m^2)

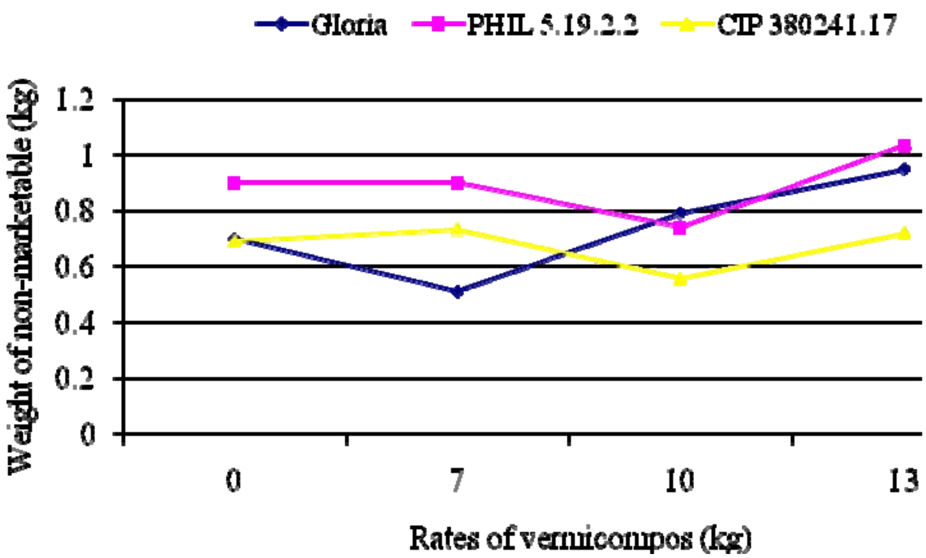

Figure 5b. Interaction on the weight of non-marketable tubers of potato entries and different rates of vermicompost (kg/5m^2)

Total and Computed Yield

Effect of the entry. No significant differences were noted on the total and computed yield of the different potato entries. Numerically however, Gloria produced the highest total and computed yield per hectare.

Effect of the rates of vermicompost. There were significant differences noted between the rates of vermicompost on the total yield per plot. Plants applied with 13 kg/5m^2 gave the heaviest yield. This coincides with the report of Betayan (2009) that increasing the rate of vermicompost improved the growth and yield of potato plants.

Interaction effect. The different potato entries and increasing rates of vermicompost significantly interacted with respect to computed yield per hectare. Gloria applied with 13 kg/5m^2 vermicompost produced the highest computed yield. This result implies that applying 13 kg/5m^2 of vermicompost to Gloria will significantly increase yield.

Table 9. Total and computed yield of three potato entries applied with different rates of vermicompost

TREATMENT	TOTAL YIELD (kg/5m^2)	COMPUTED YIELD (tons/ha)
Factor (A)		
Gloria	9.73	19.46
PHIL 5 .19.2.2	4.89	09.78
CIP 380241.17	6.67	13.34
Factor (B)		
0 kg/5m^2	4.76[d]	9.00
7 kg/5m^2	6.71[c]	13.52
10 kg/5m^2	7.69[b]	16.00
13 kg/5m^2	9.90[a]	19.00
A x B	ns	*
CV (%)	14.95	15.25

For each column, treatment means with different letter are significantly different at 5% probability levels (DMRT)

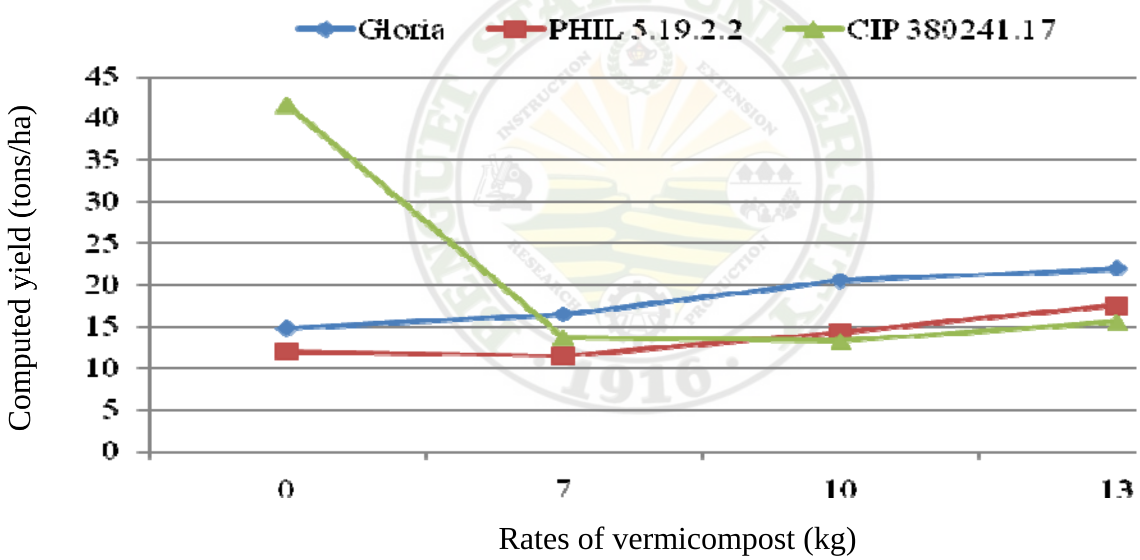

Figure 6. Interaction on the computed yield (tons/ha) of three potato entries applied with different rates of vermicompost.

