BIBLIOGRAPHY

PANICO, ADAMSON A. APRIL 2006. Agronomic Characters of Potato Entries in a Transitional Organic Farm at Englandad, Atok, Benguet. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted to: determine the agronomic characters of ten potato entries in a transitional organic farm at Englandad, Atok, Benguet; determine the best potato entries in terms of yield and resistance to pest and diseases; determine the economic benefits of growing different potato entries organically and determine which of the entries will be selected by the transitional organic farmer.

The potato entries evaluated differed in terms of plant height and weight of marketable tubers produced. Entry 380251.17 produced the tallest plants. Entry 13.1.1 was the most resistant to late blight at 60 DAP. For the marketable yield, 13.1.1 significantly produced the highest but was not significantly different with 676089. Entry 380251.17 gave comparable yield with entries 13.1.1 and 676089.

Return on cash expense (ROCE) was positive for all entries for seed tuber potato production. For table potato production, five entries obtained a positive ROCE. Based on yield, ROCE and selection made by the farmer, entries 13.1.1, 676070 and 676089, are recommended for organic production at Englandad, Atok, Benguet.

Potatoes produced from stem cuttings are more profitable if sold as seed tubers.

The different potato entries can be further evaluated in other organic farms and planting months so as to verify their adaptation and profitability.

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INTRODUCTION

Potato (*Solanum tuberosum L.*) locally known as "patatas" is a high value crop and ranks first among the vegetable grown in Benguet and mountain Province. Potato is a crop important for its nutritional value. It is primarily a source of carbohydrates or energy food with 18% starch, 2% protein, 1% ash or mineral and 78 % of water (FRDL, 1995). Potato can also contribute to the government effort to attain self- sufficiency in food and to reduce malnutrition because potato contain high an\mount of quality calorie and nutritive value. (HARRDEC, 1996).

Potato plays an important part in providing needed qualitative and quantitative sufficiency of food for developing countries (Horton, 1996). On the other hand, production of this important crop is limited due to high production costs and limited available land. To have high profit, farmers rely on purchased inputs to intensity the potato production system. (Potts, 1983). Today, the problem faced by the farmers is cost of chemical fertilizers, low yielding seeds or planting materials and soil degradation because of inappropriate management and monocropping practice. Furthermore, many farmers are still uncertain which variety will be planted and to renew their non-productive traditional varieties. Hence, farmers need new cultivars with resistance to pest and diseases, high yielding and adaptable to its environments. Planting of new varieties would be better if farmers would shift to alternative ways of production rather than the conventional way. Shifting to organic farming appears to be a logical alternative in minimizing chemical inputs. In addition, alternative farming system can achieve net returns that are comparable to those of conventional farms. (Katen, 1979 and Lockeretz *et al.*, 1981). Organic farming methods are practical an economical to increase yield, conserve the soil and maintain water quality (NPRCRTC, 1998). The shifting of convention to organic farming has three years transition. The farm is considered a transitional farm. Evaluation of potato entries in a transitional organic farm would be one of the first steps in shifting to organic farming. In organic farming, it is important that varieties should be resistant to pest and diseases so as to minimize if not use chemical pesticides.

The objectives of the study were to:

1. determine the agronomic characters of different potato entries in a transitional organic farm at Englandad, Atok, Benguet;

2. determine the best potato entries in terms of yield and resistance to pest and diseases;

3. determine the economic benefits of growing different potato entries organically; and

4. determine which of entries will be selected by the transitional organic farmer.

The study was conducted in an organic farm at Englandad, Atok, Benguet from October 2005 to January 2006.

REVIEW OF LITERATURE

Definition and importance of organic farming

Organic farming methods are practical and economical ways to increase yield, conserve the soil and maintain the water quantity and lower operating costs. Organic farms produce the same amount of yield of the same quality for the costs as conventional farmers of the same size. Moreover, organic farms are relatively free form the possible toxicities to the soil and to flora and fauna in general (NPRCRTC, 1998).

