BIBLIOGRAPHY

DONITA K. SIMONGO MAY 2007. *Growth, yield and dry matter partitioning of potato genotypes under organic production at La Trinidad, Benguet*. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted to determine the assimilates partitioning in potato leaves, stems, roots, stolons and tubers during the different stages of development; compare the efficiency of potato genotypes in terms of dry matter partitioning under organic production, and determine the best time of harvesting potatoes for optimum dry matter accumulation.

Seven potato genotypes grown under organic production were evaluated from November 2006 to February 2007 at La Trinidad, Benguet, and the following were found:

Genotypes 96-06, 13.1.1 and 5.19.2.2 were the best performers in terms of survival, vigor, canopy cover, leaf area index, net assimilation rate and crop growth rate.

Assimilates partitioned into leaves, stems, roots, stolons and tubers at 45, 60, 75 and 90 DAP differed among genotypes and at different stages of development. Among the plant organs, the roots and stolons had the highest dry matter contents in genotype 5.19.2.2 at 45, 60 and 75 DAP. However, dry matter contents of roots, stolons, tubers and harvest index were not affected by temperature, rainfall, sunshine duration and light intensities, for all the genotypes tested. Assimilates partitioned in tubers increased in most of the genotypes at 75 DAP and decreased at 90 DAP except in genotypes 96-06 and 5.19.2.2.

Genotypes 5.19.2.2, 13.1.1 and 96-06 had the highest total yield of 4.57, 4.21 kg. and 4.13 kg, respectively and computed marketable yields with respective means of 6.33, 5.46 and 5.92 tons/ha.

Genotype 573275 was highly resistant to leaf miner, cv. Ganza was intermediate and 13.1.1, 5.19.2.2, 676089 and 96-06 were moderately resistant. Genotypes 5.19.2.2, 573275, 96-06 and 13.1.1 were resistant to late blight. Cultivar Granola was susceptible to leaf miner and late blight.

Correlation analysis revealed positive significant correlations in: plant vigor with light intensity in genotypes 96-06, 573275, and Ganza; dry matter content of leaves with sunshine duration in Granola; dry matter content of stems with rainfall in genotype 96-06 and with maximum temperature in genotype 573275. Significant negative correlations were observed in: canopy cover with maximum temperature in genotype 96-06; crop growth rate with rainfall in genotypes 13.1.1 and 5.19.2.2; and leaf area index with minimum temperature. No significant correlation was observed in temperature, relative humidity, rainfall, sunshine duration and light intensity with dry matter content of roots, stolons, tubers and harvest indices in all the genotypes.

Among the characters, positive correlations in canopy cover with harvest index and in net assimilation rate with extra large tubers were observed. Highly significant positive correlations were observed between net assimilation rate and crop growth rate.

While several of the data gathered are conclusive, it is recommended that further studies maybe done to verify and confirm the results, particularly in other locations and seasons.

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INTRODUCTION

Background of the Study

The Potato, which is locally known as "patatas" or "papas", is one of the major crops in the Philippine highlands. Potatoes are grown mainly in the cool, high altitude areas with well-distributed rainfall. The most suitable elevation is between 1,500 to 2,500 masl (Haluschak, *et al.* 2001). It grows best with temperatures ranging from 17 to 22^{o}C and a soil temperature of 15 to 18 ^{o}C. Average relative humidity requirement is 86% (Horton, 1987). Potatoes grow well on a wide variety of soils. However, the ideal soil for potatoes is deep, well drained, and friable.

In the Philippines, the major potato production area is concentrated in high elevations with a temperature below 21 ^{o}C. This temperature is suitable for growth and development of quality potato tubers. The major potato producing municipalities of Benguet Province are Atok, Bakun, Buguias, Kabayan, Kibungan and Mankayan and Bauko, Mountain Province (Gayao, *et al*. 1999). The potato growing areas are usually in slightly rolling terrains and most of the growing areas like Kibungan, Mankayan and Bauko Mountain Province are rain - fed.

Potatoes are usually grown using conventional practices such as the use of inorganic fertilizers and chemical pesticides. In the highlands, potatoes are one of the most chemically sprayed crops. According to Ganga *et al.* (1995) and Gayao *et al.* (1999), fungicide control constitutes about 12% of the total production cost and this may go higher when susceptible cultivars are planted during rainy seasons. Excessive amounts of potentially hazardous chemicals are clearly undesirable in a foodstuff, particularly when it is widely consumed in comparatively large quantities, and limits of concentration may be prescribed by the FAO/WHO or by national legislation. Adequate monitoring of residues of such chemicals is however, difficult (Burton 1989).

An alternative to conventional production is the use of organic products. Organic potato production prohibits the use of synthetic chemicals, fertilizers, pesticide, growth regulators, or genetically modified varieties. Delanoy, *et al*. (2003) reported that the key to successful production of potatoes without the use of synthetic pest control products is prevention and nutritional health.

Significance of the Study

Potatoes are an important crop in the Philippine highlands and farmers grow this conventionally. The heavy use of fertilizers and pesticides cause problems such as soil depletion and recurrence of new pest and diseases. Growing potatoes organically may help the soil restore its nutrients and recurrence of pest and diseases may be reduced, and predators used will not be destroyed. As a result, there would be sound environment, safe potatoes for food, and higher income for farmers.

As in other production systems, organic potato production may require varieties which, have efficient dry matter accumulation and resistant to pests and diseases. Horton (1981) reported that dry matter production per hectare is a more meaningful yardstick for comparing crops, regardless of their use for feed, starch, or alcohol. Measures of edible energy and protein production per hectare are more appropriate indicators of the nutritional yield of crops consumed by humans. In terms of dry matter production per hectare, potatoes are among the most productive crops grown in the developing countries. Production of dry matter, edible protein, and monetary value may be used to measure the total production of food crops.

Dry matter content varies considerably between varieties and is a strongly inherited characteristic. Irrespective of cultural conditions that may affect dry matter certain varieties are consistently high in dry matter, while others are consistently low (Toolangi, 1996).

Growers must understand how to manipulate the growth of the leaf and root system of the potato crop so that radiation interception may be maximized and efficiency maintained. Tuber yield vary between seasons and between fields within seasons. Photosynthesis could be described as the process of dry matter production combined to produce glucose – sucrose – starch (Burke, 2003).

Potato plant dry matter and partitioning patterns into various part of the plant are important to fine tune management practices that optimize tuber production (Kanzikwera, *et al*, 2001).

The Objectives of the Study were to:

1. Determine the assimilates partitioning in potato leaves, stems, roots, stolons and tubers during the different stages of development;
2. Compare the efficiency of potato genotypes in terms of dry matter partitioning under organic production; and
3. Determine the best time of harvesting potatoes for optimum dry matter accumulation.

Time and Place of Study:

The field trial was conducted at Balili, La Trinidad from November 2006 to February 2007 and dry matter analysis of samples was done at the Semi-temperate Vegetable Research Development Center, BSU laboratory from March to April 2007.

REVIEW OF LITERATURE

Growth and Development of Potato

The growth of a potato plant occurs in several stages: sprout development, plant establishment, tuber initiation, tuber bulking and tuber maturation. Timing of these growth stages varies depending upon environmental factors, such as elevation and temperature, soil type, availability of moisture, cultivar selected and geographic location (Dwelle and Love, 2006).

Achieving tuber maturity is complicated. As tubers grow, develop and mature, a peak in dry matter production occurs. A minimum amount of sugar is achieved shortly thereafter. This stage is considered physiological maturity and is an indicator of when to start vine-kill and harvest (Dias, 2006). In cassava early growth is characterized by development of shoot and fibrous root and assimilate allocation changes from shoot to root with crop age (Akparobi, *et. al.* 2002).

Furthermore, Dar (1981) reported that the tuber of the potato is basically considered as a part of its stems for food storage and reproduction. The so-called root system of the plant is an extension of the stem. Stolons emerge in the subterranean portion of the stem from the axis of scale leaves and they carry adventitious root system and end in the tuber. Therefore, the potato tubers may be regarded as enlarged stolons. Also, the skins of the tubers have several lenticels and these are considered as the stomates of the tubers.

Three periods can be distinguished in the potato's growth cycle: pre-emergence/emergence, foliage growth, and tuber growth. Foliage growth and tuber growth may overlap for a considerable time especially in late-maturing varieties. Stems grow from the sprouts of the seed tuber. After stems emerge from the soil, foliage and roots develop simultaneously and their growth is correlated. Tubers generally start growing slowly about 2 to 4 weeks after emergence and continue growing at a fairly steady rate (Horton, 1987).

Balaki (1981) stated that the leaf is responsible in the production of CHO to be used for tuber growth. The same report put forward that the desired leaf area index for potato ranged from 3 to 3.5 at the bulking stage.

Burke (2003) reported that tuber yield is determined by (i) the amount of photosynthetically active radiation intercepted by the canopy (ii) the efficiency with which this radiation is converted to dry matter and (iii) the proportion of accumulated dry matter partitioned to the tubers. Each of the forgoing steps may be influenced by the grower and an understanding of their contribution to tuber yield may help explain variation in yield observed between varieties, between growing seasons and between fields within a growing season.

According to Dias (2006) achieving tuber maturity is complicated. As tuber grows, develop and mature, a peak in dry matter production occurs. A minimum amount of sugar is achieved shortly thereafter. This is important because high dry matter and low sugar content are important for processing. This stage is considered physiological maturity and is an indicator of when to start vine-kill and harvest.

Physiology of the Potato Crop

Burton (1989) reported that physiological behavior is used as an aid in classification rather than in identification, although the time when sprouting starts, and the rate of sprout growth, though varying from year to year and with the origin of the tubers, may be used to distinguish between the tubers of some varieties. The response to photoperiod may vary considerably, and is a major point of difference between *S. tuberosum* sub sp. tuberosum and *S. tuberosum* sub sp. Andigena. It may underlie a number of physiological differences such as time of maturity.

The economic yield of any crop is a function of the amount of light energy absorbed by the green foliage, the efficiency of the foliage to use the energy captured for biomass production, and the partitioning of the crop biomass to the harvested plant part. Because potatoes has one of the highest harvest indices of major crops and there may be little potential for significant shifts in total biomass accumulation, genotypes with potential for significant shifts in total biomass accumulation, genotypes with superior net photosynthesis will likely be needed for further yield improvement Flyn *et. al.* (1998) as cited by Schittenhelm *et. al*. (2004).

Environmental Requirements of Potatoes

The potato crop is grown mainly in the cool, high altitude areas with well-distributed rainfall. The most suitable elevation is between 1,500 meters to 2,500 meters above sea level (Haluschak, *et. al*. 2001). The potato grows best with temperatures ranging from 17 to 22^{o}C and with average relative humidity requirement of 86%. Soil temperatures of 15 to 18 ^{o}C appear to be the most favorable for common potato varieties (Horton, 1987).

Burton (1966) reported that temperature influences the rate of both photosynthesis and respiration, and the net effect of an increase in temperature might range from increase to a marked decrease in yield of dry matter. The same report further said that an optimum temperature for tuber formation and growth in most potato varieties is about 15^{o}C to 20^{o}C. Engel and Raeuber (1981) likewise found that the maximum temperature during the day is 20^{o}C and 14^{o}C during the night, and Bodlaender (1963) stated that the potato requires different temperature regimes for different stages of growth. High temperature appears to stimulate plant growth but is unfavorable for leaf expansion. The maximum leaf weight may be produced at 12^{o}C to 14^{o}C. Furthermore Hartmann *et. al.* as cited by Chong *et. al* (2000) reported that temperature is the single most important factor in the regulation of the timing of germination, because of its role in dormancy control and/or release, or climatic adaptation.

It has been cited that potatoes are affected by the differences in temperature, Anon (2006). It was stated by the same source that tuberization occurs earlier at lower temperatures, approximately 3 to 5 weeks earlier than those in longer, warmer days. The optimal temperature for tuberization is 55°F, the process decreases above 70°F and with certain cultivars, may stop at 85°F was also cited by the same source. Furthermore Winkler (1969) reported that, in general optimum conditions for high potato yields are average leaf temperature of 17 to 18 °C and average maximum air temperature of 20 to 23 °C. Likewise Bodlaender (1963) stated that optimum temperature for stem elongation was found to be 18 °C.

As reported by Yamachugi (1964) the soil temperature can affect tuber development. He found that stem emergence was rapid at 21°C to 24°C and the optimum soil temperature for tuber formation was between 15°C to 24°C. At 26°C to 29°C, tubers developed are misshapen and often, several tubers formed single stolons. Malik and Dwelle stated further that plants accumulated more total dry matter under cool soil (15 and 19 °C) temperatures than under hot soil (30 °C) conditions. Soil properties, Toolangi (1996) revealed that soil pH is generally not regarded as having a direct effect on dry matter but can affect total dry matter per hectare by its effect on yield.

High evaporative demand caused by low relative humidity, high solar radiation, and/or high wind speed can also reduce photosynthesis. Prolonged periods with overcast skies can reduce light intensity to levels below that required for maximum dry matter production (Stark *et. al*. 2003). Likewise Beukema and Vander Zaag (1979) stated that light used for assimilation depends on the light available (light intensity and daylength) and the light intensity intercepted by the green leaves.

The optimal photoperiod for potato yields depends upon temperature and cultivar, such that Andigena cultivars fail to tuberize unless they have received short days (Simmonds 1964). Furthermore Marique (undated), reported that the shorter the photoperiod, the greater the percentage of plant biomass that is partitioned to tuberosum cultivars, especially those that are early maturing, which may perform poorly under cool tropical conditions because tuber induction is excessively strong. The same report claims that the result of excessively strong induction is that haulm and root growth are so restricted by the strong partitioning of dry matter to tubers that the leaf area is too small to support good tuber yields.

Cooper and Fox (1996) stated that the relative performance of genotypes changes across environments, thus most breeding programs conduct multi-environment trials to evaluate genotypic adaptation over a sample of environments from the target population.

Dry Matter Accumulation

According to Horton (1987) the length of a potato variety's growth cycle is influenced by environmental conditions, so that a variety that is late under one set of growing conditions can be early under another. Likewise DPI (2006) and Toolangi (1996) reported that dry matter content varies considerably between varieties and is a strongly inherited characteristic. As reported, irrespective of cultural condition that can affect dry matter certain varieties are consistently high in dry matter, while others are consistently low.

According to Kanzikwera *et. al.* (2001) potato plant dry matter and partitioning pattern into various parts of the plant are important to fine tune management practices that optimize tuber production. The same source stated that dry matter production per hectare is a more meaningful yardstick for comparing crops, regardless of their use for feed, starch, or alcohol, and measures of edible energy and protein production per hectare are more appropriate indicators of the nutritional yield of crops consumed by humans. In terms of dry matter production per hectare, potatoes are among the most productive crops grown in the developing countries; and production of dry matter, edible protein, and monetary value can be used to measure the total production of food crops (Horton, 1987).

Two useful terms used to describe partitioning of dry matter by plants are biological yield and economic yield. The term biological yield was proposed by Nichiporovich (1960) to represent the total dry matter accumulation of a plant's system. Economic yield and agricultural yield have been used to refer to the volume or weight of those plant organs that constitute the product of economic or agricultural value. The proportion of biological yield represented by economic yield has been called harvest index, the coefficient of effectiveness, or the migration coefficient (Gardner, *et al*, 1985).

Initially, dry matter is divided between stems and leaves (growth stage II). In the second phase, which starts at tuber initiation, an increasing amount of accumulated dry matter is allocated to the tubers and decreasing fraction to leaves (growth stages III and IV). In the third phase all assimilates are allocated to the tubers (growth stage V) (Pereira and Shock, 2008).

Organic Production

Organic production is designed to work with natural processes to conserve resources, encourage self-regulation through diversity, and minimize waste and environmental impact, while preserving farm profitability. Such systems aim to produce food that is nutritious and uncontaminated with substances that could harm human health (Edward-Jones and Howells, 2000).

Organically grown crops produce consistently tests product higher than non-organically grown foods for vitamins, minerals, and other micronutrients, as well as showing much smaller amounts of nitrates, heavy metals and other contaminants. One of the main reasons for this nutritional discrepancy is that organic soil is much richer in minerals and micronutrients than non-organic soil (Anon, 2005).

The various source further stated that plants grown on healthy soil are less susceptible to pests and so; the need for pest eradication is reduced. Chemical-based agriculture however, begins with soil which is already nutrient depleted; that plants grown on depleted soil are weaker and more prone to disease and pests, so more chemicals are needed every year.

An ample supply of decaying organic matter helps to keep the soil loose and mellow and thus reduces soil compaction. Potato tubers develop and maintain normal shape better in loose, well-aerated soils. Organic matter facilitates plowing and cultivating; it enables roots of potato plants to penetrate the soil more readily, and it improves water retention; it provides food energy for the growth of desirable soil micro-organisms and supplies plant nutrients (Anon, 2006).

Components of Organic Production

Use of Organic Fertilizers

Horton (1987) reported that organic fertilizer improves the soil structure and increase the moisture retention capacity. Davis and Wilson (2002) likewise stated that the application of organic soil amendments increase soil organic matter content and offer many benefits such as: it improves soil aeration, root infiltration and both water and nutrient holding capacities and act as organic fertilizer, and pants that absorb the nutrients in the soil can tolerate damage caused by soil pathogens.

The importance of organic matter are: source of nutrients; improves CEC of the soil-high CEC protects available and exchangeable cation from leaching;

source of humus; decomposition products such as organic acids help dissolve minerals and insoluble phosphates and it improves water-holding porosity, aeration and aggregation of the soil, thus improving soil environment for normal root growth (Balaki, 1981).