Tuber dry matter

Effect of the entry. Entry PHIL 5.19.2.2 had the highest dry matter content of 23 % followed by Gloria (21 %) but not significantly different with CIP 380241.17 (Table 10). These results agree with the results of the study conducted at Puguis, La Trinidad wherein PHIL 5.19.2.2 similarly produced the highest percent of dry matter content (Tad-awan *et.al* , 2008).

Effect of the rates of vermicompost. The dry matter accumulation in tubers was found to have a significant difference. The highest dry matter content accumulation was found in potato entries applied with 13 kg/5m^2 vermicompost. The lowest dry matter was recorded in potato entries not applied with vermicompost. This confirms the statement that increasing the level of the vermicompost can promote better dry matter content (Betayan, 2009). Moreover, these results are in agreement with the report that upon increasing the rate of the vermicompost, the tuber dry matter increases (Alam, 2005).

Interaction effect. The interaction effect between the entries and the rates of vermicompost did not show any significance. The ranges of dry matter content of potatoes indicate good processing type. A dry matter content of potato ranging from 20.3 to 22.3 % of dry matter content of potato is preferable for chip possessing (Mosley and Chase, 1993).

Table 10. Dry matter content of three potato entries applied with different rates of vermicompost (%)

TREATMENT	DRY MATTER CONTENT
Factor (A)	
Gloria	21
PHIL 5.19.2.2	23
CIP 380241.17	21
Factor (B)	
0 kg/5m^2	18^c
7 kg/5m^2	21^b
10 kg/5m^2	23^{ab}
13 kg/5m^2	24^a
A x B	ns
CV (%)	9.03

For each column, treatment means with different letter are significantly different at 5% probability levels (DMRT)

Return on Cash Expense

Effect of the entry. The return on cash expense of the potato entries applied with vermicompost is shown in Table 11. Entry Gloria obtained the highest ROCE of 238 % followed by CIP 380241.17 while the lowest (67 %) was obtained from by PHIL 5.19.2.2. The high ROCE of the entries may be attributed to high yield.

Effect of the rates of vermicompost. The return on cash expense of the three potato entries applied with the 7 kg/5m^2 of vermicompost had the highest ROCE of 15 %, followed by 0 kg/5m^2 with 12.5%. Potatoes applied with 10 kg/5m^2 and 13 kg/5m^2 resulted in a negative return of cash expense. The low return on cash expense may be attributed to the high cost of vermicompost.

Table 11. Return on cash expense of three potato entries applied with different rates of vermicompost

TREATMENTS	WEIGHT OF MARKETABLE TUBERS (kg/5m^2)	GROSS INCOME (Php)	COST OF PRODUCTION (Php)	NET PROFIT (Php)	ROCE (%)
Factor (A)					
Gloria	9.00	135.00	40.00	95.00	238.00
PHIL 5.19.2.2	4.00	67.00	40.00	27.00	68.00
CIP 380241.17	6.00	90.00	40.00	50.00	125.00
Factor (B)				.00	
0 kg/5m^2	4.00	45.00	40.00		12.50
7 kg/5m^2	6.00	111.00	96.00	15.00	15.00
10 kg/5m^2	7.00	113.00	120.00	-7.00	-6.19
13 kg/5m^2	9.00	122.00	145.00	-23.00	-18.85

Total cost of production includes planting materials, fertilizer and labor. The tubers were sold at Php 15.00/kg in lump

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The study was conducted at Longlong, La Trinidad, Benguet to identify the best entry and rate of vermicompost on the growth and yield of potato; determine the interaction effect between the potato entries and application of different rates of vermicompost and to determine the economic benefit of growing potato applied with different rates of vermicompost.

The different potato entries were all vigorous and resistant to leaf miner infestation and late blight infection. PHIL 5.19.2.2 had the widest canopy cover at 45, 60 and 75 DAP. Likewise to tallest plant heights at 30 DAP. Results showed that application of 13 kg/5m^2 of vermicompost significantly increased the number of XL marketable tubers, total yield per plot and percent dry matter accumulation.

In terms of the different rates of the vermicompost, plants applied with 13 kg/5m^2 vermicompost had the highest plant survival, highly vigorous plants, tallest plants and widest canopy cover. Furthermore, it significantly had the highest number and weight of marketable tubers, computed yield, and highest tuber dry matter.