"Organic farming all various forms of sustainable agriculture such as organic agriculture, biodynamic agriculture and natural way of farming share a concern for the health and welfare of the farmer in the future. A way of farming that avoids the use of synthetic fertilizer as well as genetically modified (GMOs) and usually subscribes to the principles of sustainable agriculture. Organic farming management relies on the developing biological diversity in the field to disrupt habitat for pest organisms, and replenishment of the soil fertility. While they have different practices, they are guided with the seven principles of sustainable agriculture; ecologically sound, economic viability, socially just/equity, cultural sensitivity, appropriate technology, holistic science and human development" (Briones, 1997).

Anonymous (2002) defined organic farming as whole system approach that works to optimize the natural fertility resources of the farm. This is done through traditional practices of recycling farm-produced livestock manure, composting, crop rotation, green manuring and crop residue management. Organic agriculture also looks to local waste product manures from confinement feeding food processing waste etc. to supplement soil fertility economically.

Organic farmers apply the soil and build soil organic matter with cover crops, compost and biologically based soil amendments. Organic matter in the soil produces healthy plants that are better able to resist disease and insects. Organic farmers' primary strategy in controlling pests and diseases is prevention through good plant nutrition and management. Organic farmers use cover crops and crop rotations to change the field ecology, effectively disrupting habitat for weeds, insects, and disease organisms. Weeds are controlled through crop rotation, mechanical tillage, and hand weeding, as well as through cover crops, mulches, flame weeding, and other management methods. Organic farming relies on a diverse population of soil organisms, beneficial insects, and birds to keep pests in check. When pest populations get out of balance, growers implement a variety of strategies such as the use of insect predators, mating disruption, traps and barriers (Anonymous, 2005).

Components of organic farming

Use of organic fertilizer and organic matter. Kinoshita (1972) as cited by Tomilas (1996) reported that application of organic fertilizer in sufficient amount improves soil structure. The organic fertilizer improves the organic content of the soil and increase the quantity of nutrient element for the plant growth and development and decreases bulk density of the soil. Organic matter in the soil can also increase water absorption and lessens water run-off, leaching and erosion. Balaoing (1995) noted the nutrient content of organic fertilizer particularly rice straw which are N, P, K, Ca, Mg, Na and S. Further, he cited that organic fertilizer stimulates and increases the microbial populations in the soil. The use of organic fertilizer likewise minimizes pollution because the rotten wastes can be recycled into compost.

Importance of organic matter. Soil organic matter contributes to good soil structure and water-holding capacity Dart and Murphy (1989). Parnes (1986) claimed that organic matter is the principal source of nitrogen, phosphorous, and sulfur. The soil organism discards most of the calcium, magnesium and potassium in the decaying organic residues during the first stage of decomposition and these nutrients are quickly available to plants. Organic matter, though its effect on the physical condition of the soil increases the amount of water available for the plant growth. Cho (1986) cited that organic matter is the principal reservoir of nitrogen and other nutrients. It increases the soil buffering capacity and Helps maintain the good soil texture and protect soil from erosion and maintain a healthy community of soil microorganism. Organic matter also reduces fluctuations in soil pH, improves soil aeration, facilitate the activities of microorganism and serves as additional source of nutrient needed by the plants (Vander, 1997).

EL-nadi (1995) cited that the availability of nutrients in organic fertilizers is low due to the slow release of nutrients during decomposition, and upon decomposition of organic matter nutrients such as nitrogen, phosphorous, potassium calcium, magnesium and other elements which the plant require for its growth and development are available.

Knott (1976) claimed that application of organic fertilizer to the soil prior to planting or sowing time results in high yields. Manure provides nutrients and also humus, which improves the physical condition of the soil. Further, decompose farm manure is applied at a rate of 10-20 tons/ha. After the first plowing, this amount will slowly provide nitrogen during the vegetative growth the crop. However, full benefits of such practices would be realized over a period of 2-3 yrs.

Lang (1995) found that organic matter facilitate plowing and cultivating in potato plants. Potato tubers develop and maintain their normal shape better in soil with adequate organic matter. Menzi (1996) reported that organic fertilizers generally contain the essential element for proper plant growth. They assure the farmer for lower inorganic inputs. According to reports organic fertilizer are 50-60% cheaper than inorganic fertilizer. Moreover, organic fertilizer can be used to replace up to 50% of the inorganic fertilizer need of the farmer and at present found to be increasing the yield of crop. Organic fertilizer has long lasting effect in restoring the fertility of the soil as Brady (1974) claimed that farm manures are considered degraded animal and plant material that tend to increase the yield of crops.