On the other hand, according to the Philippine Council for Agricultural Resources Research and Development (PCARRD, 1982), the literal application of soil organic fertilizers supply an amount of nutrient requirements of the granulation, and easy root penetration. On the other hand, Korva and Varis (1990); Haraldsen *et al*. (2000) as cited by Delden (2001) reported that smaller arable crop yields in organic farming systems compared with those from conventional practices have been attributed to a mismatch between N supply and demand. Thus, in organic farming, the limited amounts of available N require more effective distribution among the various crops optimizes farm results.

It has been reported that: Potash and phosphorous will need to be provided in the form of composted farmyard manure; that if this is not available from an organic source then it can be brought in and composted on the farm for a period of three months prior to use. And that depending on the natural fertility of the soil manure is generally spread at a rate of 30 - 35 t/ha (Western Potato Council, 2003).

Diversity in crop production. The farm should have sufficient crop diversity in time and/or space that takes into account pressures from insect, weeds, diseases and other pests while maintaining or increasing soil organic matter, soil fertility, microbial activity and general soil health (Anon, 2003).

Choice of crops and varieties. Species and varieties cultivated should, as far as possible, be adapted to the soil and climatic conditions and should be resistant to pests and diseases; and that all seeds and plant materials used should be from certified organic produce or from the same farm (Anon, 2003).

MATERIALS AND METHODS

Treatments

Seven potato genotypes selected from previous evaluations under organic production were grown at Balili La Trinidad with an elevation of 1,300 m asl.

Planting Material Preparation

The planting materials from the seven potato genotypes were secured from Cabutotan, Bakun where organic production practices were followed.

The Farm

The land used was transitioned to organic production four years ago. Rotations of crops such as beans, potato, and beans were practiced. The land was fallowed for at least three months before the cropping season from March to October. Corn was planted on the borders of the farm to serve as barrier while marigold was planted in between beds to serve as pest repellants.

Land Preparation

The area was first cleared of weeds and prepared using a tractor. Plots were prepared measuring 1m wide x 5m long.

Organic Fertilizer Application and Planting

Compost at a rate of 10kg/5m^2 was evenly incorporated with the soil one month before planting.

Sprouted tuberlets of the different potato genotypes and cultivars were used as planting materials. Forty seed tubers of each genotype and culitvar were planted at a distance of 30 cm between hills and 20 cm between rows.

Cultural Management Practices Employed

Irrigation was done twice a week using a water pump with hose. Pests and diseases were controlled through the integration of mixed cropping, planting of repellant crops such as marigold, use of yellow traps and application of bio-fungicide (*Bacillus subtilis*).

Experimental Design and Treatments

The experiment was laid out following the randomized complete block design (RCBD) with three replications. Each block was subdivided into 7 plots measuring 1m x 5m. The use of the term cultivar (cultivated variety) or cv. In short is appropriate, technologically.

Treatment	Genotype Code/Cultivar	Source
V1	13.1.1	CIP, Peru
V2	96-06	CIP, Peru
V3	573275	CIP, Peru
V4	5.19.2.2	Philippines
V5	676089	CIP, Peru

V6	Ganza	CIP, Peru
V7	Granola	Germany

Data Gathered:

Destructive sampling was done at 30, 45, 60, 75 days after planting (DAP) to obtain the dry mass of the leaves, stems, roots, stolons and tubers. Plate 1 shows the different genotypes at 60 DAP.

Meteorological Data

Meteorological data such as air temperature, relative humidity, rainfall amount and sunshine duration was taken at the BSU-PAG-ASA records. Light intensity was taken weekly using the light intensity meter.

Soil Analysis

Soil samples were obtained before and after planting and brought to the Soils Laboratory at Pacdal, Baguio City for analysis.

A. Growth Parameters

1. Percent Survival. Percent survival was taken at 30 DAP by counting the number of plants that survived and computed using the formula:

$$\% \text{ Survival} = \frac{\text{No of plants that survived}}{\text{Total no. of plants planted}} \times 100$$

2. <u>Plant Vigor</u>. This was recorded at 30, 45, and 60 (DAP) using the following rating scale by Palomar and Sanico, 1994.

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

3. <u>Canopy Cover.</u> A hand - made grid with a wooden frame and a threaded wire was used. A marker was placed at the center of four sample plants at random per replication, and then the grid was placed against the marker. Canopy cover was taken at 30, 45, 60 and 75 DAP.

4. <u>Leaf Area Index (LAI).</u> The leaf area of two sample plants was collected at 45, 60 and 75 dap. Two green leaves from the lower, middle and upper parts were considered from the sample plants using the Tracing Technique method by Saupe (2006). This compares a paper replica of the surface to be measured to a standard of known area.

$$\text{Leaf area (mm}^2\text{)} = \text{weight of leaf tracing (g) x conversion factor (mm}^2\text{ gm}^{-1}\text{)}$$

$$\text{Leaf area Index (LAI)} = \frac{\text{Leaf area (mm}^2\text{)}}{\text{Ground area (mm}^2\text{)}}$$

Note: The leaf area was determined by multiplying the leaf area per leaf to the total number of leaves per plant.

5. Net Assimilation Rate (NAR). This is the dry matter accumulation rate per unit of leaf area per unit of time and was taken following the formula by Fitter and Hay, 1981:

$$\text{NAR g / m}^{-2}\text{/d} = \frac{\ln W_2 - \ln W_1 \text{ x (La)}}{T_2 - T_1}$$

Where:

L_A = Leaf area

W = Weight

T = Time (days)

6. Crop Growth Rate. This was computed following the formula by Gardner, 1985:

$$\text{CGR} = \text{(NAR) x (LAI)}$$

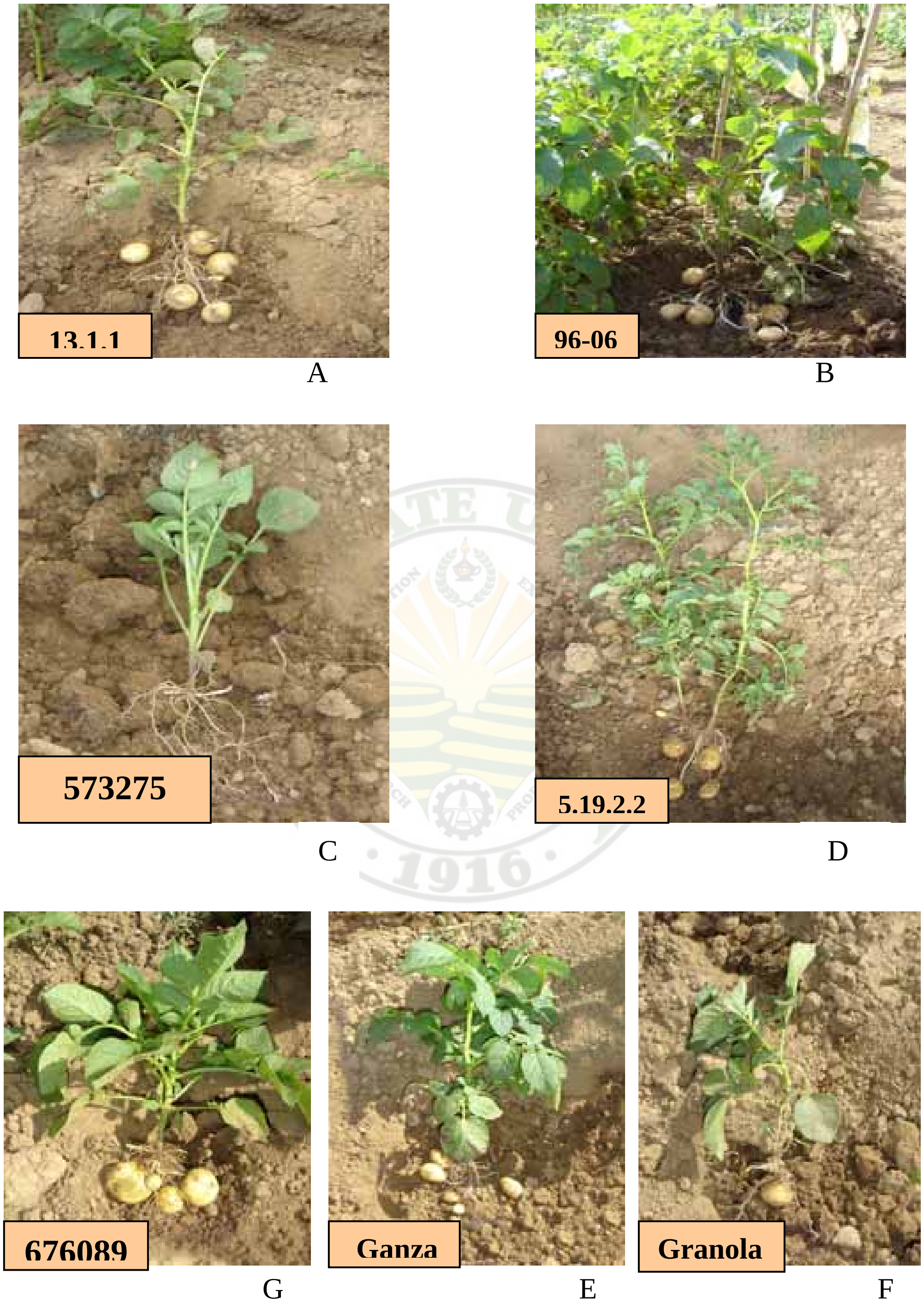

Plate 1. The genotypes and cultivars sampled at 60 DAP.

B. Yield and Yield Components

1. Tuber Yield Parameters

a. Number and weight of marketable tubers per plot (kg). All tubers of marketable quality (small, medium, extra and large) were counted and weighed.

b. Number and weight of non-marketable tubers per plot (kg). These were the tubers that are malformed, damaged by insects and diseases and those with more than 10% greening.

c. Total yield per plot. This is the sum of weight of marketable and non-marketable tubers per plot.

d. Computed yield (t/ha). This was computed following the formula.

$$\text{Yield (kg)} = \frac{\text{Total marketable yield/plot x } 10{,}000 \text{ m}^2}{5\text{m}^2}$$

$$\text{Yield (tons/ha)} = \frac{\text{Yield (kg)}}{1000}$$

C. Dry Matter Parameters

At 45, 60, and 75 DAP, destructive sampling was done to determine the dry matter partitioned in the leaves, stems, roots, stolons and tubers. Samples of the leaves, stems, roots, stolons and tubers were separated and weighed, packed in brown paper bag labeled properly and placed in the oven just after arriving from the field to the laboratory. The oven was set at 80^{o}C. After 56 hours the dry weight was taken.

1. % Dry Matter Content of Leaves, Stems, Roots, Stolons and Tubers.

Plate 2 presents the procedure in determining the dry matter of the different genotypes and cultivars.

Dry matter content of the leaves, stems, roots, stolons and tubers were obtained by the following formula:

$$\%DMC = 100 - MC$$

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

2. Harvest Index (%)

Harvest Index is the ratio of the economic yield to biological yield, which is expressed as:

$$\%\,HI = \frac{TDW}{LDW + SDW + RSDW} \times 100$$

Where:
TDW = Tuber dry weight
RSDW = root and stolons dry weight
LDW = leaf dry weight
SDW = Stem dry weight

Separation of leaves, stems, roots, stolons and tubers

Slicing of potato tubers into cubes

Weighing of potato tubers

Weighing of potato leaves

Weighing of potato stems

Oven drying of the leaves, stems, roots, stolons and tubers

Plate 2. Procedure in dry matter determination of the different genotypes and cultivars.

D. Other Data

1. Leaf Miner Incidence

The appearance of insect pest was observed during the growth stage of the plant using the following scale (CIP, 2001):

SCALE	DESCRIPTION
1	No apparent injury
2	Injury confined to youngest leaves
3	Some older leaves exhibiting injury
4	Over 50 % of the leaves injured
5	Over 90 % of the leaves injured

2. Late Blight Infection

Late blight was observed during the growth stage of the plant at 60 and 75 DAP using the CIP rating scale (Henfling, 1987):

CIP scale value	Blight (%)		Symptoms
	Mean	limit	
1	0		No late blight observable
2	2.5	Traces -< 5	Late blight present. Maximum 10 lesions per plant
3	10	5 -< 15	Plants look healthy, but lesions are easily seen at closer distance. Maximum foliage area affected by lesions or destroyed corresponds to no more than 20 leaflets.
4	25	15 -< 35	Late blight easily seen on most plants. About 25% of foliages is covered with lesions or destroyed.
5	50	35 -< 65	Plot looks green; however, all plants are affected. Lower leaves are dead. About half the foliage area is destroyed.
6	75	65 -< 85	Plots look green with brown flecks. About 75% of each plant is affected. Leaves of the lower half of plants are destroyed.
7	90	85 -< 95	Plot neither predominantly green nor brown. Only top leaves are green. Many stems have large lesions.
8	97.5	95 -< 100	Plot is brown-colored. A few top leaves still have some green areas. Most stems have lesions or are dead.
9	100		All leaves and stems dead.

The description of symptoms is based on plants with 4 stems and 10 to 12 leaves per stem.

Analysis of Data

The data was analyzed through analysis of variance in RCBD except for leaf miner and late blight. Significance among treatment means was analyzed using the Duncan's multiple Range Test (DMRT). Correlation analysis was also done.

According to Amid (2005), the degree of relationship between two variables can be measured using the Pearson product moment correlation coefficient (R) which characterizes the independence of X and Y. The coefficient R is a parameter, which can be estimated from sample data using the formula:

$$R = \frac{N\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{[n\,\Sigma x^{2} - (\Sigma x)^{2}]\,[n\,(\Sigma y\,) - (\Sigma y)^{2]}}}$$

RESULTS AND DISCUSSION

Meteorological Data

The minimum and maximum air temperature during the study period ranged from 12.6 to 15.6 ^{o}C and 23.5 to 24.2 ^{o}C, respectively while relative humidity ranged from 77 to 80 % (Table 1). Horton (1987) stressed that potato grows best with temperature ranging from 17 to 22 ^{o}C and with an average relative humidity of 86%. Temperature and relative humidity during the conduct of the study were observed to be appropriate for potato production. A very little rainfall of 2.5, 2.4 and 0.05 mm was recorded in November, December and January, respectively. Sunshine duration in the month of November, December and January was low ranging from 386.6 to 381.4 mm as compared to the sunshine duration in February, which is 521.6 mm (Table 1). Light intensity was observed to be low from November to January with December having the lowest light intensity of 45.1 Klux while February had the highest light intensity with 76.4 Klux.

Table 1. Meteorological data from November 2006 to February 2007.

MONTH	AIR TEMP. (^oC) MIN	AIR TEMP. (^oC) MAX	RELATIVE HUMIDITY (%)	RAIN-FALL AMT. (mm)	SUNSHINE DURATION (mm)	LIGHT INTENS-ITY[*] (Klux)
Nov.	15.2	23.5	80	2.5	381.4	57.2
Dec.	15.6	24.2	78	2.4	387.0	45.1
Jan.	13.9	23.9	77	0.03	386.6	58.9
Feb.	12.6	23.6	77	0	521.6	76.4

Soil Analysis Before Planting and After Harvesting

Results of the analysis revealed that soil pH before planting was 6.72 and slightly decreased to 6.31 after harvest (Table 2). Organic matter, phosphorus, potassium and nitrogen increased. The increase in the organic matter, phosphorus, potassium and nitrogen was probably due to the application of compost hilled-up at 30 DAP. Smilde (undated) reported that the decomposing humus is a slow-release source of nutrients to plants and carbon to microorganisms. The same report stated that crops with shallow root system like potatoes might absorb only the partially released nutrients from the fertilizer applied. Furthermore, Colting (1981) pointed out the following: that organic residues with narrow C:N ratio (i. e. legumes), take longer time to decompose. That, long term benefits are derived from fully decomposed residues with wide C:N ratio. That organic matter with C:N ratio higher than 30 usually immobilizes

N at the earlier stage of decomposition. Examples of C:N ratios used in the Colting report were: cereal straw (C:N ratio = 80); green manure (C:N ratio = 20); stable organic matter (C:N ratio = 110-120).

Table 2. Soil analysis before planting and after harvesting.

SOIL PROPERTY	BEFORE PLANTING	AFTER HARVEST
PH	6.72	6.31
Organic matter (%)	2.50	4.50
Nitrogen	0.13	0.23
Phosphorus (ppm)	90	140
Potassium (ppm)	312	341

Plant Survival

Table 3 shows significant differences on the percent plant survival among the seven genotypes evaluated at 30 DAP. Genotype 13.1.1 significantly had the highest plant survival of 98 % followed by 5.19.2.2 with plant survival of 97 %. The rest of the genotypes had plant survivals ranging from 30 to 85 %. The variability of the plant survival rate as found in the study was mainly affected by their sprouting ability as exhibited by their genetic characteristics affected by the environmental factors prevailing during the conduct of the trial.

Table 3. Percent survival of seven potato genotypes grown at La Trinidad under organic production.