Significant interactions were obtained between the potato entries and application of different rates of vermicompost. Results indicate that increasing the rates of vermicompost 13 kg/5m^2 results to high survival, most marketable medium, small and marble-sized tubers of Gloria entry. Entry CIP 380241.17 and application of 13 kg/5m^2 produced the tallest final height and least weight of non-marketable tubers. Application of 13 kg/5m^2 made PHIL 5.19.2.2 resulted in wide widest canopy cover at 45, 60 and 75

DAP and least number of non-marketable tubers. Vermicompost applied at 10 $kg/5m^2$ obtained the least weight of non-marketable tubers.

Conclusions

Among the entries used in the study, Gloria had the highest survival rate, was resistant to late blight and produced the most marketable tubers. It also significantly produced the highest total and computed and highest ROCE (238%).

Among the rates of vermicopost, application of 13 $kg/5m^2$ produced the plants with the highest survival rate, high vigor and resistance to leaf miner and late blight. Furthermore, the plants applied with 13 $kg/5m^2$ produced the highest yield of marketable tubers. However, the plants had the lowest ROCE (-18.85 %) due to the high cost of vermicomost.

In terms of yield, producing Gloria applied with 13 $kg/5m^2$ of vermicompost might be the best combination to increase marketable yield. However, based on ROCE, Gloria applied with 7 $kg/5m^2$ might be the best combination for a positive ROCE.

Recommendations

Based on the results of the study, Gloria is recommended and profitable to grow at Longlong, La Trinidad, Benguet.

Application of 7 $kg/5m^2$ vermicompost is recommended for a high ROCE. Applying 13 $kg/5m^2$ vermicompost is also recommended for high yield and tuber dry mater.

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APPENDICES

Appendix Table 1. Plant survival of potato entries applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	65	55	70	190	63
T2	75	80	60	215	72
T3	90	85	85	98	87
T4	95	100	100	295	98
V2					
T1	85	55	60	200	67
T2	55	65	75	195	65
T3	90	60	80	230	77
T4	90	85	90	265	88
V3					
T1	65	55	60	180	60
T2	80	85	75	240	80
T3	85	90	90	265	88
T4	95	90	100	285	95
TOTAL	902	905	945		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr>F
Replication	2	176.16	89.58	1.27	0.001
Treatment	13	5.9758	445.83	6.31	0.3011
Factor A	2	316.6	25.69	2.24^{ns}	0.1300
Factor B	3	4816.66	158.10	22.73^{**}	0.0001
A x B	6	483.33	1605.55	1.14^{ns}	0.3725
Error	22	1554.16	70		
TOTAL	35	7350			

** = Highly Significant Coefficient of variation (%) = 10.7

ns = Not significant

Appendix Table 2. Plant vigor of potato entries applied with different rates of vemicompost at 30 DAP

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	5	5	4	14	5
T2	5	4	5	14	5
T3	5	5	5	15	5
T4	5	5	5	15	5
V2					
T1	4	5	5	14	5
T2	5	4	5	14	5
T3	5	5	4	14	5
T4	5	5	5	15	5
V3					
T1	5	5	4	14	4
T2	5	4	4	13	5
T3	5	5	4	14	5
T4	5	5	5	15	5
TOTAL	59	57	55	171	5

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.667	0.333			
Factor A	2	0.167	0.083	0.39^{ns}	19.00	99.00
Factor B	3	0.972	0.324	1.53^{ns}	9.55	30.82
A x B	6	0.278	0.046	0.22^{ns}	5.14	10.92
Error	22	4.667	0.212			
TOTAL	35	6.750				

ns = Not significant

Coefficient of variation (%) = 9.70

Appendix Table 3. Plant vigor at 45 DAP of potato entries applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	5	4	3	12	4
T2	4	5	5	14	5
T3	5	4	4	13	4
T4	5	5	5	15	5
V2					
T1	3	4	5	12	4
T2	4	5	5	14	5
T3	4	4	5	13	4
T4	4	5	3	12	4
V3					
T1	5	4	4	13	4
T2	5	4	3	12	4
T3	4	5	4	13	4
T4	5	5	4	14	5
TOTAL	53	54	50	157	4

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.722	0.361			
Factor A	2	0.389	0.194	0.36^{ns}	19.00	99.00
Factor B	3	0.972	0.324	0.60^{ns}	9.55	30.82
A x B	6	2.278	0.380	0.70^{ns}	5.14	10.92
Error	22	11.944	0.543			
TOTAL	35	16.306				

ns = Not significant

Coefficient of variation (%) = 16.90

Appendix Table 4. Initial plant height of potato entries applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	3.79	3.70	3.93	11.42	3.81
T2	4.29	4.38	4.46	13.30	4.38
T3	4.31	4.89	4.93	14.13	4.71
T4	5.16	5.21	5.13	15.50	5.17
V2					
T1	5.16	5.21	5.14	15.51	5.17
T2	4.89	4.73	5.02	14.64	4.88
T3	6.01	5.03	5.42	14.66	5.49
T4	5.68	6.31	5.35	17.52	5.84
V3					
T1	6.27	4.23	4.23	14.73	4.91
T2	4.61	5.14	4.55	14.30	4.76
T3	4.34	4.51	5.30	14.15	4.72
T4	5.13	5.35	5.92	16.40	5.46
TOTAL	59.64	58.69	59.38	176.26	4.94