Koshino (1990) claimed that nutrient elements organic fertilizers are released slowly, which is particularly important in avoiding salt injury, insuring a continuous supply of nutrients during the growing season and producing products of better quality.

Use of compost in organic farm. Sangatnan and Sangatnan (1990) claimed that successive applications of compost enrich the soil organic matter and improve the physical, chemical and biological properties of the soil. Compost application also builds up the absorbing capacity of the soil. Soils with compost have less water evaporation than the soil without compost applied. Therefore, compost is recommended in crop production, to increase crop yield and to minimize water evaporation from the soil.

Source of organic matter

The most common natural organic fertilizers in the Philippines are chicken manure, hog manure, and sunflower compost. Chicken manure is more extensively used in the province of Benguet than any other kind of manure. The farmers usually apply 20 to 30 tons per hectare (Bautista, *et al.* 1983). The kind of organic materials according to source are crop residues, green manure, pig manure, cattle manure, poultry, used of mushroom compost, municipal refuse, and residues after soil extraction and residues from processing animal product (Bucu, 1991).

The decomposition of organic materials is a digestive process of bacteria, fungi and actinomycetes in the presence of oxygen. It is a common to pile organic raw material with sufficient supply of water and air that used to compost (Inoko, 1985).

Diverse cropping. Diverse ecosystems in nature have a higher degree of stability than those with only a few species. This is also true for agroecosystems. Farms with diverse crops have a better chance of supporting beneficial insects and other organisms that assist in pollination and pest management. Diversity above ground also suggests diversity in the soil, providing better nutrient cycling, disease suppression, tilth, and nitrogen fixation. Diverse cropping should be practiced so that there will be lesser pest infestation and no use of synthetic fertilizer and pesticides. Sanitation is also practiced to reduce alternate hosts of the insects and minimize infestation (Anonymous, 2005).

Importance of variety evaluation in organic farming

Bautista and Mabesa (1997) cited that selecting the right variety would minimize problem associated with water and fertilizer management. Varieties should be high yielding, pest and disease resistant and early maturing so that production would entail less expense and ensure more profit. HARRDEC (1996) further cited varietal that evaluation is important in order to observe performance character such as yield, earliness, vigor, maturity and keeping quality because different varieties have wide range of differences in plant size and in yield performance. However, the varieties to be selected should be high yielding, insect and diseases resistant and early maturing.

There is a variation in the yielding ability of the different varieties when grown under the same method of culture. A variety yield well in one region is not a guarantee that it will perform well in another region (Reily and Shry, 1991). In addition, choosing variety that is most suited to the prevailing climatic condition could assure success at lowest possible cost per hectare. In choosing the right variety, the adaptability to climatic condition, potential, yield, maturity, resistant to insect pest and diseases and market demand must be consider (Anonymous, 2000).

Varietal evaluation in potato. Murakami (1991) conducted an on-farm potato evaluation and found not all clones were not superior as those in the in the on- station trial. Out of the 22 clones only two clones exhibited comparable level of yield ability, adaptability and stability with their popular local variety. Thus, as a role, new clones usually differ in cultural characteristics. Therefore, several series of evaluation must be made at different strategic location and seasons.

Beukema (1985) stated that clonal selection and evaluation is important in a breeding program. The standard procedure involves the selection of healthy- looking and high yielding plant in the field. Tubers of each selected are harvested and kept separate to be planted in the next season trial. Plants are carefully inspected for any abnormalities and if found in the first generation (F_1) clones are rejected and remove right away from the field. Hence, successful potato production begins with long-term labor intensively breeding.

MATEIALS AND METHODS

The farm and Farmer's Practices

The Farm

The transitional organic farm is located at Englandad, Sayangan, Atok, Benguet as shown in fig.1. The farm is specifically located on the top of the mountain with an elevation of 2,300 meters above sea level.