GENOTYPE	PLANT SURVIVAL (%)
13.1.1	98^{a}
96-06	85^{a}
573275	30^{b}
5.19.2.2	97^{a}
676089	75^{a}
GANZA	74^{a}
GRANOLA	50^{b}
CV (%)	17.73

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

Plant Vigor

The plant vigor at 30, 45, and 60 DAP of the seven genotypes is shown in Table 4. Genotypes 13.1.1 and 5.19.2.2 significantly exhibited highly vigorous growth at 30, 45, and 60 DAP. Genotype 573275 had moderate vigor at 30 DAP but recovered at 45 and 60 DAP. Cultivar Granola had moderate vigor rates at 30 and 45 DAP and less vigorous at 60 DAP. The variation on plant vigor among the genotypes evaluated may be due to their genetic characteristics as affected by the environmental factor prevailing during the study period.

Table 4. Plant vigor of seven potato genotypes Grown at La Trinidad under organic production.

GENOTYPE	PLANT VIGOR		
	30 DAP	45 DAP	60 DAP
13.1.1	5^a	5^a	5^a
96-06	4^b	5^a	5^a
573275	3^c	4^b	4^b
5.19.2.2	5^a	5^a	5^a
676089	4^b	4^b	5^a
GANZA	4^b	5^a	5^a
GRANOLA	3^c	3^c	2^c
CV (%)	8.82	6.50	6.50

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

Rating Scale:

5 = Highly vigorous
4 = Moderately vigorous
3 = Vigorous
2 = Less vigorous
1 = Poor vigor

Canopy Cover

Significant differences on the canopy cover at 30, 45, 60 and 75 DAP was observed among the seven genotypes (Figure 1).

All the genotypes showed an increasing canopy cover from 30 to 60 DAP but decreased at 75 DAP. Genotype 96-06 significantly had the highest canopy cover followed by genotypes 5.19.2.2 and 13.1.1. At 60 DAP genotype 5.19.2.2 significantly had the highest canopy cover followed by that of 96-06 and 13.1.1. Cultivar Granola had the lowest canopy cover at 30 up to 60 DAP. The canopy cover differed among genotypes, which may be attributed by their inherent characteristics. Amer and Hatfield (2004) reported that the peak of leaf area is chiefly influenced by variety, fertilizer and planting date.

One of the environmental factors that affected the vegetative growth may be light intensity. The light intensity was low from November to February ranging from 57.2 to 58.9 Klux and increased to 76.4 Klux from the month of January. This conforms with the report of Dar (1981) that at lower light intensities, haulm growth is stimulated and tuber growth is delayed. Furthermore, the same author put forward that some of the genotypes started to senesce while others was early attacked with leaf miner, thus the lower leaves fall of resulting to lower canopy. Amer and Hatfield (2004) also reported that leaf area decreased during the maturity stage because of senescing leaves in the lower part of the canopy.

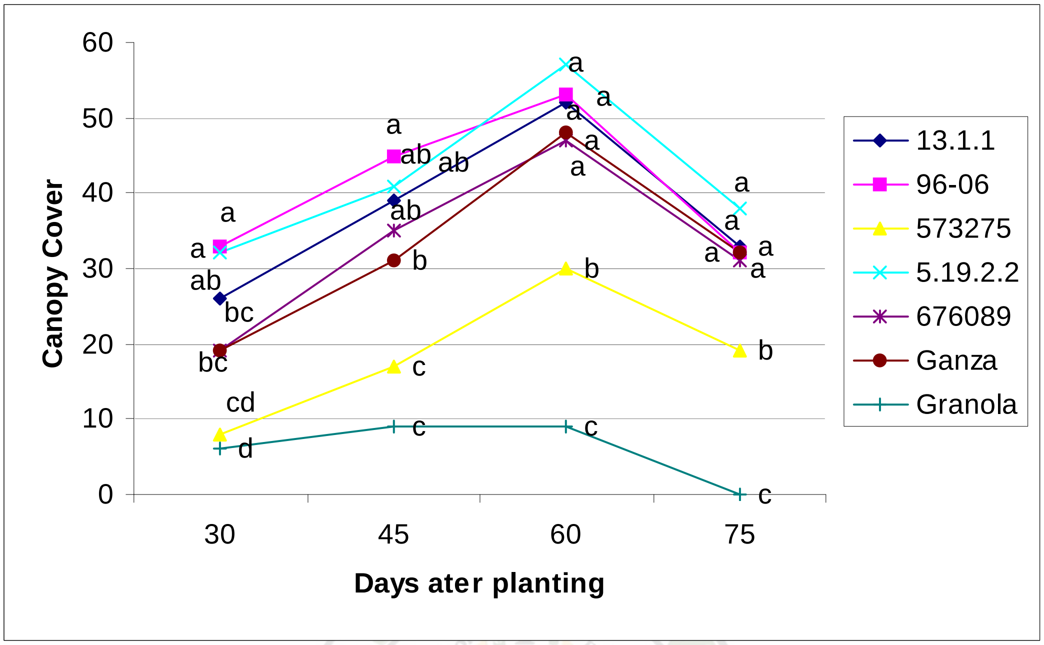

Figure 1. Canopy cover of seven potato genotypes grown at La Trinidad under organic production.

Leaf Area Index

All the genotypes had increased in their leaf area indices at 60 DAP but at 75 DAP, some genotypes of which had decreased while the others increased (Figure 2).

Genotype 5.19.2.2 significantly had the highest leaf area index at 45 DAP followed by genotypes 96-06 and 13.1.1 while genotypes 573275 and cv. Granola had the lowest leaf area indices. At 65 DAP all the genotypes increased in their leaf area indices with genotype 5.19.2.2 showing the significantly highest followed by 96-06 and 697089, while cv. Granola had the lowest leaf area index.

Genotypes 5.19.2.2, 676089, 573275 and cv. Ganza showed an increasing leaf area indices at 75 DAP while genotypes 96-06, 13.1.1 and cv. Granola had a decreased leaf area index at 75 DAP (Figure 2). The decrease in the leaf area indices was possibly due to the falling down of leaves. The falling of leaves during the study was due to the leaf miner infestation and senescence. Amer and Hatfield, (2004) reported that leaf area decreased at maturity stage because of senescing leaves in the lower part of the canopy. However in the case of cv. Granola decrease in leaf area index at 75 DAP was observe to be caused by leaf miner infestation and late blight infection.

Significant variability of leaf area index among the genotypes evaluated may be attributed to their genetic characteristics as influenced by these factors and other factors such as insect and disease infection.

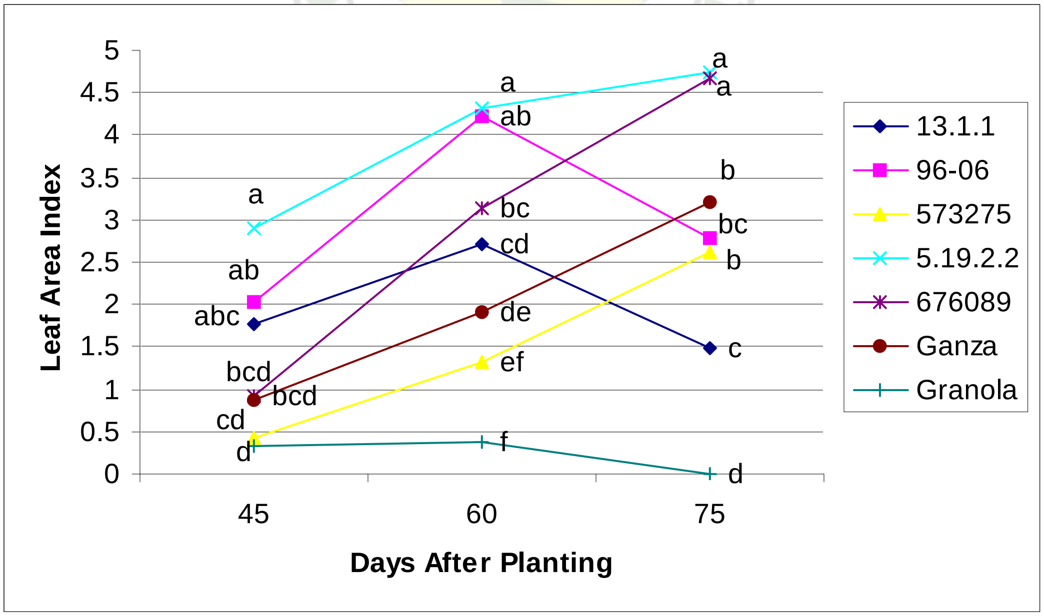

Figure 2. Leaf area index of seven potato genotypes grown at La Trinidad under organic production.

Net Assimilation Rate (NAR)

Net assimilation rate or the dry matter accumulation rate per unit leaf area is one of the useful parameters on growth analysis, which influence the increase in plant weight per unit area of assimilatory tissue (usually leaf area: A_L) per unit of time (Fitter and Hay, 1981).

Net assimilation rate of the seven genotypes at 45, 60 and 75 DAP are presented in Figure 3. On the other hand, results showed no significant differences among the genotypes on their net assimilation rate at 45 and 75 DAP. Also, statistical analyses showed significant differences on the net assimilation rates of all the genotypes tested at 60 DAP.

All the genotypes showed an increasing net assimilation rate at 60 DAP except for cultivar Granola. Genotype 5.19.2.2 significantly had the highest net assimilation rate at 45 up to 75 DAP. Genotypes 676089 had the second highest net assimilation rate at 60 DAP followed by genotypes 96-06 and cv. Ganza. At 75 DAP, it was observed that genotypes 676089, 96-06, 573275 and 13.1.1 increased in their net assimilation rate except for cultivars Ganza and Granola. Results showed that genotypes 676089, 96-06, 573275 and 13.1.1 had an increased dry weight accumulation per unit area of assimilatory per unit of time. The increase in the net assimilates may be due to the biological dry biomass or economic dry biomass of genotypes. The increased or decreased net assimilation rate among the genotypes tested may have been affected mainly by their inherent characteristic.

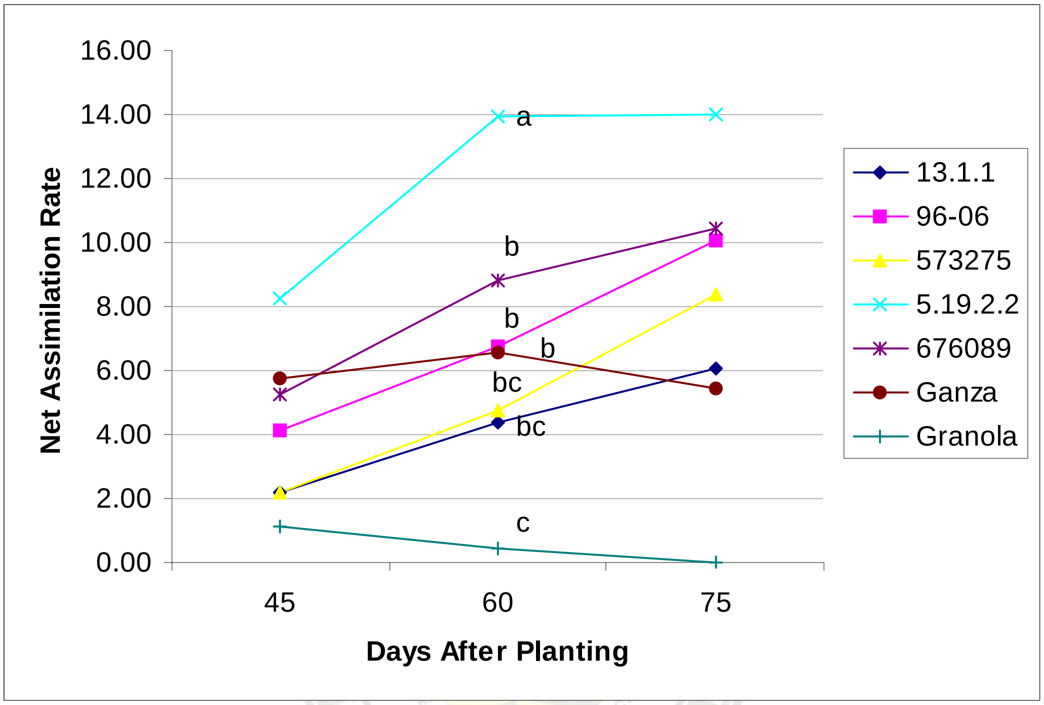

Figure 3. Net assimilation rate of seven potato genotypes grown at La Trinidad under organic production.

Crop Growth Rate

The crop growth rates of different genotypes evaluated during the study are shown in Figure 4. Crop growth rate is the dry matter accumulation percent of land area per unit of time (Gardner *et. al*. 1985).

Figure 4 showed an increasing crop growth rates from all the genotypes at 60 DAP except in cv. Granola. Genotype 5.19.2.2 significantly had the highest crop growth rate at 45 to 65 DAP while cv. Granola was the lowest. At 75 DAP genotype 676089 significantly increased in its growth rate while genotypes

573275 and cv. Ganza had little increase. On the other hand, Genotypes 5.19.2.2, 96-06 and 13.1.1 showed decreasing growth rates, which indicate that these genotypes had attained their maturity period. On the other hand, genotypes 676089 and 573275 were still accumulating dry matter, which indicate that these genotypes had longer period of maturity.

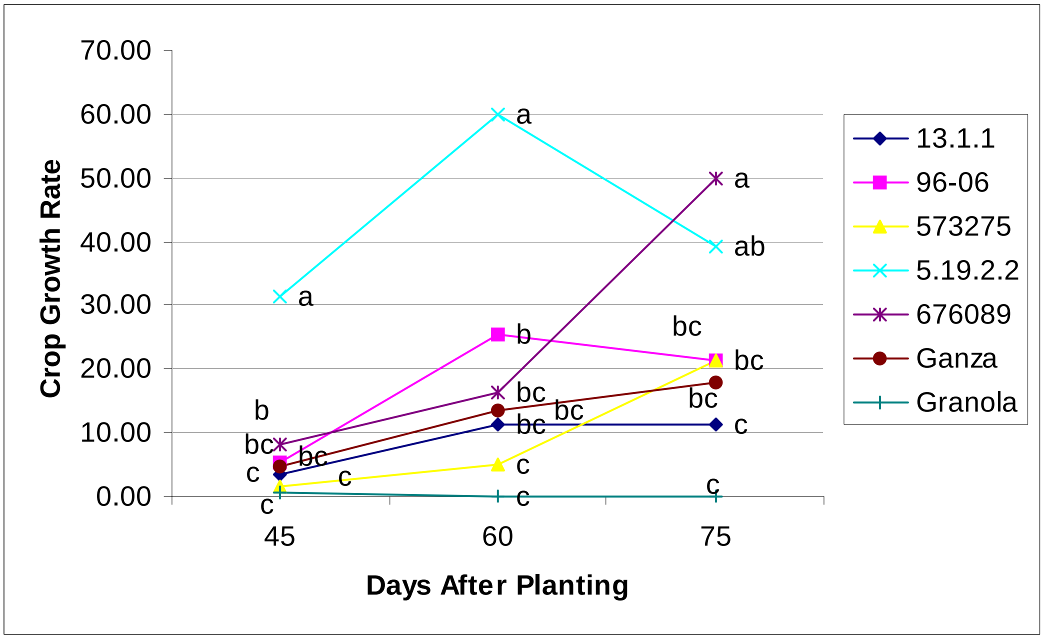

Figure 4. Crop growth rate of seven potato genotypes grown at La Trinidad under organic production.

Yield Components

At harvest, the yield was classified according to sizes as prescribed. The classified tubers were counted, weighed and recorded. Extra large tubers had an average weight of 100 to 150 g, large tubers had an average weight of 50 to 99 g, medium tubers had an average weight of 26 to 49 g, small tuber had an average weight of 10 to 25 g and marble tubers had an average weight of 3 to 9 g. Non-marketable tubers are the smallest size, rotten, and had more than 10% damage and greening.

Number of Marketable Tubers According to Size/Plot

Extra Large Tubers. Table 5 shows the number of marketable tubers according to size per plot of the seven genotypes evaluated. Significant differences were observed among the treatments on the number of extra large tubers. Genotype 13.1.1 significantly produced the most tubers while cv. Granola produced no extra large tubers. The rest of the extra large tubers ranged from 4 to 7.

Large Tubers. The genotypes significantly differed in their mean number of large tubers (Table 5). Genotype 13.1.1 significantly produced the most tubers 32. Cultivars Ganza and Granola, produced 6 and 0 tubers, respectively. The rest of the genotypes produced 11 to 14 large tubers.

Medium Tubers. No significant differences were observed among the treatment means on the number of medium tubers (Table 5). Genotype 13.1.1 produced the highest number of medium tubers with 41 while cv. Granola had no medium tubers (Table 5).

Small Tubers. The number of small tubers was significantly different among the seven genotypes evaluated (Table 5). Genotype 13.1.1 significantly produced the highest number of small tubers (26) while cultivar Granola had the least (5). The rest of the entries produced numbers of small tubers ranging from 8 to 17.

Non-marketable Tubers

Table 5 shows the number of non-marketable tubers of the different genotypes evaluated. Among the genotypes evaluated, no significant differences were noted on the number of non-marketable tubers.

Table 5. Number of marketable (extra large, large, medium, small and marble) and non Marketable tubers of seven potato genotypes grown at La Trinidad under organic production.