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.041	0.020			
Factor A	2	3.993	1.997	8.58^{ns}	19.00	99.00
Factor B	3	4.054	1.351	5.81^{ns}	9.55	30.82
A x B	6	1.319	0.220	0.94^{ns}	5.14	10.92
Error	22	5.118	0.233			
TOTAL	35	14.526				

ns = Not significant

Coefficient of variation (%) = 9.77

Appendix Table 5. Final plant height of potato entries applied with different rates of vermicompost

TREATMENTS		REPLICATION		TOTAL	MEAN
	I	III	III		
V1					
T1	60.08	62.10	72.12	194.3	64.77
T2	92.02	90.31	89.29	271.62	90.54
T3	94.51	91.92	88.18	274.61	91.54
T4	93.19	93.50	95.99	282.68	94.23
V2					
T1	77.70	96.68	66.51	240.89	80.30
T2	94.26	96.45	97.58	288.29	96.10
T3	93.65				
		89.82	95.36	278.83	92.94
T4	102.52	94.84	94.39	291.75	97.25
V3					
T1	80.82	81.90	88.27	250.99	83.66
T2	98.70	89.50	99.70	287.9	95.97
T3	98.79	97.02	96.62	292.43	97.48
T4	97.24	95.44	96.96	289.64	96.55
TOTAL	1083.48	1079.48	1080.97	3243.93	90.11

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	2.266	1.133			
Factor A	2	412.128	206.064	6.32^{ns}	19.00	99.00
Factor B	3	2247.254	749.085	23.00*	9.55	30.82
A x B	6	263.791	43.965	1.35^{ns}	5.14	10.92
Error	22	716.502	32.568			
TOTAL	35	3641.941				

* = Significant

ns = Not significant

Coefficient of variation (%) = 6.33

Appendix Table 6. Reactions of three potato entries to leaf miner infestations at 30 DAP applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	5	5	4	14	5
T2	5	5	5	15	5
T3	5	5	5	15	5
T4	4	5	5	14	5
V2					
T1	4	5	5	14	5
T2	5	4	5	14	5
T3	5	4	5	14	5
T4	5	5	4	14	5
V3					
T1	5	4	4	13	4
T2	5	4	4	13	4
T3	5	5	4	14	5
T4	5	5	4	14	5
TOTAL	58	56	54	168	5

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.677	0.333			
Factor A	2	0.677	0.333	1.22^{ns}	19.00	99.00
Factor B	3	0.222	0.074	0.27^{ns}	9.55	30.82
A x B	6	0.444	0.074	0.27^{ns}	5.14	10.92
Error	22	6.000	0.273			
TOTAL	35	8.000				

ns = Not significant

Coefficient of variation (%) = 11.19

Appendix Table 7. Reactions of three potato entries to leaf miner infestations at 45 DAP applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	4	5	4	13	4
T2	5	5	4	14	5
T3	5	5	4	14	5
V2					
T1	4	5	4	13	4
T2	5	5	4	14	5
T3	5	4	5	14	5
T4	5	4	4	13	4
V3					
T1	5	3	4	12	4
T2	5	5	4	14	5
T3	4	5	4	13	4
T4	4	5	4	13	4
TOTAL	55	56	50	161	4

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	1.722	0.861			
Factor A	2	0.399	0.194	0.56^{ns}	19.00	99.00
Factor B	3	0.972	0.324	0.94^{ns}	9.55	30.82
A x B	6	0.278	0.046	0.13^{ns}	5.14	10.92
Error	22	7.611	0.346			
TOTAL	35	10.972				

ns = Not significant

Coefficient of variation (%) = 13.15

Appendix Table 8. Reactions of potato entries to leaf miner infestations at 60 DAP applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	5	4	3	12	4
T2	4	5	4	13	4
T3	5	4	4	13	4
T4	4	5	5	14	5
V2					
T1	3	4	4	11	4
T2	3	4	4	11	4
T3	4	3	4	11	4
T4	4	5	4	13	4
V3					
T1	5	3	4	12	4
T2	4	4	4	12	4
T3	4	3	4	11	4
T4	5	5	4	14	5
TOTAL	50	49	48	147	4