The farm has sandy loam soil and was previously planted with carrots. Other crops planted during the conduct of the study were cala lily and other grasses which served as insect repellant and barriers (Lesoc, 2005).

The Farmer

Mrs. Toria Lesoc is 45 years old transitional organic practitioner. She attended several training/ seminars on organic farming. Since her first training in 2000, she shifted to organic farming. She also attended trainings held at BSU from 2005-2006.

She is practicing organic farming for the last three years.

Practices of the Farmer

Land preparation. The farmer prepared the land one week before planting. Practices during land preparation include weeding, raised beds (plot) for planting and application of basal fertilizer. Land preparation usually done manually by using hand tools like grab hoe, Japanese hoe and sharp wooden stick use for weeding, planting and for harvesting.

Planting. The farmer plants early morning or in the late afternoon of the day. Direct planting is the usual practiced for all crops.

Fertilization. The farmer incorporate farm-made compost into the soil as a basal fertilizer during land preparation. One month after planting, compost is side-dressed. Organic fertilizer is thus applied twice during the crop duration.

Water management. The plants are irrigated once or twice a week after planting throughout the growing period. Irrigation is however, not maintained due to limited supply of water.

Pest management. The farmer control pests by hand picking, removing of the hosts plant and planting of repellant plants. Chemical pesticides are not applied.

Seed selection. The farmer prefers varieties resistant to insects and diseases, high yielding and adapted to the local condition.

The Experiment Proper

Planting Materials

Fifteen potato entries grown from rooted stem cuttings were acquired from the Northern Philippines Root Crops Research and Training Center (NPRCRTC). These entries were selected from an observational trial for organic production at Balili, La Trinidad, Benguet.

Land Preparation, Experimental Design and Treatments

An area of 150 m^2 was thoroughly prepared and divided into three blocks. Each block contained 15 plots with a dimension of 1 m x 5 m. The experiment was laid out following the randomized complete block design (RCBD) replicated three times.

The treatments were as follows:

TREATMENT	ENTRY	ORIGIN
A1	380251.17	CIP, Peru
A2	384558.10	CIP, Peru
A3	676070	CIP, Peru
A4	Ganza	CIP, Peru
A5	573275	CIP, Peru
A6	676089	CIP, Peru
A7	5.19.2.2	Philippines
A8	Kennebec	USA
A9	575003	CIP, Peru
A10	13.1.1	CIP, Peru

Planting and Fertilizer Application

Rooted potato stem cuttings were planted in a double row plot with a distance of 25 cm x 30 cm between hills and rows. The entries were equally applied with compost made from chicken dung, sunflower, pig manure and crop residues from the farm thoroughly mixed with the soil as basal fertilizer before planting.

Cultural Management Practices

The farmer's management practices in organic potato production were followed. These include planting of marigold around the blocks to serve as insect repellant and wind barrier and use of fruit fly catcher.

Data Gathered

I. Meteorological Data. Temperature and relative humidity was taken using a wet and dry bulb psychrometer.

II. Soil Chemical Properties. Soil samples were taken to the Bureau of soils, Pacdal, Baguio City for the analysis of:

1. Organic matter (%)
2. Nitrogen (%)
3. Phosphorous (ppm)
4. Potassium (pm)
5. pH

III. Growth Parameters

1. Plant vigor. This was recorded at 35 and 65 days after planting (DAP) using the CIP rating scale (NPRCRTC, 2000).

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

2. Canopy cover. This was taken during the vegetative stage at 30,45, 60, and 75 DAP using a wooden frame 120 cm x 6 cm having equally sized 12 x 6 grids. Holding

the grid over the foliage of four representative previously marked plants, grids covered with effective leaves were counted.

3. Plant height (cm). This was measured using ten random sample plants per plot at 30 DAP. Plants were measured from the base up to the tip of tallest shoot.

IV. Pest and Disease Incidence

Late Blight incidence. This was observed started at 45, 60 and 75 DAP using the CIP Scale (Henfling, 1982).