GENOTYPE	NUMBER OF MARKETABLE TUBERS					NUMBER OF NON-MARKETABLE TUBERS
	Extra-large	Large	Medium	Small	Marble	
13.1.1	10^{a}	32^{a}	41	26^{a}	26	19
96-06	7^{ab}	14^{b}	29	17^{ab}	19	31
573275	4^{bc}	11^{bc}	25	8^{b}	7	18
5.19.2.2	7^{ab}	14^{b}	30	14^{b}	23	17
676089	4^{bc}	11^{bc}	28	11^{b}	12	22
GANZA	6^{ab}	12^{bc}	17	14^{b}	15	21
GRANOLA	0^{c}	0^{c}	0	5^{b}	4	11
CV (%)	26.32	20.95	27.28	17.07	25.66	28.45

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

Weight of Marketable Tubers According to Size/Plot

Extra Large Tubers. Table 6 shows the weight of tubers. The genotypes evaluated significantly differed in their mean weights of extra large tubers. Genotype 5.19.2.2 significantly outranked the cultivars Ganza and Granola with weights of 0.83, 0.47 and 0 kg, respectively. The rest of the genotypes produced weights ranging from 0.32 to 0.65 kg.

Large Tubers. Significant differences among treatment means of the genotypes evaluated produced large tuber weights (Table 6). Genotype 13.1.1 significantly had the highest tuber weight of 1.52 kg followed by genotype 5.19.2.2 (1.05 kg). The cultivar Granola had no large tuber. The rest of the genotypes had weights ranging from 0.63 to 0.84 kg.

Medium Tubers. Statistical analysis showed significant differences among the medium mean weights of the seven genotypes (Table 6). Genotype 5.19.2.2 significantly had the highest mean weight of 1.39 followed by 96-06, 676089 and 13.1.1 with mean weights of 1.29, 1.27 and 1.22 kg, respectively. The least was produced by genotype 573275 with mean weight of 0.59 kg while cv. Granola had no medium tubers.

Small Tubers. Table 6 showed no significant differences among the treatment means of small weight tubers. The tubers weighed from 0.04 to 1.04 kg.

Marble Tubers. Mean weights of marble tubers revealed no significant differences among treatment means of the genotypes evaluated (Table 6).

Non-marketable Tubers

Table 6 shows the weight of non-marketable tubers of the different genotypes evaluated. Among the genotypes evaluated, no significant differences were noted on the weight of non-marketable tubers.

Table 6. Weight of marketable (extra large, large, medium, small and marble) and non-marketable tubers of seven potato genotypes grown at La Trinidad under organic production.

GENOTYPE	WEIGHT OF MARKETABLE TUBERS					WEIGHT OF NON-MARKETABLE TUBERS
	Extra-large	Large	Medium	Small	Marble	
13.1.1	0.65^{ab}	1.52^{a}	1.22^{a}	0.42	0.35	0.09
96-06	0.65^{ab}	0.84^{b}	1.29^{a}	1.04	0.27	0.12
573275	0.33^{b}	0.59^{bc}	0.29^{b}	0.20	0.07	0.123
5.19.2.2	0.83^{a}	1.05^{ab}	1.39^{a}	0.79	0.4	0.05
676089	0.32^{b}	0.63^{b}	1.27^{a}	0.7	0.1	0.07
GANZA	0.47^{b}	0.69^{b}	0.61^{ab}	0.7	0.16	0.08
GRANOLA	0^{c}	0^{c}	0^{b}	0.04	0.03	0.03
CV (%)	8.93	12.97	16.56	22.17	16.32	4.95

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

Total Yield

The mean total yield of the seven genotypes evaluated at La Trinidad, Benguet under organic production are shown in Table 7, while Plate number 3 shows tubers harvested from the different genotypes and cultivars. Significant differences were observed among the genotypes evaluated. Genotype 5.19.2.2 significantly produced the highest total mean yield of 4.57 kg followed by genotypes 96-06 and 13.1.1 with respective mean total weights of 4.21 and 4.13 kg. The rest of the genotypes produced yield ranging from 0.067 to 2.67 kg. Results showed low mean yields. This may be attributed to the growth performance of the genotypes affected by environmental factors. Ivins and Bremner, (1964) pointed out that to attain high yield in the tropics, a fast bulking rate and longer bulking period are necessary. Earlier results showed that the leaf area indices of the genotypes evaluated were lower and higher than the desired leaf area index of potato, which ranged from 3 to 3.5 at the tuber bulking stage. According to Kleinkopt, *et al* (2007) canopies with leaf area indices greater than 3 to 3.5 are limited by sunlight duration and will not have greater bulking rates than crops with normal range of leaf area index. Cultivar Granola was the lowest yielder among the genotypes. This may be attributed to its slow growth as shown by its low canopy cover, leaf area index, net assimilation rate and crop growth rate. The same genotype was also attacked with leaf miner and with late blight as early as 60 DAP which increased rapidly causing early senesce. This shows that cultivar Granola may not be adapted for organic production.

Plate 3. Tubers harvested from the potato genotypes and cultivars.

Computed Marketable Yield

The computed yield in t/ha (Table 7) of the seven genotypes evaluated at La Trinidad under organic production. Significant variations on the computed mean yield among the genotypes evaluated were observed.

Genotype 5.19.2.2 significantly had the highest computed marketable mean yield of 6.33 tons/ha followed by genotypes 13.1.1 and 96-06 with computed marketable mean yields of 5.72 and 5.46 tons/ha, respectively. The three genotypes significantly outyielded the check cultivars Ganza and Granola. The high yielding genotypes were observed to have developed wider canopies as early as 30 DAP and this continued to increase at 60 DAP but slightly decreased at 75 DAP. The low yielding genotypes had low canopy covers at 30 DAP which slowly developed at 75 DAP. Cultivar Granola produced few small leaves and thin stems, thus, solar radiation was limited resulting to decreased photosynthesis, thus, lesser assimilates diverted into the tubers. This genotype was also infected by leaf miner as early as 45 DAP and by late blight at 60 DAP which resulted to its early senesce. As reported by Dwelle and Love (2006), larger canopy intercept higher solar radiation, which increased photosynthesis diverting more assimilates into the tubers during bulking stage resulting to higher yield.

Results showed that genotypes 5.19.2.2, 96-06, and 13.1.1 significantly produced the highest yield of 6.33, 5.92 and 5.46 tons/ha, respectively. Though the yield was low, these genotypes were the most adapted under organic production at La Trinidad condition. According to Molitas (2005) the usual yield of potato per hectare in the highlands ranged from 20 - 25 t/ha under conventional production. The low yield obtained under organic production may be attributed with the slow growth of the plants as shown by low canopy, leaf area index, net assimilation rate and crop growth rate. As reported by Burton (1979), assimilation rates of crops may reach an optimal of 100% if the total soil surface is covered with green leaves. Likewise, Monteith (1979) stressed that crop growth rates should be proportional to the rate of photosynthesis, which depends on the amount of intercepted solar radiation by foliage. The low yield may also be attributed to the transitional state of the farm used in the study. According to Anon (2003), the establishment of an organic management system and building of soil fertility requires an interim period, the conversion period. The same report put forward that general rule indicates that the first two complete years of cultivation under control will be considered in transition or in conversion. During this stage, a decrease in yield is expected.

Table 7. Total yield and computed yield of seven potato genotypes grown at La Trinidad under organic production.

GENOTYPE	TOTAL YIELD/PLOT (kg)	COMPUTED YIELD (tons/ha)
13.1.1	4.13^{a}	5.92^{a}
96-06	4.21^{a}	5.46^{ab}
573275	1.54^{b}	2.72^{c}
5.19.2.2	4.57^{a}	6.33^{a}
676089	2.67^{b}	4.28^{abc}
GANZA	2.47^{b}	3.42^{bc}
GRANOLA	0.067^{c}	0.11^{d}
CV (%)	26.70	29.13

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

Dry Matter Contents of Leaves, Stems, Root, stolons and Tubers of the Seven Potato Genotypes at 45, 60, 75 and 90DAP

Dry matter partitioning in leaves, stems, roots, stolons and tubers of seven genotypes at 45, DAP is presented in Figure 5.

At 45 DAP, the roots and stolons had the highest dry matter partitioned in genotypes 5.19.2.2, 13.1.1, 676089 and 96-06 (Figure 5). The tubers partitioned the second highest dry matter in genotypes 5.19.2.2, 96-06 and 13.1.1. The stems partitioned had the lowest in genotypes 573275 and 96-06 followed by the dry matter partitioned into the leaves in genotypes 573275 and 676089.

At 60 DAP, the same trend was exhibited from all the genotypes (Fig. 6). The dry matter partitioned into the different organs varied among the genotypes. Dry matter accumulation into the different organs of the potato plants may be attributed to the genetic characteristics of the genotypes. According to Devlin and Witham (1983), the leaves nearest the root translocated metabolites primarily to the roots. Photosynthate moving out of the leaves maybe translocated in the direction of the roots. This may be one possible reason why dry matter content of the roots and stolons were high in some genotypes.

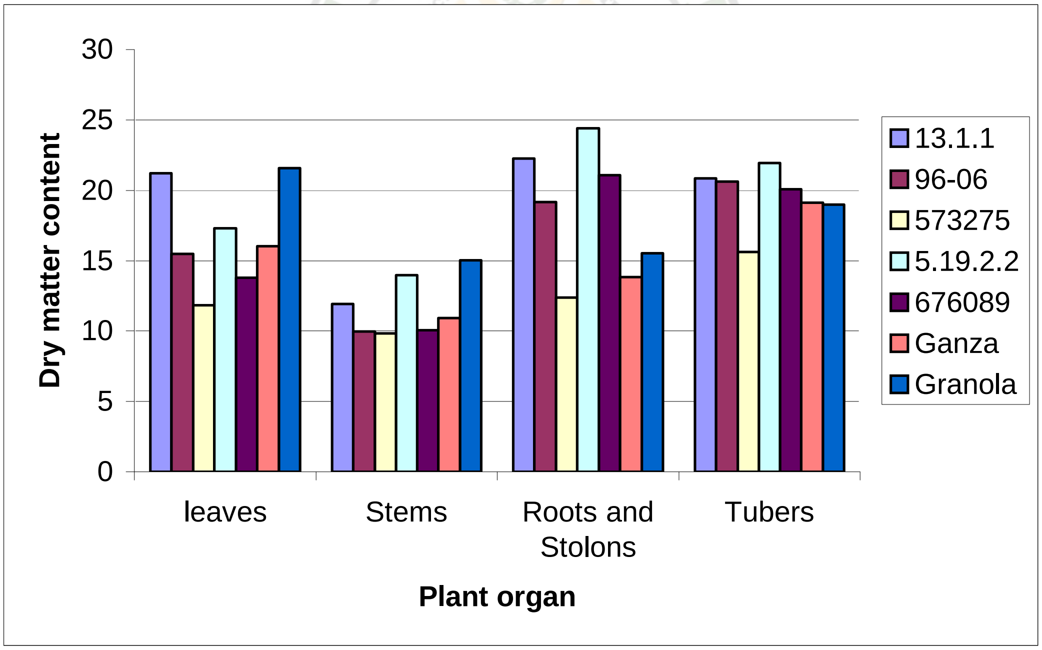

Figure 5. Dry matter content at 45 DAP of seven potato genotypes grown at La Trinidad under organic production.

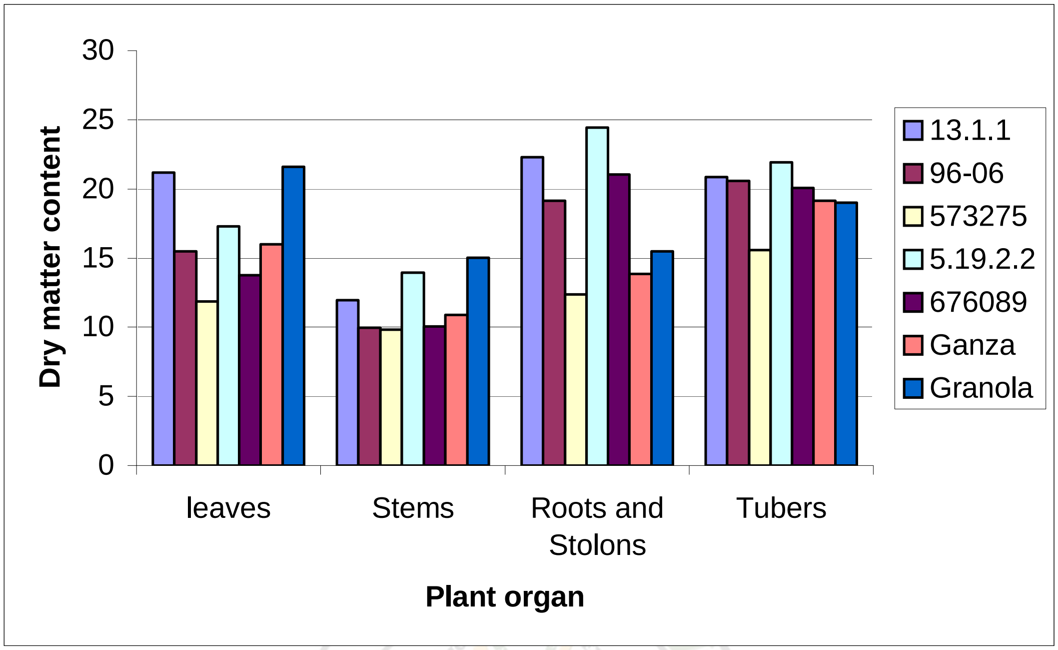

Figure 6. Dry matter content at 60 DAP of seven potato genotypes grown at La Trinidad under organic production.

At 75 DAP, the dry matter partitioned into the tubers had increased in all the genotypes. The dry matter partitioned into the leaves, roots and stolons had decreased diverting assimilates into the tubers (Figure 7).

The roots and stolons had the highest dry matter partitioned in genotype 5.19.2.2. The highest dry matter partitioned into the tubers was in genotypes 5.19.2.2, 96-06 and 13.1.1. The lowest dry matter was partitioned in the stems in genotypes 96-06 and 13.1.1 followed by 5.19.2.2, cv. Ganza, 573275 and 676089. The dry matter partitioned into the roots and stolons in genotypes 13.1.1, 96-06 and 676089 had decreased and the dry matter partitioned into the leaves increased in genotypes 13.1.1, 96-06 and 5.19.2.2 (Figure 7).

At 90 DAP the dry matter partitioned in the leaves, roots and stolons increased while dry matter partitioned in the tubers decreased except in genotypes 5.19.2.2 and 96-06. The dry matter partitioned in the stems was lowest in genotype 573275 followed by 5.19.2.2, 96-06 and cv. Ganza (Figure 7). Results showed that 5.19.2.2 and 96-06 were of the early maturing genotypes. The stems were observed to have the lowest dry matter content from 45 to 90 DAP. The low dry matter in the stem may be due to the fact that the stems are not the storage organs but merely serve as vehicle for the translocation of assimilates within the plant.

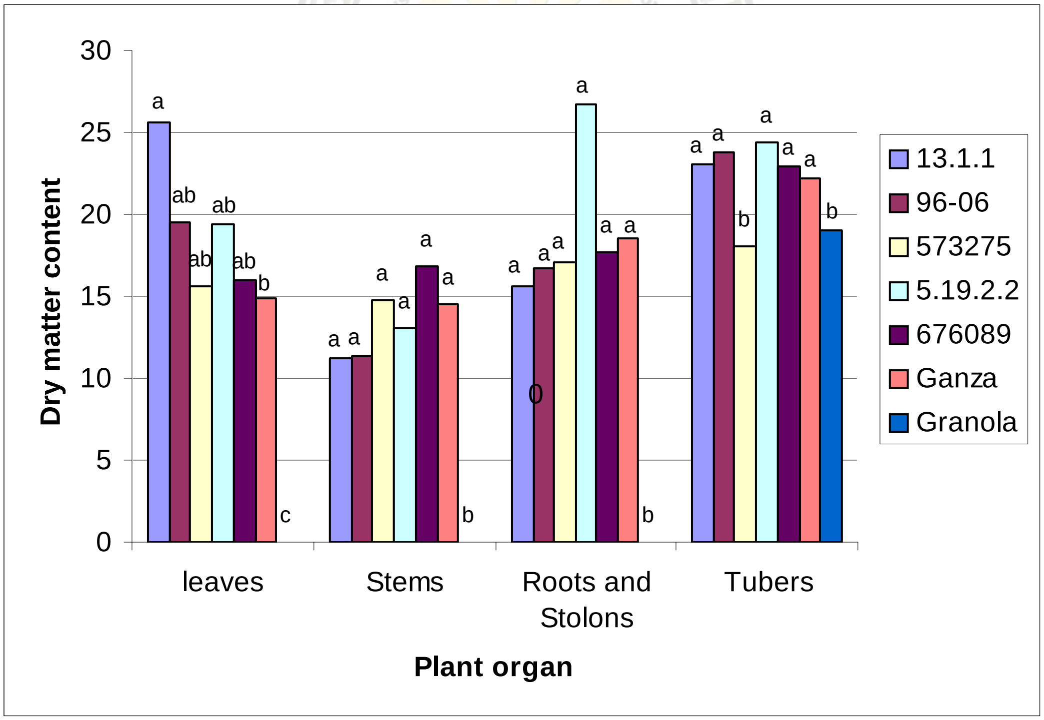

Figure 7. Dry matter content at 75 DAP of seven potato genotypes grown at La Trinidad under organic production.