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.167	0.083			
Factor A	2	1.500	0.750	1.67^{ns}	19.00	99.00
Factor B	3	2.750	0.917	2.05^{ns}	9.55	30.82
A x B	6	0.500	0.083	0.19^{ns}	5.14	10.92
Error	22	9.833	0.447			
TOTAL	35	14.750				

ns = Not significant

Coefficient of variation (%) = 16.37

Appendix Table 9. Reactions of three potato entries to late blight infections at 30 DAP applied with vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	1	2	2	4	2
T2	1	1	2	3	1
T3	1	2	1	3	1
T4	1	1	2	3	1
V2					
T1	2	1	1	4	1
T2	1	1	2	4	1
T3	2	1	1	3	1
T4	1	1	1	3	1
V3					
T1	3	2	3	8	3
T2	1	2	2	4	2
T3	1	2	1	3	1
T4	1	1	2	3	1
TOTAL	14	12	15	41	1

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr > F
Replication	2	0.389	0.194	1.00	0.34840
Treatment	13	5.6	0.43	1.31	0.2801
Factor A	2	1.16	0.58	1.75^{ns}	0.1971
Factor B	3	1.88	0.62	1.89^{ns}	0.1610
A x B	6	1.94	0.32	0.97^{ns}	0.4668
Error	22	7.33	0.33		
TOTAL	35	13.0000			

ns = Not significant

Coefficient of variation (%) = 22.10

Appendix Table 10. Reactions of three potato entries to late blight infections at 45 DAP applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	1	2	2	5	2
T2	1	1	2	4	1
T	1	2	1	4	1
T4	1	1	2	4	1
V2					
T1	2	2	1	4	1
T2	1	2	2	4	1
T3	1	1	2	4	1
T4	1	2	1	4	1
V3					
T1	4	3	1	4	1
T2	2	2	2	4	1
T3	1	2	2	4	1
T4	1	1	2	4	1
TOTAL	15	21	21	49	1

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr>F
Replication	2	0.88	0.194	1.26	0.3041
Treatment	13	8.52	0.65	1.86	0.0972
Factor A	2	2.38	1.19	3.38*	0.525
Factor B	3	3.19	1.06	3.01*	0.518
A x B	6	2.05	0.34	0.97*	0.4657
Error	22	7.7	0.35		
TOTAL	35	16.30			

*= significant

Coefficient of variation (%) = 20.19

Appendix Table 11. Reactions of three potato entries to late blight infections at 60 DAP applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	2	3	3	8	3
T2	2	1	3	6	2
T3	2	3	1	7	2
T4	2	2	2	6	2
V2					
T1	3	2	2	7	2
T2	2	2	2	7	2
T3	3	1	1	6	2
T4	2	2	1	6	3
V3					
T1	3	5	2	12	4
T2	2	2	3	7	2
T3	2	3	1	6	2
T4	3	2	3	8	3
TOTAL	26	30	28		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr>F
Replication	2	0.16	0. 83	0.17	0.84
Treatment	13	10.25	0.78	1.65	0.14
Factor A	2	3.16	1.58	3.32*	0.0551
Factor B	3	4.08	1.36	2.85^{ns}	0.0606
A x B	6	2.83	0.47	0.99^{ns}	0.45
Error	22	10.50	0.47		
TOTAL	35	20.75			

*= significant
ns = Not significant

Coefficient of variation (%) = 26.90

Appendix Table 12. Canopy cover of three potato entries at 30 DAP applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	12	11	14	51	17
T2	15	18	17	50	17
T3	18	19	16	53	18
T4	20	19	18	57	19
V2					
T1	14	21	14	49	16
T2	18	18	11	47	16
T3	12	15	20	47	16
T4	20	16	18	57	18
V3					
T1	20	16	17	53	18
T2	18	14	13	45	14
T3	13	12	19	43	15
T4	12	15	20	47	16
TOTAL	192	194	197		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr>F
Replication	2	1.05	0.52	0.06	0.94
Treatment	13	106.64	8.20	0.88	0.5824
Factor A	2	3.55	1.77	0.19 ns	0.5824
Factor B	3	23.63	7.87	0.85 ns	0.8276
A x B	6	78.44	13.07	1.40 ns	0.48
Error	22	204.94	9.31		0. 25
TOTAL	35	311.63			

ns = Not significant   Coefficient of variation (%) = 18.4

Appendix Table 13. Canopy cover of three potato entries at 45 DAP applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	35	28	30	93	31
T2	33	38	39	110	37
T3	46	35	32	100	33
T4	43	35	45	123	41
V2					
T1	40	32	39	192	31
T2	33	45	41	119	40
T3	41	35	48	124	41
T4	49	38	42	129	43
V3					
T1	38	30	28	96	32
T2	31	39	33	103	34
T3	40	32	39	111	37
T4	0	42	41	113	38
TOTAL	451	402	457		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr>F
Replication	2	34.66	17.33		0.5125
Treatment	13	495.41	38.10	1.52	1.888
Factor A	2	182.0	91.00	6.62*	0.0438
Factor B	3	237.41	79.13	3. 15*	0.0455
A x B	6	41.33	6.88	0.27*	0.9432
Error	22	553.33	25.15		
TOTAL	35	1048.750			