Blight	Scale	Description
1	1	No blight to be seen
01-1	1	Very few plants in larger plants with lesions. Not more than lesion per 10m of row (+/-30plants).
1.1- 2	2	Up to 10 small lesions per plants.
3.1-10	3	Up to 30 small lesions per plant, or up to 1in each 20 leaflet attack.
10.1-24	4	Most plants are visibly attacked and 1 in 3 leaflets infected. Multiple infections per leaflets.
25-29	5	Nearly every leaflet with lesions. Multiple infections per leaflets are common. Field or plot looks green, but all plants in plots are blighted.
47-50	6	Every plant blighted and half the leaf area destroyed by ploy looks green, freckled, and brown, blight is very obvious.
75-90	7	As previous, but ¾ of each plant blighted branches over helming killed off, and the only green leafs, if any, there are the top of the plant shade of plants maybe more spindly due to extensive foliage loss. Plots look neither brown nor green.

1-1-97	8	Some leaves and most stems are green. Plot looks brown with some leaves patches.
97.1-99.9	9	Few green leaves almost all with blight lesions remain. Many stem lesions. Plot looks brown.

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

V. Yield and Yield Components

1.Weight of marketable tubers per plot (g). All marketable tubers, which are of marketable size, not malformed and without 10 % greening of the total surface area were counted and weighted at harvest.

3. Weight of non-marketable tubers per plot (g). This was taken by weighing all non-marketable tubers at harvest which were cracked, severely scabbed, deformed, pest damaged, rotten tuber and with more than 10% greening.

4. Total yield per plot(g). The sum of the weight of marketable and non-marketable tuber yield in each plot were weighted.

6. Dry matter content (%). This was taken by slicing three sample tubers of medium, big, small into very small cubes (3-4 m^3). These cubes were mixed together to get a good representative of 100 g. Three100 g samples were taken as replicates and oven-dried at 80^0C for 36 hours. The dry matter content was computed using the formula:

a. % Dry matter content (DMC) = 100- MC

$$\text{b. \%Moisture (MC)} = \frac{\text{Fresh weight – Oven-dried weight}}{\text{Fresh weight}} \times 100$$

VI. Cost and Return Analysis. All production cost were recorded and net profit was obtained. Return on cash expense was computed as:

$$ROCE = \frac{\text{Net Profit}}{\text{Total cost of production}} \times 100$$

Data Analysis

All quantitative data were analyzed using Analysis of Variance (ANOVA) for randomized complete block design (RCBD) with three replications. The significance of differences among the treatment means were tested using Duncan's Multiple Range Test (DMRT).

RESULT AND DISCUSSION

Meteorological data

Table 1 shows the temperature and relative humidity during the conduct of the study . The Highest temperature was 22.25^{o}C in the month of December and lowest temperature is 14.25^{o}C. Relative humidity range from 82-94%.

Relative humidity was observed to be high. This condition might have affected the occurrence of late blight during the conduct of the study.

Soil chemical properties

Table 2 shows the pH, OM,N,P and K before planting and after harvesting. The soil had an original pH of 6.34 and 4.5 OM. These are known to be ideal for potato production. According to Lambert (1995) normal soil contains 1-4 % organic matter.

Table 1. Temperature and relative humidity during the conduct of the study

MONTH	WEEK	TEMPERATURE (^{o}C)	RELATIVE HUMIDITY (%)
NOVEMBER	4th	17.5	86
DECEMBER	1st	18.0	82
	2nd	14.75	86
	3rd	14.25	94
	4th	22.25	94
JANUARY	1st	17.25	86
	2nd		
	3rd	16.5	90
MEAN		15.92	

As for Nitrogen, the initial content of the soil was 0.0225 after harvesting, it decreased to 0.2. The decreased could be due to the high demand of the nutrient by the crop. As for Phosphorous and Potassium, the original contents of the soil slightly increased. This may due to the kind of compost used by the farmer.

The soil pH 6.34 before planting and at harvesting soil pH 6.23 was obtained. It appears that soils have slightly reduction of pH which was due to slow release of organic nutrient required by the plant.

Growth Parameters

Plant Vigor

Table 3 shows that all plants are highly vigorous at 35 DAP. At 65 DAP, potato entries 380251.17, Ganza, 573275 and Kennebec showed a decrease in their plant vigor. The poor vigor of the different potato genotypes grown organically may be due to unfavorable temperature during the conduct of the study. Very low temperature might have contributed to low vigor of the plants during the conduct of the study. Many studies show that low temperature affect growth of plants. Figure 1 shows the plants at 30 DAP.