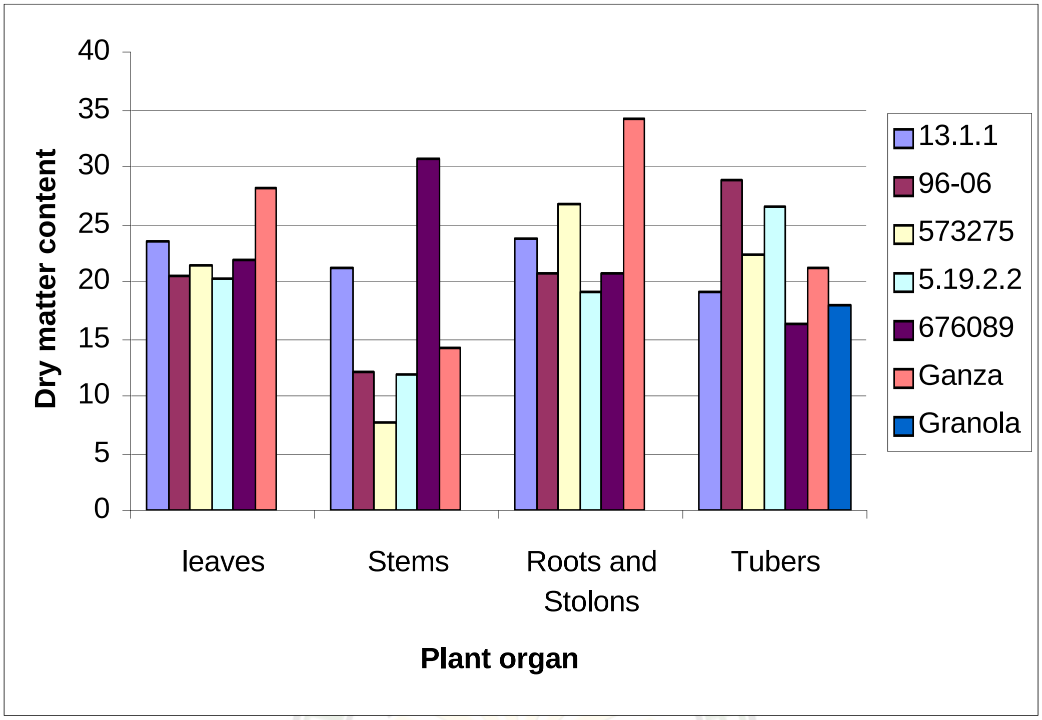

Figure 8. Dry matter content at 90 DAP of seven potato genotypes grown at La Trinidad under organic production.

Dry Matter Accumulation in the Different Plant Organs

Dry matter content of leaves at 45, 60, 75 and 90 DAP is presented in Figure 9. The dry matter partitioned in the leaves was high at 60 to 75 DAP in genotype 13.1.1 followed by genotypes 96-06 and 5.19.2.2. Dry matter partitioned in the leaves at 90 DAP decreased in genotypes 13.1.1 but increased in genotypes 96-06 and 5.19.2.2. Results indicate that most assimilates in the leaves were translocated to the tubers in genotype 13.1.1 while a three fourth fraction of assimilates may be translocated to the tubers in genotypes 96-06 and 5.19.2.2.

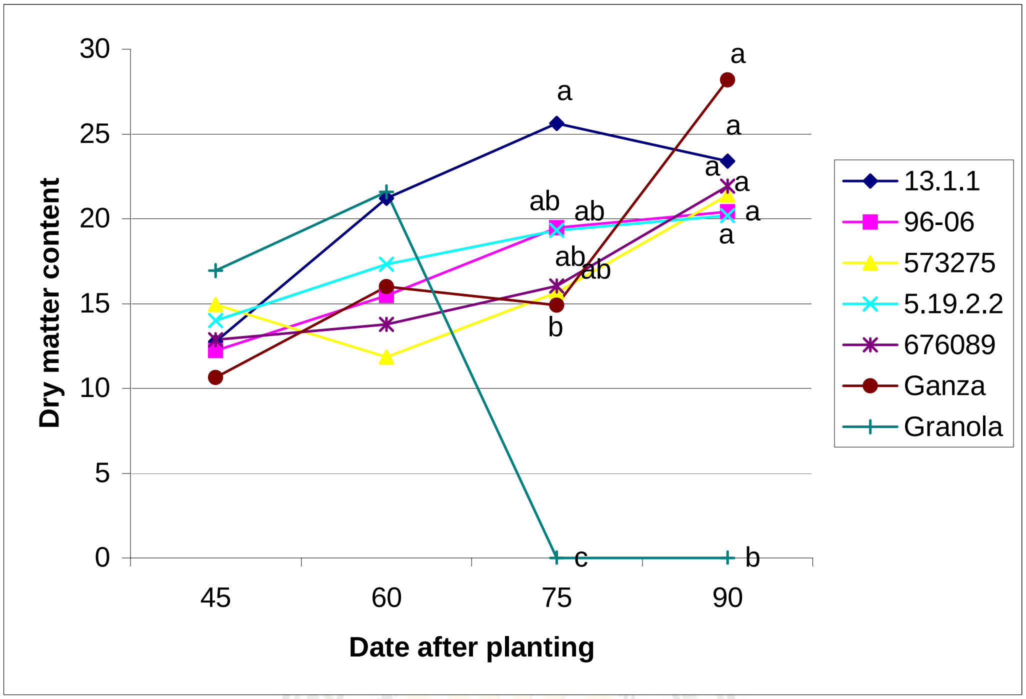

Figure 9. Dry matter content of leaves of seven potato genotypes grown at La Trinidad under organic production.

The dry matter content of stems among the genotypes evaluated at 45, 60, 75 and 90 DAP is presented in Figure 10. Dry matter partitioned in the stems was high at 45 DAP in genotypes 96-06 and 13.1.1. Increased dry matter assimilates in the stem at 60 DAP was shown in cultivar Granola. At 75 DAP genotype 676089 had the highest dry matter assimilates in the stems and continuously increased at 90 DAP. The dry matter partitioned in the stems of all the genotypes differed at 45, 60, 75 and 90 DAP. Some genotypes decreased in dry matter accumulation in the stems at 60 DAP, increased at 75 DAP but decreased at 90 DAP. The fluctuation on dry matter accumulation in the stems may have been affected by the genetic characteristics of the different genotypes, tested.

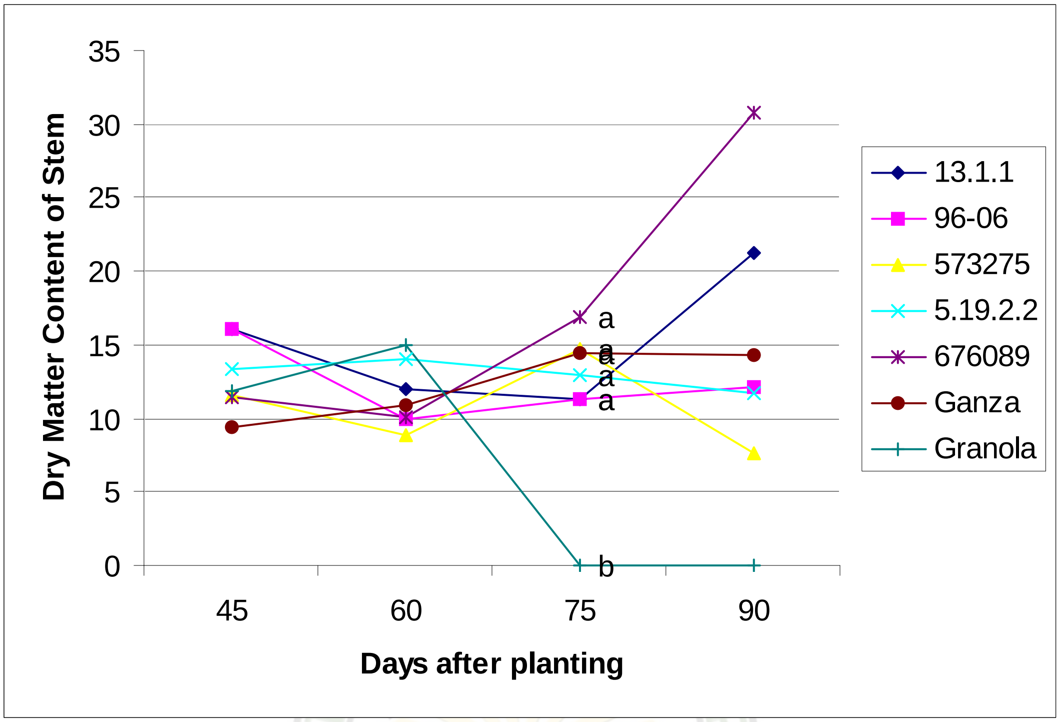

Figure 10. Dry matter content of stems at 45, 60, 75 and 90 DAP of seven potato genotypes grown at La Trinidad under organic production.

Figure 11 shows the dry matter content of roots and stolons at 45, 60, 75 and 90 DAP. The highest dry matter assimilates partitioned in the roots and stolons were noted at 45 and 75 DAP in genotype 5.19.2.2. . At 90 DAP, dry matter assimilates partitioned in the roots and stolons increased in most of the genotypes while this decreased in genotype 5.19.2.2. Results showed that roots and stolons attained higher dry matter accumulation from 45, 75 and 90 DAP. According to Devlin and Witham (1983), the leaves nearest the root translocated metabolites primarily to the roots. Photosynthates moving out of the leaves maybe translocated in the direction of the roots. This may be a possible reason why dry matter content in the roots and stolons were high at 45, 75 and 90 DAP.

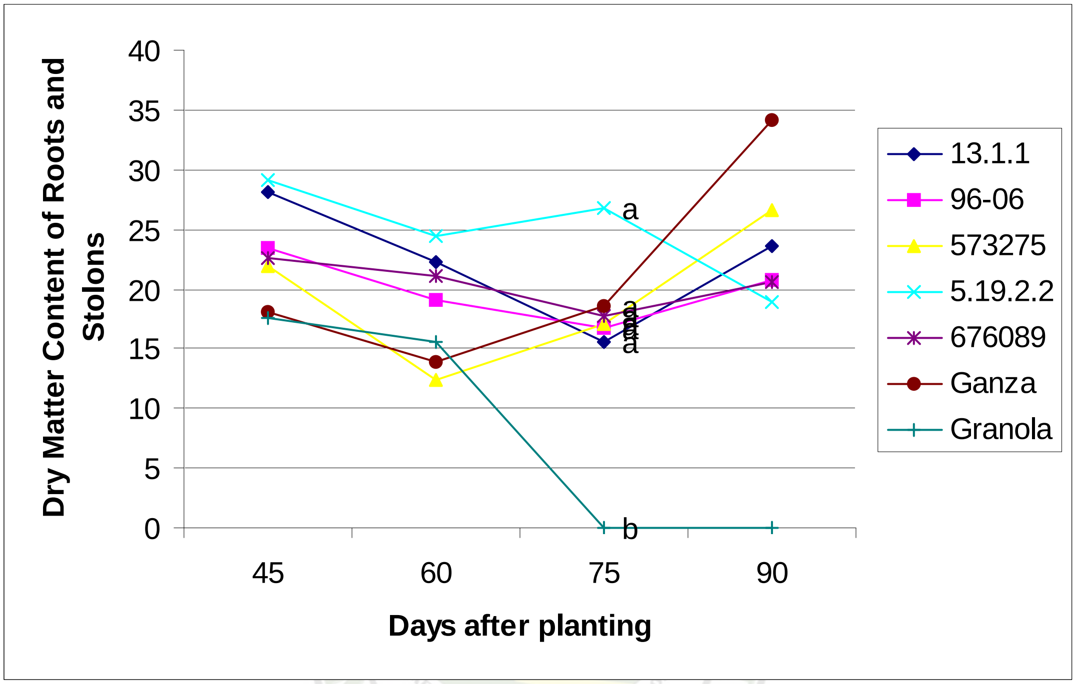

Figure 11. Dry matter content of roots and stolons of seven potato genotypes grown at La Trinidad under organic production.

Dry matter content of tubers at 45, 60, 75 and 90 DAP is presented in Figure 12. All the genotypes and cultivars tested were observed to have an increased dry matter content at 60 to 75 DAP. Results showed that dry matter partitioned into the tubers was high at 45 DAP in genotypes 5.19.2.2 and 13.1.1 while this very low in genotypes 573275 and 676089. Dry matter partitioned in the tubers increased at 60 to 75 DAP in genotypes 5.19.2.2, 13.1.1 and 96-06. The high dry matter at 75 DAP indicates early maturity of the genotypes. An increasing dry matter in genotypes 96-06 and 5.19.2.2 was observed at 90 DAP.

This indicates that maturity in genotypes 96-06 and 5.19.2.2 was at 90 DAP. Genotype 13.1.1 showed a decrease in dry matter at 75 DAP. The decrease may indicate maturity of the genotype at 75 DAP.

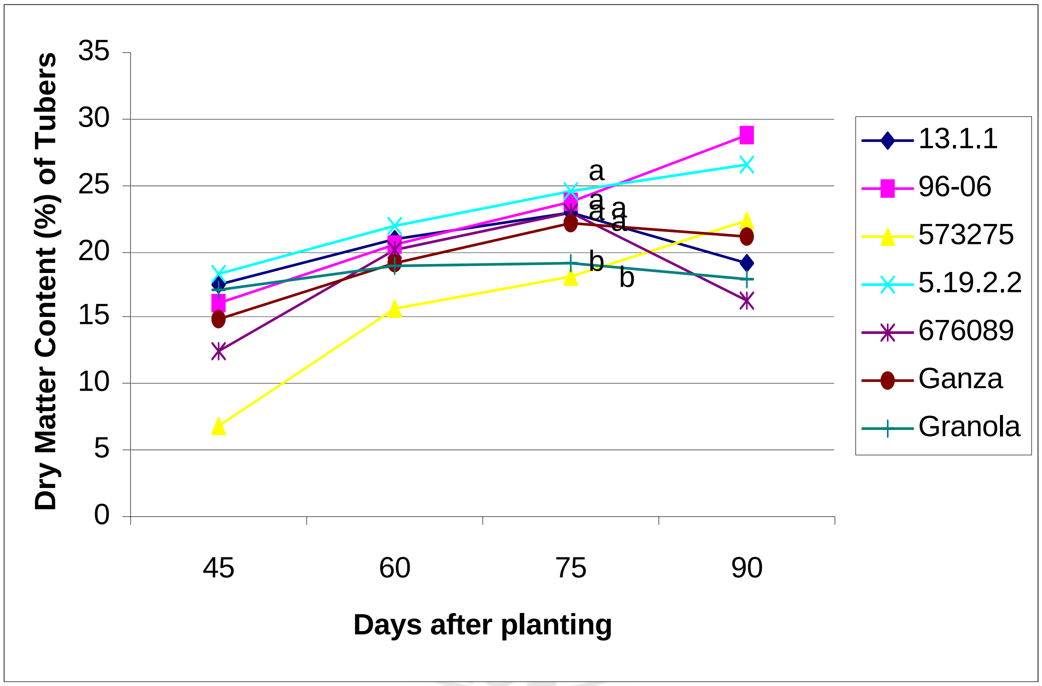

Figure 12. Dry matter content of tubers of seven potato genotypes grown at La Trinidad under organic production.

Harvest Index at 45, 60, 75, and 90 DAP

Harvest index of the seven genotypes and cultivars at 45, 60, 75 and 90 DAP is presented in Figure 13. No significant differences among genotypes and cultivars evaluated were observed at 45 and 60 DAP.

Harvest index differed significantly among the genotypes evaluated at 75 and 90 DAP (Figure 13). At 45 DAP cultivar Granola had the highest harvest index followed by cultivar Ganza. The harvest index of cultivar Granola decreased at 60 DAP while cultivar Ganza had increased harvest index. At 75 DAP genotypes 96-06, 5.19.2.2, cv.Ganza, 676089 and 13.1.1 increased in their harvest indices. At 90 DAP all the harvest indices of the genotypes and cultivars decreased except for genotype 96-06 which had an increased harvest index. Results showed that the harvest indices in most of the genotypes increased which conforms with the earlier result of an increase in dry matter content in tubers at 75 DAP in all the genotypes. This implies that increase in economic yield may result on the increase in harvest index. At 90 DAP a decrease in the harvest index was observed hence dry matter content of tubers at 90 DAP decreased while the dry matter in the leaves, stolons and tubers increased. Results showed that a decrease in economic yield would mean low harvest index.

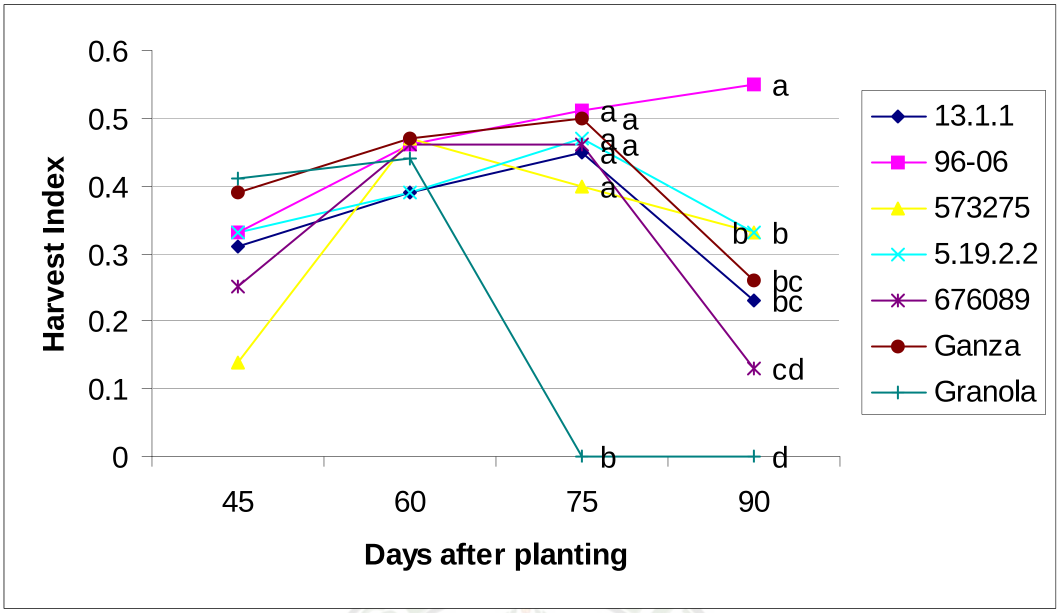

Figure 13. Harvest index of seven potato genotypes grown at La Trinidad under organic production.