*= Significant

Coefficient of variation (%) = 13.52

Appendix Table 14. Canopy cover of three potato entries at 60 DAP applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	1	11	111		
V1					
T1	39	41	35	115	38
T2	48	44	36	128	43
T3	53	61	51	165	55
T4	55	63	53	171	57
V2					
T1	56	46	55	157	52
T2	60	55	75	190	63
T3	71	64	63	198	66
T4	72	76	83	231	77
V3					
T1	53	58	55	166	55
T2	71	49	58	178	59
T3	65	76	45	186	62
T4	77	73	70	220	73
TOTAL	720	706	679		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr>F
Replication	2	72.38	36.19	0.62	0.54
		4196.69	322.82	5.52	0.002
Factor A	2	1909.05	954.52	16.33**	0.0001
Factor B	3	2043.19	681.064	11.65**	0.0001
A x B	6	172.055	28.67	0.49*	0.8084
Error	22	1286.27	58.46		
TOTAL	35	5482.97			

** = highly significant
*= significant

Coefficient of variation (%) = 13.07

Appendix Table 15. Canopy cover of three potato entries at 75 DAP applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	1	11	111		
V1					
T1	33	35	22	90	30
T2	41	54	31	126	42
T3	38	43	40	121	40
T4	50	39	44	133	44
V2					
T1	36	42	51	129	43
T2	39	53	59	146	49
T3	53	45	41	138	46
T4	64	54	38	156	52
V3					
T1	28	45	37	110	37
T2	42	25	48	115	38
T3	48	38	33	119	40
T4	55	57	43	155	52
TOTAL	527	530	446		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr>F
Replication	2	69.05	48.02	0.61	0.5547
Treatment	13	1514.27	116.48	1.47	0.2066
Factor A	2	490.05	245.02	3.09^{ns}	0.065
Factor B	3	744.22	248.07	343*	0.0464
A x B	6	183.94	30.65	0.39^{ns}	0.8797
Error	22	1745.27	79.33		
TOTAL	35	3259.55			

* = Significant

ns = Not significant

Coefficient of variation (%) = 20.76

Appendix Table 16. Number of marketable extra large tubers applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	1	11	111		
V1					
T1	2	1	2	5	2
T2	2	2	2	6	2
T3	2	3	3	8	3
T4	2	3	4	9	3
V2					
T1	1	1	1	3	1
T2	1	2	2	5	2
T3	3	2	2	7	3
T4	2	4	2	9	4
V3					
T1	3	2	2	7	3
T2	5	2	1	8	3
T3	3	1	5	9	3
T4	2	4	7	13	4
TOTAL	29	17	33		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr>F
Replication	2	0.055	0.027	0.09	0.9121
Treatment	13	7.69	0.59	1.97	0.0778
Factor A	2	0.055	0.027	0.09^{ns}	0.9121
Factor B	3	6.797	2.32	7.73**	0.0001
A x B	6	0.61	0.101	1.13^{ns}	0.9088
Error	22	12.30	0.300		
TOTAL	35	107.030			

**=Highly significant
ns=not significant

Coefficient of Variation (%) = 15.1

Appendix Table 17. Number of marketable large tubers applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	1	11	111		
V1					
T1	5	3	3	11	4
T2	3	4	5	12	4
T3	4	3	6	13	4
T4	2	5	3	15	5
V2					
T1	1	1	2	5	2
T2	3	2	5	10	3
T3	4	5	3	12	4
T4	4	3	4	11	4
V3					
T1	3	1	3	7	2
T2	3	3	3	9	3
T3	6	3	3	12	4
T4	7	4	2	13	5
TOTAL	43	37	39		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr>F
				1.62	
Replication	2	2.05	1.02		0.2203
Treatment	13	15.02	1.15	1.82	0.1035
Factor A	2	0.22	0.11	0.18^{ns}	0.8404
Factor B	3	15.52	4.17	6.59**	0.0024
A x B	6	0.22	0.37	0.06^{ns}	00.9990
Error	22	13.94	0.63		
TOTAL	35	28.97			

**=Highly significant
ns=not significant

Coefficient of Variation (%) = 16.8

Appendix Table 18. Number of marketable medium tubers applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	1	11	111		
V1					
T1	6	4	5	15	5
T2	9	7	5	21	7
T3	10	5	3	18	6
T4	8	12	9	29	10
V2					
T1	2	4	3	9	3
T2	2	6	3	11	4
T3	6	8	8	22	7
T4	5	9	9	23	8
V3					
T1	4	2	5	11	4
T2	4	5	6	15	5
T3	7	4	6	17	6
T4	7	90	3	19	6
TOTAL	70	75	65	40	

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr>F
Replication	2	9.38	4.69	0.96	0.3995
Treatment	13	190.61	14.66	2.99	0.0115
Factor A	2	57.05	28.52	5.81*	0.0004
Factor B	3	104.11	34.703	7.07*	0.0017
A x B	6	20.05	3. 34	8.46**	0.0001
Error	22	107.94	4.90		
TOTAL	35	298.55			