Leaf Miner Incidence at 45, 60, and 75 DAP

Visual rating for leaf miner incidence was done at the potato vegetative stage. Observation showed that most of the genotypes were highly resistant at 45 DAP except for cultivar Granola (Figure 14). At 60 DAP most of the genotypes had intermediate resistant ratings except for genotype 573275 which is highly resistant. The infestation by leaf miner at 75 DAP slightly increased in genotypes 13.1.1, 96-06, 5.19.2.2, and 676089 while this increased rapidly in cv. Granola. Based on the results the genotypes evaluated and cultivar Ganza were moderately resistant to leaf miner while cultivar Granola showed susceptibility to leaf miner in conformity with the results of Simongo, *et al*. (2004). The moderate infection by leaf miner to the genotypes tested showed their resistance to the pest attributed to the crop production diversity practiced in the study area and the set-up of yellow traps.

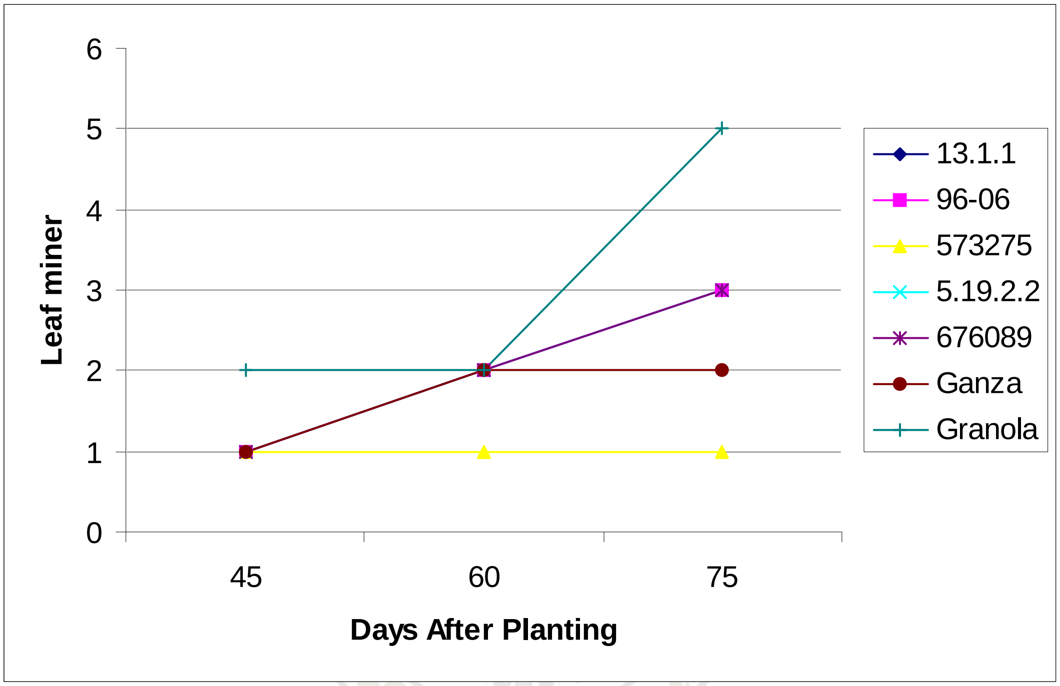

Figure 14. Leaf miner ratings of seven potato genotypes grown at La Trinidad under organic production.

Late Blight Infection at 60 and 75 DAP

Late blight infection at 65 and 75 is presented in Figure 15. Results showed that the prevailing weather during the evaluation period did not favor the occurrence of the disease. At 60 to 75 DAP genotypes 5.19.2.2, 573275, 96-06 and 13.1.1 showed zero infections (Figure 15). The genotype 13.1.1 and cultivar Ganza showed the least infection at 60 and 75 DAP while infection from cultivar Granola increased at 75 DAP. Results indicate, infection was moderate as exhibited by the susceptible cultivar Granola. The low late blight incidence may be attributed to the low relative humidity that was recorded during the conduct of the study associated with their genetic characteristics. Horton (1987) reported that the average relative humidity required for potato production is 86% confirming that the relative humidity within the evaluation period of the study did not favor the development of the disease. However, some of the genotypes tested showed resistance to late blight.

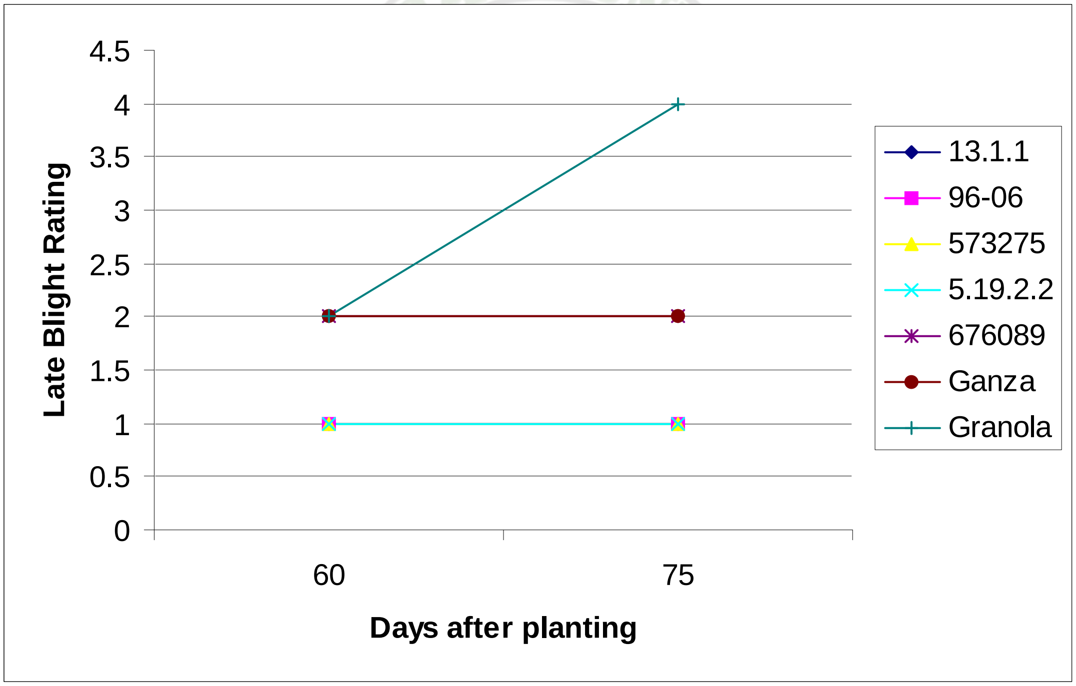

Figure 15. Late blight rating of seven potato genotypes grown at La Trinidad under organic production.

Correlation Analysis

Correlation Between Meteorological Data and Plant Vigor of the Seven Potato Genotypes

No significant correlation of plant vigor with minimum temperature, maximum temperature, relative humidity, rainfall and sunshine duration in all the genotypes evaluated was noted (Table 8).

In the case of light intensity, significant positive correlation was found on the plant vigor rating of 96-06, 573275 and cultivar Ganza. This result reveals that these three genotypes exhibited highly vigorous growth as light intensity increased. This implies that genotype 96-06, 573275 and cultivar Ganza are suitable for dry season planting. This finding contradicts the report of Gardner *et al.*, (1985) that if the light level continues to increase, there is less increase in carbon exchange rate (CER) for each unit increase in light level until the light saturation level is reached.

As shown by this results, any increase in light level after this level will not significantly increase CER; therefore leaves are more efficient at utilizing light energy at low irradiance levels.

Table 8. Correlation between meteorological data and plant vigor of the seven potato genotypes.

METEOROLOGICAL DATA	CORRELATION COEFFICIENT						
	13.1.1	96-06	573275	5.19.2.2	676089	Ganza	Granola
Min. Temperature	-	-0.649	-0.649	-	-0.983	-0.649	0.983
Max. Temperature	-	-0.693	-0.693	-	-0.971	-0.6933	0.971
Relative Humidity	-	-0.991	-0.991	-	-0.381	-0.991	0.381
Rainfall	-	0.447	0.470	-	-0.530	0.470	0.530
Sunshine Duration	-	0.872	0.872	-	0.860	0.872	-0.860
Light Intensity	-	0.996*	0.996*	-	0.572	0.996*	0.572

* = significant at 5% level of significance

Correlation Between Meteorological Data and Canopy Cover of the Seven Potato Genotypes

Canopy cover of the genotypes and cultivars showed no significant correlation with minimum temperature, RH, rainfall and light intensity. Maximum temperature had a significant negative correlation (R = -0.949) with canopy cover while sunshine duration showed a positive significant correlation (R = 0.983) with canopy cover in genotype 96-06 (Table 9). As results indicate, as the temperature increases, canopy development decreases confirming the report of Periera and Shock (2006), that potato is best adapted to cool climates such as tropical highlands with mean daily temperatures favoring foliar development and retard in tuberization. Based on the result canopy cover increases as sunshine duration increases. This finding corroborates with the report of Anon, (2007) that long bright days favor photosynthesis and development of top growth. As this result showed, genotype 96-06 was responsive to increased sunshine duration.

Although correlation was not significant in most of the genotypes, negative correlation between temperature and canopy was noted. The increase in temperature may enhance a decrease in canopy cover. Ewing (1981) pointed out that at high temperature, changes in plant morphology and a significant reduction in tuber yield. Solar radiation is positively correlated with canopy cover in all the genotypes tested. The increase in solar radiation may contribute for the development of greater canopy cover and the long bright days may enhance development of top growth.

Table 9. Correlation between meteorological data and canopy cover of the seven potato genotypes.

METEOROLOGICAL DATA	CORRELATION COEFFICIENT						
	13.1.1	96-06	573275	5.19.2.2	676089	Ganza	Granola
Min. Temperature	-0.868	-0.659	-0.970	-0.916	-0.886	-0.960	-0.104
Max. Temperature	-0.895	-0.949*	-0.751	-0.910	-0.802	-0.791	-0.764
Relative Humidity	-0.221	0.065	-0.450	-0.182	-0.390	-0.400	0.576
Rainfall	0.064	0.264	-0.143	-0.088	0.085	-0.115	0.477
Sunshine Duration	0.874	0.983*	0.677	0.852	0.783	0.724	0.871
Light Intensity	0.294	-0.012	0.534	0.269	0.455	0.483	-0.566

Correlation Between Meteorological Data and Leaf Area Index of the Seven Potato Genotypes

Genotype 96-06 (Table 10) showed significant negative correlation between minimum temperature and leaf area index that as minimum temperature increases leaf area indices decreased. No significant correlation was shown among the leaf area indices of the other genotypes with any of the meteorological data. This implies that the leaf indices of the other genotypes were not affected by temperature, relative humidity, rainfall, sunshine duration and light intensity. The result further implies that leaf area index is attributed to the inherent characteristics of the genotypes.

Table 10. Correlation between meteorological data and leaf area index of the seven potato genotypes.

METEOROLOGICAL DATA	CORRELATION COEFFICIENT						
	13.1.1	96-06	573275	5.19.2.2	676089	Ganza	Granola
Min. Temperature	-0.817	-0.999*	-0.272	-0.631	-0.471	-0.321	-0.280
Max. Temperature	-0.983	-0.727	0.496	0.113	0.299	0.451	-0.882
Relative Humidity	0.773	0.302	-0.854	-0.581	-0.725	-0.827	0.792
Rainfall	-0.292	-0.766	-0.805	-0.974	-0.913	-0.835	0.367
Sunshine Duration	0.904	0.526	-0.702	-0.364	-0.534	-0.665	0.973
Light Intensity	-0.615	-0.087	0.748	0.744	0.857	0.930	-0.972

Correlation Between Meteorological Data and Net Assimilation Rate of the Seven Potato Genotypes

Except for rainfall with genotype 5.19.2.2, no significant correlation was shown between meteorological data and net assimilation rate of the genotypes (Table 11). Rainfall has significant negative correlation with the net assimilation rate of genotype 5.19.2.2. This indicates that as rainfall increases, the net assimilation rate of genotype 5.19.2.2 decreases. This implies that 5.19.2.2 is not suitable for planting during the wet season but rather during the dry season. During rainy months is genotype produces higher haulm growth with less yield.

Table 11. Correlation between meteorological data and net assimilation rate of the seven potato genotypes.

METEOROLOGICAL DATA	CORRELATION COEFFICIENT						
	13.1.1	96-06	573275	5.19.2.2	676089	Ganza	Granola
Min. Temperature	-0.442	-0.309	-0.280	-0.784	-0.562	-0.789	0.478
Max. Temperature	0.331	0.462	0.489	-0.105	0.196	-0.991	-0.293
Relative Humidity	-0.747	-0.834	-0.851	-0.390	-0.647	0.802	0.720
Rainfall	-0.899	-0.828	-0.810	-0.999*	-0.951	-0.247	0.916
Sunshine Duration	-0.562	-0.674	-0.697	-0.153	-0.441	0.923	0.529
Light Intensity	0.874	0.735	0.745	0.581	0.798	-0.551	0.854

** = Highly significant at 1% level of significance

Correlation Between Meteorological Data and Crop Growth Rate of the Seven Potato Genotypes

Correlation between meteorological data and crop growth rate is presented in Table 12. Significant negative correlation between rainfall and crop growth rate was noted in genotypes 13.1.1 and 5.19.2.2. It was observed that, as rainfall increase the crop growth rates of genotypes 13.1.1 and 5.19.2.2 decreases. This implies that genotypes 13.1.1 and 5.19.2.2 are best adapted under dry season cropping. The crop growth rates of the other genotypes and cultivars were not affected by any of the meteorological data.

Table 12. Correlation between meteorological data and crop growth rate of the seven potato genotypes.

METEOROLOGICAL DATA	CORRELATION COEFFICENT						
	13.1.1	96-06	573275	5.19.2.2	676089	Ganza	Granola
Min. Temperature	-0.799	-0.895	-0.031	-0.831	-0.049	-0.550	0.693
Max. Temperature	-0.130	-0.307	0.692	-0.183	0.679	0.212	-0.029
Relative Humidity	-0.367	-0.193	-0.955	-0.316	-0.949	-0.659	0.510
Rainfall	-0.999**	-0.981	-0.638	-0.998*	-0.651	-0.946	0.790
Sunshine Duration	-0.128	0.052	-0.854	-0.075	-0.845	-0.455	0.284
Light Intensity	0.561	0.403	0.797	0.516	0.795	0.807	-0.686

* = Significant at 5% level of significance
** = Highly significant at 1% level of significance

Correlation Between Meteorological Data and Dry Matter Content of Leaves of the Seven Potato Genotypes

There is significant effect of the environmental factors on dry matter contents of the leaves of genotypes 13.1.1, 573275 and cultivar Granola (Table 13). Significant positive correlation was exhibited between 13.1.1 and rainfall. Significant negative correlation (R = 0.979) between dry matter content of leaves and minimum temperature was shown in genotype 573275. This indicates that dry matter content of the leaves decreases as temperature increases. Significant positive correlation was also observed between sunshine duration and dry matter content of the leaves of cultivar Granola. Hence, as sunshine duration increases dry matter content of the leaves increases. This implies that cultivar Granola is best grown under long bright days.

Table 13. Correlation between meteorological data and dry matter content of leaves of the seven potato genotypes.

METEOROLOGICAL DATA	CORRELATION COEFFICIENT						
	13.1.1	96-06	573275	5.19.2.2	676089	Ganza	Granola
Min. Temperature	-0.436	-0.754	-0.979*	-0.669	-0.922	-0.777	-0.314
Max. Temperature	-0.009	0.051	0.098	-0.087	-0.150	-0.429	-0.768
Relative Humidity	-0.425	-0.366	-0.023	-0.270	0.040	0.283	0.864
Rainfall	-0.947*	-0.824	-0.171	-0.899	-0.537	-0.602	-0.059
Sunshine Duration	-0.259	-0.135	0.217	-0.050	0.297	0.518	0.962*
Light Intensity	0.700	0.432	-0.334	0.443	-0.133	-0.213	-0.773

* = Significant at 5% level of significance

Correlation Between Meteorological Data and Dry Matter Content of Stems of the Seven Potato Genotypes

Correlation between meteorological data and dry matter content of stems is presented in Table 14. Significant positive correlation between rainfall and dry matter content of the stems was exhibited by genotype 96-06. This indicates that the dry matter content of the stems in genotype 96-06 increases as rainfall increases. Thus, this implies that genotype 96-06 is best adapted under wet season cropping..

Genotype 573275 showed significant positive correlations between maximum temperature and dry matter content of the stems. As results show dry matter content of the stems of genotype 573275 increased as temperature increased. Negative significant correlation (R = -0.976) between sunshine duration and dry matter content in the stems was also shown by genotype 573275. Correlation between dry matter content of stems and sunshine duration showed that dry matter content of stems increases as sunshine duration decreases. This implies that genotype 573275 is best adapted under short bright days.