**= Highly significant

* = Significant

Coefficient of variation (%) = 8.45

Appendix Table 19. Number of marketable small tubers per plot applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	1	11	111		
V1					
T1	10	9	7	26	9
T2	6	8	9	22	7
T3	9	10	7	27	9
T4	13	11	10	34	11
V2					
T1	6	5	8	18	6
T2	7	6	4	16	5
T3	3	7	3	13	4
T4	4	6	9	19	6
V3					
T1	6	3	5	13	4
T2	5	5	2	12	4
T3	3	7	5	15	5
T4	7	3	6	14	5
TOTAL	77	80	75		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr>F
Replication	2	5.0555	2.5277	2.23	0.1313
Treatment	13	34.644	2.6688	2.35	0.0371
Factor A	2	10.055	5.0277	4.43*	0.0241
Factor B	3	0.1944	3.0648	2.70*	0.0012
A x B	6	10.3888	1.7314	1.53*	0.0021
Error	22	24.9444	1.1338		
TOTAL	35	59.6388			

* = Significant Coefficient of variation (%) =6.28

Appendix Table 20. Number of marketable marble sized tubers applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	1	11	111		
V1					
T1	6	3	3	12	4
T2	5	6	4	14	5
T3	6	4	3	13	5
T4	7	4	6	16	5
V2					
T1	4	3	2	9	3
T2	2	5	4	11	4
T3	4	5	2	11	4
T4	7	4	2	13	4
V3					
T1	2	2	3	7	2
T2	4	2	1	7	2
T3	3	2	2	7	2
T4	4	3	3	11	4
TOTAL	46	30	35		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr>F
Replication	2	0.166	0.0833	0.02	0.9795
Treatment	13	48.2500	3.7115	0.92	0.5466
Factor A	2	22.166	11.0833	2.76*	0.0855
Factor B	3	20.3055	6.76851	1.68*	0.0018
A x B	6	5.611	0.9351	1.23*	0.0014
Error	22	88.500	4.0227		
TOTAL	35	136.7500			

* = Significant

Coefficient of variation (%) = 28.14

Appendix Table 21. Total number of marketable tubers applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	29	20	19	68	23
T2	25	27	25	77	26
T3	31	25	26	82	27
T4	32	35	34	101	34
V2					
T1	14	14	16	44	15
T2	15	21	19	55	18
T3	20	27	18	65	22
T4	23	26	26	75	25
V3					
T1	18	15	18	51	17
T2	21	17	13	51	17
T3	22	17	20	59	20
T4	25	23	15	63	21
TOTAL	257	267	224		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	29.55555	14.7776	2	3.44	5.72
Treatment	13	933.6388	84.8762	8	2.26	3.18
Factor A	2	526.7222	263.3611	24	3.44^{ns}	5.72
Factor B	3	354.9722	188.3240	11	3.05*	4.82
A x B	6	51.94444	8.65740	1	2.55^{ns}	3.76
Error	22	237.7778	10.8080			
TOTAL	35	1200.972				

* = Highly Significant — Coefficient of variation (%) = 14.96
ns = Not significant

Appendix Table 22. Number of non- marketable tubers applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	1	11	111		
V1					
T1	9	9	10	28	9
T2	5	7	3	15	5
T3	9	10	18	27	9
T4	3	5	4	12	4
V2					
T1	4	7	6	17	6
T2	2	5	4	11	4
T3	6	3	2	11	4
T4	4	2	7	13	4
V3					
T1	8	10	8	26	9
T2	9	7	3	19	6
T3	8	4	7	19	6
T4	5	3	4	12	4
TOTAL	72	72	76	210	70

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	Pr>F
Replication	2	0.888	0.444	0.08	0.9227
Treatment	13	244.444	18.8034	3.42	0.0055
Factor A	2	67.555	33.7777	6.14**	0.0076
Factor B	3	91.5555	30.5185	5.54**	0.0055
A x B	6	84.4444	14.0740	2.56*	0.0495
Error	22	121.111	5.5050		
TOTAL	35	365.5556			

** = Highly Significant

*= Significant

Coefficient of variation (%) = 38.39

Appendix Table 23. Total weight of marketable tubers applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	1.50	1.90	1.30	5	2
T2	2.58	1.98	1.30	8	3
T3	3.50	2.92	3.83	10	3
T4	3.51	3.11	4.01	11	4
V2					
T1	1.05	1.25	1.23	4	1
T2	1.20	1.09	1.30	4	1
T3	2.30	1.95	2.00	6	2
T4	1.80	1.00	1.50	4	1
V3					
T1	1.90	1.29	1.50	4	1
T2	2.30	2.56	1.30	7.5	3
T3	1.68	0.90	2.50	6.3	1
T4	2.77	2.80	3.53	8	3
TOTAL	26.09	33	24		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	2.738	1.369			
Factor A	2	42.030	21.015	21.84*	19.00	99.00
Factor B	3	34.237	11.412	11.86*	9.55	30.82
A x B	6	6.859	1.143	1.19*	5.14	10.92
Error	22	21.166	0.962			
TOTAL	35	107.030				