Table 14. Correlation between meteorological data and dry matter content of stems of the seven potato genotypes.

METEOROLOGICAL DATA	CORRELATION COEFFICEINT						
	13.1.1	96-06	573275	5.19.2.2	676089	Ganza	Granola
Min. Temperature	-0.200	0.797	0.728	0.221	-0.435	-0.400	-0.599
Max. Temperature	-0.487	0.318	0.984*	0.125	-0.282	0.135	-0.716
Relative Humidity	0.563	0.125	0.912	-0.020	0.092	-0.497	0.612
Rainfall	0.142	0.943*	0.191	0.225	-0.409	-0.757	-0.247
Sunshine Duration	0.539	-0.104	-0.976*	-0.076	0.194	-0.321	0.684
Light Intensity	-0.554	-0.342	0.796	-0.035	0.013	0.642	-0.506

* = Significant at 5% level of significance

<u>Correlation Between Meteorological Data and Dry Matter Content of Roots and Stolons of the Seven Potato Genotypes</u>.

The correlations between metrological data and dry matter content of roots and stolons are presented in Table 15. No significant correlation was shown among meteorological data and dry matter content of roots and stolons in all the genotypes and cultivars evaluated. This may imply that dry matter content of the roots and stolons was not much affected by the temperature, relative humidity, rainfall, sunshine duration and light intensity. As the result implies dry matter contents of roots and stolons may be affected by the inherent characteristics of the genotypes.

Table 15. Correlation among meteorological data and dry matter content of roots and stolons of the seven potato genotypes.

METEOROLOGICAL DATA	CORRELATION COEFFICIENT						
	13.1.1	96-06	573275	5.19.2.2	676089	Ganza	Granola
Min. Temperature	0.195	0.331	0.105	0.858	0.113	-0.360	-0.531
Max. Temperature	-0.444	-0.299	-0.106	0.708	-0.518	-0.341	-0.702
Relative Humidity	0.802	0.689	0.235	-0.407	0.850	0.236	0.641
Rainfall	0.735	0.808	0.267	0.661	0.677	-0.234	-0.155
Sunshine Duration	0.637	0.504	0.174	-0.577	0.700	0.298	0.692
Light Intensity	-0.917	-0.830	-0.281	0.217	-0.948	-0.162	-0.555

Correlation Between Meteorological Data and Dry Matter Content of Tubers of the Seven Potato Genotypes.

Table 16 shows the correlation between meteorological data and dry matter content of tubers. No significant correlation was observed between the meteorological data and dry matter content of tubers in all the genotypes and cultivars evaluated. Tuber dry matter content of all the genotypes, as the results show was not affected by temperature, relative humidity, rainfall, sunshine duration and light intensity. This indicates that dry matter content of tubers is attributed to their genetic characteristics and not affected by environmental factors. As Peet (2006) reported, dry matter content varies between varieties and is a strongly inherited characteristic.

Table 16. Correlation between meteorological data and dry matter content of tubers of seven genotypes.

METEOROLOGICAL DATA	CORRELATION COEFFICIENT						
	13.1.1	96-06	573275	5.19.2.2	676089	Ganza	Granola
Min. Temperature	-0.223	-0.677	-0.767	0.105	-0.351	-0.566	-0.513
Max. Temperature	0.391	-0.292	-0.308	0.562	0.257	0.034	0.045
Relative Humidity	-0.743	-0.073	-0.117	-0.752	-0.641	-0.472	-0.449
Rainfall	-0.726	-0.779	-0.906	-0.377	-0.798	-0.919	-0.849
Sunshine Duration	-0.580	0.117	0.103	-0.674	-0.458	-0.256	-0.250
Light Intensity	0.862	0.255	0.326	0.785	0.784	0.658	0.619

Correlation Between Meteorological Data and Harvest Index of the Seven Potato Genotypes

The correlation between meteorological data and harvest index of all the genotypes and cultivars evaluated shown in Table 17. No significant correlation between meteorological data and harvest index was noted. As the result implies, the harvest indices of all the genotypes and cultivars evaluated were not affected by the temperature, rainfall, relative humidity, sunshine duration and light intensity. This therefore implies that harvest index was solely attributed to the genetic characteristics of the genotypes and cultivars studied.

Table 17. Correlation between meteorological data and harvest index of the seven potato genotypes.

METEOROLOGICAL DATA	CORRELATION COEFFICIENT						
	13.1.1	96-06	573275	5.19.2.2	676089	Ganza	Granola
Min. Temperature	0.212	-0.729	-0.737	0.058	0.035	0.276	0.078
Max. Temperature	0.597	-0.228	-0.249	0.615	0.375	0.546	-0.413
Relative Humidity	-0.724	-0.207	-0.181	-0.866	-0.527	-0.600	0.669
Rainfall	-0.244	-0.923	-0.915	-0.503	-0.306	-0.093	0.521
Sunshine Duration	-0.678	0.015	0.040	-0.759	-0.462	-0.589	0.554
Light Intensity	0.728	0.412	0.389	0.821	0.561	0.577	-0.743

Correlation Among Characters

Meyer and Anderson (1952) reported that the development of every organ in growing plant is attributed to some degree by physiological processes of physico- chemical conditions prevailing in some other organ or organs. Such relationship existing among the organs of a plant are termed growth correlations or simply correlations. Growth correlations are not only exerted by one organ on another but also occur among tissues and even among cells.

Table 18 shows the summary of the correlation coefficient of seven potato genotypes characters studied. Canopy cover showed no significant correlation with the other plant characters except on the harvest index.

Canopy cover showed significant positive correlation (R = 0.665) with harvest index. Thus, as canopy cover increases harvest index increases which contradicts the statement of Belanger, et al., (2000), that any factor resulting in a decrease in total biomass will indirectly decrease the harvest index . No significant correlation was observed in leaf area index with other plant characters. This result indicates that leaf area index was not affected by plant character.

Significant positive correlation between net assimilation rate and crop growth rate was noted. It was noted that net assimilation rate increased as the crop growth rate increased which is conclusive since crop growth rate is the product of net assimilation rate when multiplied with leaf area index as cited by Gardner *et al*. (1985).

Significant positive correlation (R = 0.652) between net assimilation rate and extra large tuber weight was observed. This indicates that extra large tuber weight increase as net assimilation rate increases.

Correlation in crop growth rate with other characters was not significant. This implies that crop growth rate was not affected by other plant characters.

For the yield components, no significant correlations were noted, thus, none of the plant characters studied affected the yield.

Dry matter content of leaves, stems, roots and stolons and tubers showed no significant correlation among all the characters studied.

No significant correlation between harvest index and among other plant characters, which implies that harvest index, was not affected by any of the characters. As results showed, dry matter content of leaves, stems, roots, stolons and tubers were not affected by any other plant character.

Table 18. Correlation among growth and yield parameters of the seven genotypes evaluated

	CC	LAI	NAR	CGR	XLWT.	LWT.	MWT.	SWT.	MAR WT.	NMWT	TOT.YLD.	LDMC	SDMC	RSDMC	TDMC	HI
CC	1.000	-0.379	-0.126	-0.279	0.127	-0.191	0.055	0.189	0.261	0.121	0.314	0.030	-0.186	-0.246	0.407	0.665*
LAI		1.000	0.323	0.548	0.201	-0.463	-0.283	-0.291	0.040	-0.419	-0.286	0.085	-0.371	-0.092	-0.064	0.197
NAR			1.000	0.840**	0.652*	0.033	-0.155	-0.159	-0.079	-0.525	0.062	0.061	-0.087	0.535	-0.076	-0.508
CGR				1.000	0.322	0.696*	0.418	-0.224	-0.099	-0.529	-0.050	0.080	-0.240	0.463	-0.008	-0.367
XLWT					1.000	-0.445	0.226	0.106	0.414	-0.017	0.390	0.056	0.285	0.224	-0.361	-0.019
LWT.						1.000	-0.061	-0.119	-0.742	-0.293	-0.147	-0.283	0.108	0.193	0.253	-0.259
MWT.							1.000	0.007	0.194	0.476	0.714	-0.282	0.072	-0.236	-0.011	-0.098
SWT.								1.000	0.038	0.169	0.578	-0.072	-0.180	-0.411	-0.260	0.039
MRWT.									1.000	0.279	0.408	0.117	0.047	-0.199	-0.144	0.083
NMWT.										1.000	0.234	0.098	0.198	-0.121	-0.162	-0.095
Tot. yld.											1.000	-0.255	-0.183	-0.330	-0.101	-0.097
LDMC												1.000	0.329	0.405	-0.080	-0.148
SDMC													1.000	0.542	-0.271	-0.257
RSDMC														1.000	0.217	-0.379
TDMC															1.000	0.433
HI																1.000

** = Highly significant at 5% level of significance
XLWT = extra large tuber weight
TOT YLD = total yield
* = Significant at 5% level of significance
LWT = large tuber weight
LDMC = leaves dry matter content
CC = canopy cover
MWT = medium tuber weight
SDMC = stem dry matter content
LAI = leaf area index
SWT -= small tuber weight
RSDMC = root & stolons dry matter content
NAR = net assimilation rate
MRWT = marble tuber we
TDMC = tuber dry matter content
CGR = crop growth rate
NMWT = non-marketable tuber weight
HI = harvest index

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted to determine assimilates partitioning in the leaves, stems, roots, stolons and tubers during the different stages of the potato plant development; compare the efficiency of potato genotypes in terms of dry matter partitioning under organic production, and determine the best time of harvesting for optimum dry matter accumulation.

Seven potato genotypes and cultivars grown and selected from previous studies under organic production were evaluated from November 2006 to February 2007 at La Trinidad, Benguet under organic production. Treatments were laid out following the Randomized Complete Block Design with 40 tubers per replication. Destructive sampling was done at 45 DAP and every 15 days thereafter until harvest. The data gathered were: meteorological data, soil analysis, growth parameters, yield components, dry matter parameters and other data. The data was analyzed through ANOVA using the single factorial in RCBD except for leaf miner and late blight ratings. Correlation between meteorological data and growth characters and in among plant characters were analyzed using Pearson correlation movement correlation coefficient (R), which characterizes the independence of X and Y.

The minimum and maximum air temperature during the study period ranged from 12.6 to 15.6 ^{o}C and 23.5 to 24.2 ^{o}C, respectively while relative humidity ranged from 77 to 80 %. A very low rainfall about 2.5, 2.4 and 0.05 mm was noted in November, December and January. Sunshine duration ranged from 381.4 to 521.6 mm. Light intensity ranged from 45.1 to 76.4 Klux. Soil pH is 6.72 before and 6.31 after harvest. Organic matter, phosphorus, potassium and nitrogen in the soil increased.

Genotype 13.1.1 significantly had high plant survival of 98 % followed by genotypes 5.19.2.2 and 13.1.1 with plant survival of 97 and 85%, respectively. Genotypes 13.1.1 and 5.19.2.2 significantly had highly vigorous growth at 30, 45 and 60 DAP. Cultivar Granola had moderate vigor at 30 and 45 DAP and less vigor at 60 DAP.

Canopy cover was significantly high in genotype 96-06 followed by 5.19.2.2 and 13.1.1. On leaf area index genotype 5.19.2.2 had the highest leaf area index at 45 DAP followed by genotypes 96-06 and 13.1.1. Genotype 5.19.2.2 had the highest leaf area index at 45 DAP followed by genotypes 96-06 and 13.1.1 while 573275 and cultivar Granola had the lowest leaf area index. At 60 DAP, all the genotypes increased in their leaf area indices with genotype 5.19.2.2 having the highest followed by 96-06 and 676089. Genotypes 5.19.2.2, 96-06, 13.1.1 and cultivar Ganza showed an increasing leaf area indices at 75 DAP while genotypes 676089, 573275 and cultivar Granola decreased.

No significant differences were observed among genotypes on their net assimilation rates at 45 and 75 DAP. At 60 DAP genotype 5.19.2.2 significantly had the highest net assimilation rate. On the crop growth rate, genotype 5.19.2.2 had the highest at 45 to 65 DAP followed by 676089 at 45 DAP and 96-06 at 60 DAP followed by 676089. Genotype 676089 increased in crop growth rate attaining the highest among the genotypes at 75 DAP. Genotype 573275 and cultivar Ganza increased at 75 DAP but not significantly comparable with 676089.

Genotypes 5.19.2.2, 13.1.1 and 96-06 had the highest total yield of 4.57, 4.21 and 4.13 kg, respectively and computed marketable yields with respective means of 6.33, 5.46 and 5.92 tons/ha. Genotype 13.1.1 had produced the most marketable tubers and the highest weight of tubers. Genotype 5.19.2.2 produced the heaviest weights of large, medium, small and marble tubers.

On the partitioning of assimilates in different plant organs of the seven potato genotypes and cultivars, the highest assimilate was partitioned into the roots and stolons of genotype 5.19.2.2 at 45, 60 and 75DAP and in cultivar Ganza at 90 DAP. The least assimilate was partitioned into the stems in genotypes 573275, 676089 and 96-06 at 45 to 60 DAP; in genotypes 13.1.1 and 96-06 at 75DAP and in genotype 573275 at 90 DAP.

As to assimilate partitioning in the leaves, highest dry matter content in the leaves in genotype 13.1.1 was noted at 75 DAP. The dry matter content in the stems was high at 90 DAP in genotype 676089. In the roots and stolons, the highest assimilates was partitioned at 90 DAP in cultivar Ganza. The highest assimilates partitioned in tubers was noted at 90 DAP in genotypes 96-06 and 5.19.2.2 but at 75 DAP high assimilate was partitioned in all the genotypes.

Harvest index differed significantly among the genotypes evaluated at 75 and 90 DAP but did not differ at 45 and 60 DAP. Cultivar Granola had the highest harvest index at 45 DAP but decreased at 60 DAP with cultivar Ganza having the highest harvest index followed by genotypes 96-06 and 573275. At 75 DAP, genotypes 96-06, 5.19.2.2, cultivar Ganza, 676089 and 13.1.1 increased in their harvest indices while 573275 decreased. At 90 DAP, all the harvest indices of the genotypes decreased except for genotype 96-06 which had an increased in harvest index.

Data on leaf miner and late blight incidence was recorded during the conduct of the study. Genotypes 5.19.2.2, 573275, 96-06 and 13.1.1 had zero late blight infection at 60 to 75 DAP. The genotype 13.1.1 and cultivar Ganza showed the least infection but was moderately infected at 75 DAP. At 60 DAP most of the genotypes were of intermediate resistance except for genotype 573275 which is highly resistant. The infestation of leaf miner at 75 DAP slightly increased from genotypes 13.1.1, 96-06, 5.19.2.2, and 676089 while this increased rapidly with cultivar Granola. Infection of late blight was moderate as showed by the susceptible check cultivar Granola with late blight rating of 4 with only 25% infection at 75 DAP while the rest showed minimal infection with ratings of 2 (2.5%) to zero infection at 75 DAP.

Correlation analysis revealed significant positive correlations in: plant vigor with light intensity in genotypes 96-06, 573275, and cultivar Ganza; dry matter content of leaves with sunshine duration in cultivar Granola; dry matter content of stems with rainfall in genotype 96-06 and with maximum temperature in genotype 573275. Significant negative correlations was observed in: canopy cover with maximum temperature in genotype 96-06; crop growth rate with rainfall in genotypes 13.1.1 and 5.19.2.2; leaf area index with minimum temperature. No significant correlation was observed in temperature, relative humidity, rainfall, sunshine duration and light intensity with dry matter content of roots, stolons, tubers and harvest indices in all the genotypes and cultivars tested.

On the correlation among plant characters, canopy cover is positively correlated significantly with harvest index, net assimilation rate and extra large tubers and between net assimilation rate and crop growth rate.

Conclusions

Based on the results of the study the following conclusions are drawn:

1) Among the genotypes and cultivars evaluated 96-06, 13.1.1 and 5.19.2.2 were best performers based on survival, vigor, canopy cover, leaf area index, net assimilation rate and crop growth rate.

2) Genotypes 5.19.2.2, 96-06 and 13.1.1 had the highest total yield per plot and computed marketable yield indicating that these genotypes may be the most adapted under organic production at La Trinidad.
3) On the dry matter partitioning of assimilates, the roots and stolons had the highest assimilates partitioned in genotype 5.19.2.2 at 45, 60 and 75 DAP.
4) Assimilates were partitioned in the tubers at 75 DAP in most of the genotypes except for 96-06 and 5.19.2.2 which had partitioned assimilates in the tubers at 90 DAP.
5) Dry matter content of roots, stolons, tubers and harvest index were not affected by temperature, rainfall, sunshine duration and light intensity in any of the genotypes. This shows that dry matter content is attributed to the inherent characteristics of the genotypes, tested.
6) The significant positive correlation of dry matter content of some organs with sunshine duration indicates the importance of longer expressure of the genotypes to bright sunshine.
7) The negative correlation of crop growth rate with rainfall in 13.1.1 and 5.19.2.2 shows the suitability of these genotypes to dry season planting.
8) Among the genotypes evaluated 573275 was highly resistant to leaf miner, cultivar Ganza was intermediate and 13.1.1, 5.19.2.2, 676089 and 96-06 were moderately resistant. Genotypes 5.19.2.2, 573275, 96-06 and 13.1.1

were resistant to late blight. The resistance of these genotypes to leaf miner and late blight indicates their adaptability to organic production.