* = Significant

Coefficient of variation (%) = 14.25

Appendix Table 24. Weight of non-marketable tubers applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	0.500	0.700	0.900	2.100	0.700
T2	0.300	0.400	0.840	1.540	0.513
T3	1.000	0.400	0.980	2.380	0.793
T4	0.950	0.900	1.000	2.850	0.950
V2					
T1	0.800	1.000	0.900	2.700	0.900
T2	0.800	0.800	1.100	2.700	0.900
T3	0.430	0.590	1.200	2.220	0.740
T4	0.900	1.300	0.900	3.100	1.033
V3					
T1	0.450	0.630	1.000	2.080	0.693
T2	1.000	0.900	0.300	2.200	0.733
T3	0.150	1.000	0.520	1.670	0.557
T4	0.510	1.300	0.350	2.160	0.720
TOTAL	7.790	9.920	9.990	27.700	0.769

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.261	0.130			
Factor A	2	0.300	0.150	1.60^{ns}	19.00	99.00
Factor B	3	0.230	0.077	0.82^{ns}	9.55	30.82
A x B	6	0.259	0.043	0.46^{ns}	5.14	10.92
Error	22	2.063	0.094			
TOTAL	35	3.113				

ns = Not significant

Coefficient of variation (%) = 21.10

Appendix Table 25. Total yield per $5m^2$ of potato entries applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1T1	2	2.6	2.2	6	2.36
T2	2.8	2.38	2.14	9	3.18
T3	4.5	3.3	4.81	11	4.12
T4	4.4	4	5.01	13	4.6
V2	1.8	1.25	1.13		
T1				3	2.06
T2	2.1	1.89	2.4	4	2.03
T3	2.7	2.54	3.2	6	2.74
T4	2.7	2.3	2.40	6	2.4
V3	2.35	1.92	2.30		
T1				6.08	2.02
T2	3.3	2.46	2.8	7.2	3.23
T3	2.83	1.9	4.02	7.97	2.65
T4	3.28	4.1	2.88	10.16	3.33
TOTAL	24.32	26.50	29.00	56.94	32.12

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	2.022	1.011			
Factor A	2	39.928	19.964	15.23^{ns}	19.00	99.00
Factor B	3	37.728	12.576	9.59*	9.55	30.82
A x B	6	8.510	1.418	1.08^{ns}	5.14	10.92
Error	22	28.843	1.311			
TOTAL	35	117.032				

* = Significant

^{ns} = Not significant

Coefficient of variation (%) = 14.95

Appendix Table 26. Computed yield (tons/ha) of potato entries applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	14.8	15.0	14.4	44.2	14.73
T2	16.2	16.8	16.28	49.28	16.43
T3	21.0	19.2	21.16	61.36	20.45
T4	18.9	24.0	22.8	65.7	21.90
V2					
T1	11.6	11.8	12.6	36	12.00
T2	10.0	11.6	12.8	34.4	11.47
T3	13.46	12.98	16.4	42.84	14.28
T4	17.4	21.0	14.2	52.6	17.53
V3					
T1	15.7	9.66	12.6	37.96	12.64
T2	16.6	13.0	11.4	41	13.67
T3	13.3	15.8	10.64	39.74	13.25
T4	16.42	19.0	11.12	46.54	15.51
TOTAL	185.38	189.84	176.4	551.62	15.32

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	9.111	4.556			
Factor A	2	162.015	81.007	14.89^{ns}	19.00	99.00
Factor B	3	146.151	48.717	8.95^{ns}	9.55	30.82
A x B	6	33.622	5.604	1.03^{ns}	5.14	10.92
Error	22	119.669	5.440			
TOTAL	35	470.569				

ns = Not significant

Coefficient of variation (%) = 15.25

Appendix Table 27. Dry matter content of potato entries applied with different rates of vermicompost

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	III	III		
V1					
T1	18	18	20	56	19
T2	21	20	20	61	20
T3	25	21	21	67	22
T4	22	25	24	71	24
V2					
T1	18	18	19	55	18
T2	24	25	22	71	24
T3	20	26	25	71	24
T4	24	25	26	75	25
V3	20				
T1		18	17	55	18
T2	18	23	19	60	20
T3	23	22	23	68	23
T4	21	20	26	67	22
TOTAL	254	261	262	777	22

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	3.167	1.583			
Factor A	2	22.167	11.083	2.92^{ns}	19.00	99.00
Factor B	3	143.639	47.880	12.62*	9.55	30.82
A x B	6	16.278	2.713	0.71^{ns}	5.14	10.92
Error	22	83.500	3.795			
TOTAL	35	268.750				

* = Significant
ns = Not significant

Coefficient of variation (%) = 11.26