Recommendations

Based on the results of the study, the following are recommended:

1. Genotypes 96-06, 13.1.1 and 5.19.2.2 may be planted for organic production at La Trinidad, Benguet.
2. Genotypes 13.1.1, 573275, 676089, cultivars Ganza and Granola may be harvested as early as 75 DAP. Genotypes 96-06 and 5.19.2.2 could be harvested at 90 DAP.
3. Since sunshine duration significantly affects dry matter content of leaves cultural management practices that encourage maximum sunlight interception should be practiced. These practices may include proper spacing and cropping scheme.
4. Genotypes 13.1.1 and 5.19.2.2 are best planted during the dry season.
5. Since dry matter content of the tubers was not affected by any of the environmental factors in the study, verification should be done in other locations and seasons.
6. The strong indication that dry matter allocation in the tubers is largely genetic encourages researchers to continuously search for genotypes with efficient dry matter partitioning, high yield and harvest index under organic production.

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APPENDICES

APPENDIX TABLE 1. Analysis of variance for plant survival

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	392.667	196.333			
Treatment	6	11110.286	1851.714	11.17**	3.00	4.82
Error	12	1990.000	165.833			
Total	20	13492.952				

** Highly significant

CV% = 17.73
SX = 7.43

APPENDIX TABLE 2. Analysis of variance for plant vigor at 30 dap

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.667	8.333			
Treatment	6	14.476	2.413	6.20**	3.00	4.82
Error	12	4.667	0.389			
Total	20	19.810				

** Highly significant

CV% = 16.58
SX = 0.36

APPENDIX TABLE 3. Analysis of variance for plant vigor at 45 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.286	0.143			
Treatment	6	10.286	1.714	12.0**	3.0	4.82
Error	12	1.714	0.143			
Total	20					

** Highly significant

CV% = 8.82
SX = 0.22

APPENDIX TABLE 4. Analysis of variance for plant vigor at 60 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.381	0.190			
Treatment	6	21.333	3.556	44.8**	3.0	4.82
Error	12	0.952	0.079			
Total	20	22.667				

** Highly significant

CV% = 6.50
SX = 0.16

APPENDIX TABLE 5. Canopy cover at 30 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	299.810	149.905			
Treatment	6	2078.000	346.333	8.01**	3.0	4.82
Error	12	518.857	43.238			
Total	20	2896.667				

** Highly significant

CV% = 18.76
SX = 3.80

APPENDIX TABLE 6. Analysis of variance for canopy cover at 45 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	590.095	295.048			
Treatment	6	3190.286	531.714	10.92**	3.0	4.82
Error	12	584.572	48.714			
Total	20	4364.952				

** Highly significant

CV% = 22.48
SX = 4.03

APPENDIX TABLE 7. Analysis of variance for canopy cover at 60 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	586.952	293.476			
Treatment	6	5134.476	855.746	29.48**	3.0	4.82
Error	12	348.381	29.032			
Total	20	6089.810				

** Highly significant

CV% = 12.76
SX = 3.11

APPENDIX TABLE 8. Analysis of variance for canopy cover at 75 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	60.667	30.333			
Treatment	6	3009.619	501.603	24.01**	3.0	4.82
Error	12	250.667	20.889			
Total	20	3320.952				

** Highly significant

CV% = 17.32
SX = 2.64

APPENDIX TABLE 9. Analysis of variance for leaf area index at 45 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.004	0.002			
Treatment	6	0.050	0.008	7.06**	3.0	4.82
Error	12	0.014	0.001			
Total	20	0.069				

** Highly significant

CV% = 4.30
SX = 0.02

APPENDIX TABLE 10. Leaf area index at 60 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	111.870	55.935			
Treatment	6	40293.104	6715.517	21.96**	3.0	4.82
Error	12	3669.256	305.771			
Total	20	44074.230				

** Highly significant

CV% = 16.43
SX = 10.10

APPENDIX TABLE 11. Analysis of variance for leaf area index at 75 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	190.062	95.031			
Treatment	6	49807.532	8301.255	12.31**	3.0	4.82
Error	12	8091.235	674.270			
Total	20	58088.829				

** Highly significant

CV% = 25.94
SX = 14.99

APPENDIX TABLE 12. Net assimilation rate at 45 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	16.835	8.417			
Treatment	6	151.713	25.285	1.67ns	3.0	4.82
Error	12	182.234	15.186			
Total	20	350.782				

ns not significant

CV% = 20.63
SX = 2.25

APPENDIX TABLE 13. Analysis of variance for net assimilation rate at 60 DAP (g/cm^2/day)

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	8.081	4.041			
Treatment	6	0.547	8.425	1.57^{ns}	3.0	4.82
Error	12	64.367	5.364			
Total	20	72.995				

^{ns}not significant

CV% = 13.23
SX = 1.34

APPENDIX TABLE 14. Analysis of variance for net assimilation rate at 75 DAP (g/cm^2/day)

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	1.738	0.869			
Treatment	6	84.838	14.140	3.63*	3.0	4.82
Error	12	46.736	3.895			
Total	20	133.312				

*Significant

CV% = 21.95
SX = 1.14

APPENDIX TABLE 15. Analysis of variance for crop growth rate at 45 DAP (g/cm$^2_{soil}$/day)

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.244	0.122			
Treatment	6	4.691	0.782	2.20^{ns}	3.0	4.82
Error	12	4.268	0.356			
Total	20	4.268				

^{ns}not significant

CV% = 19.63
SX = 0.34

APPENDIX TABLE 16. Analysis of variance for crop growth rate at 60 DAP (g/cm$^{2}_{soil}$/day)

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.079	0.039			
Treatment	6	1.734	0.287	1.44^{ns}	3.0	4.82
Error	12	2.387	0.199			
Total	20	4.189				

^{ns}not significant

CV% = 17.77
SX = 0.26

APPENDIX TABLE 17. Analysis of variance for crop growth rate at 75 DAP (g/cm$^{2}_{soil}$/day)

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.066	0.033			
Treatment	6	3.191	0.532	3.72*	3.0	4.82
Error	12	1.922	0.160			
Total	20	5.179				

*Significant

CV% = 26.86
SX = 0.23

APPENDIX TABLE 18 Analysis of variance for number of marketable extra large tubers per plot.

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	69.714	34.857			
Treatment	6	182.476	30.413	3.41*	3.0	4.82
Error	12	106.952	8.913			
Total	20	359.952				

*Significant

CV% = 26.32
SX = 1.72

APPENDIX TABLE 19. Analysis of variance for number of marketable large tubers per plot

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	249.810	124.905			
Treatment	6	1641.905	273.651	5.95**	3.0	4.82
Error	12	551.524	45.960			
Total	20	2443.238				

** Highly significant

CV% = 20.95
SX = 3.91

APPENDIX TABLE 20 Analysis of variance for number of marketable medium tubers per plot.

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	382.952	191.476			
Treatment	6	3032.667	505.444	268ns	3.0	4.82
Error	12	2265.048	188.754			
Total	20	5680.667				

ns not significant

CV% = 27.28
SX = 7.93

APPENDIX TABLE 21. Analysis of variance for number of marketable small tubers per plot

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	50.667	25.333			
Treatment	6	1334.952	222.492	5.33**	3.0	4.82
Error	12	501.333	41.778			
Total	20	1886.952				

** Highly significant

CV% = 17.07
SX = 3.73

APPENDIX TABLE 22. Analysis of variance for number of marketable marble tubers per plot.

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	514.667	257.333			
Treatment	6	1162.952	193.825	1.02^{ns}	3.0	4.82
Error	12	2279.333	189.944			
Total	20	1906.952				

^{ns}not significant

CV% = 25.66
SX = 7.96

APPENDIX TABLE 23. Analysis of variance for number of non-marketable tubers per plot

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	256.095	128.048			
Treatment	6	1761.619	293.603	1.48^{ns}	3.0	4.82
Error	12	2379.238	198.270			
Total	20	43.396.952				

^{ns}not significant

CV% = 28..45
SX = 8.13

APPENDIX TABLE 24. Analysis of variance for weight of marketable extra large tubers per plot (kg)

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.106	0.053			
Treatment	6	1.361	0.227	6.96**	3.0	4.82
Error	12	0.391	0.033			
Total	20	1.858				

** Highly significant

CV% = 8.93
SX = 0.10

APPENDIX TABLE 25. Analysis of variance for weight of marketable large tubers per plot (kg)

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	TABULAR F .01
Replication	2	1.026	0.513			
Treatment	6	3.871	0.645	5.20**	3.0	4.82
Error	12	1.487	0.124			
Total	20	6.384				

** Highly significant

CV% = 12.97
SX = 0.20

APPENDIX TABLE 26. Analysis of variance for weight of marketable medium tubers per plot (kg).

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	TABULAR F .01
Replication	2	1.427	0.713			
Treatment	6	5.123	0.854	4.11*	3.0	4.82
Error	12	2.495	0.208			
Total	20	9.045				

* Significant

CV% = 16.56
SX = 0.26

APPENDIX TABLE 27. Analysis of variance for weight of marketable small tubers per plot (kg).

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	TABULAR F .01
Replication	2	0.830	0.415			
Treatment	6	2.211	0.369	2.09ns	3.0	4.82
Error	12	2.117	0.176			
Total	20	5.158				

ns not significant

CV% = 22.17
SX = 0.24

APPENDIX TABLE 28. Analysis of variance for weight of marketable marble tubers per plot (kg).

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.176	0.088			
Treatment	6	0.333	0.055	0.88^{ns}	3.0	4.82
Error	12	0.753	0.063			
Total	20	1.262				

^{ns}not significant

CV% = 16.32
SX = 0.14

APPENDIX TABLE 29. Analysis of variance for weight of non-marketable tubers per plot (kg).

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.008	0.004			
Treatment	6	0.022	0.004	1.02^{ns}	3.0	4.82
Error	12	0.042	0.004			
Total	20	0.072				

^{ns}not significant

CV% = 4.95
SX = 0.03

APPENDIX TABLE 30. Analysis of variance for total yield per plot (kg)

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	2.092	1.046			
Treatment	6	48.632	8.105	14.19^{**}	3.0	4.82
Error	12	6.854	0.571			
Total	20	57.578				

** Highly significant

CV% = 26.70
SX = 0.44

APPENDIX TABLE 31. Analysis of variance for yield tons/ha

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	21.542	10.771			
Treatment	6	135.754	22.626	7.31**	3.0	4.82
Error	12	37.117	3.093			
Total	20	194.413				

** Highly significant

CV% = 29.74
SX = 1.01

APPENDIX TABLE 32. Analysis of variance for dry matter content of leaves at 45 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	82.608	41.304			
Treatment	6	74.864.	12.477	2.33ns	3.0	4.82
Error	12	64.284	5.357			
Total	20	221.756				

ns not significant

CV% = 17.16
SX = 1.34

APPENDIX TABLE 33. Analysis of variance for dry matter content of leaves at 60 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	266.661	133.330			
Treatment	6	236.292	39.382	1.91ns	3.0	4.82
Error	12	246.938	20.578			
Total	20	749.891				

ns not significant

CV% = 27.09
SX = 2.62

APPENDIX TABLE 34. Analysis of variance for dry matter content of leaves at 75 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	96.538	48.269			
Treatment	6	1119.201	186.534	6.09**	3.0	4.82
Error	12	367.475	30.623			
Total	20	1583.214				

** Highly significant

CV% = 18.89
SX = 3.19

APPENDIX TABLE 35. Analysis of variance for dry matter content of leaves at 90 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	170.217	85.108			
Treatment	6	1422.506	237.084	10.57**	3.0	4.82
Error	12	269.221	22.435			
Total	20	1861.221				

**Highly significant

CV% = 24.94
SX = 10.60

APPENDIX TABLE 36. Analysis of variance for dry matter content of stems at 45 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	340.382	170.191			
Treatment	6	112.389	18.731	0.48ns	3.0	4.82
Error	12	472.442	39.370			
Total	20	925.213				

nsnot significant

CV% = 22.83
SX = 3.62

APPENDIX TABLE 37. Analysis of variance for dry matter content of stems at 60 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	65.084	32.542			
Treatment	6	91.710	15.285	1.08^{ns}	3.0	4.82
Error	12	169.768	14.147			
Total	20	326.562				

^{ns}not significant

CV% = 15.43
SX = 2.17

APPENDIX TABLE 38. Analysis of variance for dry matter content of stems at 75 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	77.493	38.747			
Treatment	6	1734.945	289.157	2.68^{ns}	3.0	4.82
Error	12	1294.393	107.866			
Total	20	3106.831				

^{ns}not significant

CV% = 16.11
SX = 2.20

APPENDIX TABLE 39. Analysis of variance for dry matter content of stems at 90 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	77.493	38.747			
Treatment	6	1734.945	289.157	2.68^{ns}	3.0	4.82
Error	12	1294.393	107.866			
Total	20	3106.831				

^{ns} not significant

CV% = 24.44
SX = 5.99

APPENDIX TABLE 40. Analysis of variance for dry matter content of roots and stolons at 45 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	72.317	36.159			
Treatment	6	361.091	60.182	2.14^{ns}	3.0	4.82
Error	12	336.808	28.067			
Total	20	770.216				

^{ns}not significant

CV% = 23.06
SX = 3.06

APPENDIX TABLE 41. Analysis of variance for dry matter content of roots and stolons at 60 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	116.721	58.361			
Treatment	6	372.525	62.087	0.68^{ns}	3.0	4.82
Error	12	1093.900	91.158			
Total	20	1583.146				

^{ns}not significant

CV% = 5.94
SX = 5.51

APPENDIX TABLE 42. Analysis of variance for dry matter content of roots and stolons at 75 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	932.340	466.170			
Treatment	6	1148.414	191.402	3.56*	3.0	4.82
Error	2	646.001	53.833			
Total	20	2726.755				

*Significant

CV% = 22.40
SX = 4.24

APPENDIX TABLE 43. Analysis of variance for dry matter content of roots and stolons at 90 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	150.321	75.161			
Treatment	6	1970.644	378.444	2.01*	3.0	4.82
Error	12	1955.978	162.998			
Total	20	4076.963				

ns not significant

CV% = 11.70
SX = 7.37

APPENDIX TABLE 44. Analysis of variance for dry matter content of tubers at 45 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	139.803	69.902			
Treatment	6	286.771	47.795	1.14ns	3.0	4.82
Error	12	503.002	41.917			
Total	20	929.576				

ns not significant

CV% = 23.39
SX = 3.74

APPENDIX TABLE 45. Analysis of variance for dry matter content of tubers at 60 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	6.963	3.481			
Treatment	6	74.500	12.417	1.77ns	3.0	4.82
Error	12	84.226	7.019			
Total	20	165.689				

ns not significant

CV% = 13.52
SX = 1.53

APPENDIX TABLE 46. Analysis of variance for dry matter content of tubers at 75 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.800	0.400			
Treatment	6	104.373	17.395	6.26**	3.0	4.82
Error	12	33.354	2.779			
Total	20	138.527				

ns not significant

CV% = 7.61
SX = 0.96

APPENDIX TABLE 47. Analysis of variance for dry matter content of tubers at 90 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	20.425	10.212			
Treatment	6	339.351	56.558	2.89ns	3.0	4.82
Error	12	234.458	19.538			
Total	20	594.234				

ns not significant

CV% = 21.79
SX = 2.55

APPENDIX TABLE 48. Analysis of variance for harvest index at 45 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.010	0.005			
Treatment	6	0.150	0.025	1.12ns	3.0	4.82
Error	12	0.267	0.022			
Total	20	0.427				

ns not significant

CV% = 9.53
SX = 0.09

APPENDIX TABLE 49. Analysis of variance for harvest index at 60 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.004	0.002			
Treatment	6	0.022	0.004	0.27^{ns}	3.0	4.82
Error	12	0.166	0.014			
Total	20	0.193				

^{ns}not significant

CV% = 26.73
SX = 0.07

APPENDIX TABLE 50. Analysis of variance of harvest index at 75 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.057	0.029			
Treatment	6	0.582	0.097	7.06**	3.0	4.82
Error	12	0.165	0.014			
Total	20	0.803				

^{ns}not significant

CV% = 29.32
SX = 0.07

APPENDIX TABLE 51. Analysis of variance for harvest index at 90 DAP

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F	
					.05	.01
Replication	2	0.003	0.001			
Treatment	6	0.543	0.090	10.8**	3.0	4.82
Error	12	0.107	0.009			
Total	20	0.652				

**Highly significant

CV% = 5.83
SX = 0.05

BIOGRAPHICAL SKETCH

The author was born to Mr. Luis Kios Senior and Mrs. Gina Camolo Kios on January 20, 1957 in Lubas, La Trinidad, Benguet.

She completed her elementary education at Lubas Elementary School at La Trinidad, Benguet. She finished her secondary education at San Jose High school. She continued her college education at Mountain State Agricultural College (MSAC) and finished with a degree of Bachelor of Science in Forestry. In 1985 she pursued her Master's degree major in Horticulture and minor in Extension in the same school now Benguet State University (BSU) and was able to finish in 1992.

She is presently working as a Researcher at the Northern Philippine Root Crop Research and Training Center (NPRCRTC) based at Benguet State University under the Crop Improvement Department.

She was a widow with three children in 1984: Denver, Donna and Douglas Jr. and in 1989 she got married to Mr. Antonio Simongo and blessed with one beautiful daughter Antonette.

DONITA K. SIMONGO