Table 2. Soil chemical properties of the experimental area before planting and after planting

	pH	OM (%)	N (%)	P (ppm)	K (ppm)
Before planting	6.34	4.5	0.225	395	676
After planting	6.23	4.0	0.2	405	752

Fig. 1. Overview of plants at 30 DAP

Table 3. Plant vigor of ten potato entries at 35 and 65 DAP

ENTRY	PLANT VIGOR	
	35 DAP	65 DAP
380251.17	5	2[ab]
384558.10	5	1[bc]
676070	5	2[ab]
Ganza	5	1[ab]
573275	5	1[ab]
676089	5	3[a]
5.19.2.2	5	2[ab]
Kennebec	5	1[ab]
575003	5	2[ab]
13.1.1	5	3[a]

Rating scale: 1 – Poor vigor; 2 – Less vigorous; 3 – Vigorous; 4 – Moderately vigorous; 5 – Highly vigorous.

<u>Canopy Cover</u>

Table 4 shows the canopy cover of different potato entries taken at 30, 45, 60 and 75 DAP. It was observed that at 30 to 60 DAP, 380251.17 and 676089 had the highest canopy cover and Kennebec had the lowest. However, there were no significant differences among the entries. At 60 DAP, it was observed that the canopy decreased in most of the entries. This could be due to the severe late blight infestation caused by high relative humidity. Further observation revealed that 676089 and 13.1.1 which maintained the highest canopy covers were observed to be moderately resistant to late blight.

Table 4. Canopy cover of ten potato entries at 30, 45 and 60 DAP

ENTRY	CANOPY COVER*		
	30 DAP	45 DAP	60 DAP
380251.17	26	27	6[c]
384558.10	21	18	6[c]
676070	20	23	15[bc]
Ganza	19	15	16[bc]
573275	22	24	16[bc]
676089	22	27	25[ab]
5.19.2.2	18	21	15[bc]
Kennebec	19	10	5[c]
575003	20	14	14[bc]
13.1.1	24	31	29[a]
CV (%)	15.38	16.90	33.98

*Means with common letters are not significantly different by DMRT (P>0.05)

Plant Height

Table 5 and Figure 2 show the height of ten potato entries at 30 DAP. It was observed that tallest plants were produced by 380251.17 which are significantly different with the other entries. On the other hand, Ganza produced the shortest plants among to the entries. The differences in height could be attributed to their genotypic characteristics and adaptation to the place.

Table 5. Plant height of ten potato entries at 30 DAP

ENTRY	HEIGHT* (cm)
380251.17	21.80[a]
384558.10	11.91[def]
676070	14.41[cd]
Ganza	9.22[f]
573275	10.82[ef]
676089	18.94[b]
5.19.2.2	17.23[bc]
Kennebec	12.50[cd]
575003	16.80[bc]
13.1.1	18.18[b]
CV (%)	11.26

*Means with common letters are not significantly different by DMRT (P>0.5)

<u>Late Blight Incidence</u>

It was observed that all of the potato entries had various reactions to late blight (Table 6). This could be due to the high relative humidity which is favorable to late blight infection. At 75 DAP, most of the plants were infected with late blight which could be due to high relative humidity which favored late blight infection.

Table 6. Late blight incidence of ten potato entries at 45, 60 and 75 DAP

ENTRY	LATE BLIGHT INCIDENCE		
	45 DAP	60 DAP	75 DAP
380251.17	4^{cd}	6^{b}	9^{a}
384558.10	6^{ab}	8^{a}	9^{a}
676070	4^{cd}	6^{b}	8^{b}
Ganza	6^{ab}	8^{a}	9^{a}
573275	4^{cd}	6^{b}	9^{a}
676089	3^{d}	5^{bc}	7^{c}
5.19.2.2	4^{cd}	5^{bc}	9^{a}
Kennebec	7^{a}	9^{a}	9^{a}
575003	5^{bc}	6^{b}	8^{b}
13.1.1	3^{d}	4^{c}	7^{c}

Description: 1= Highly resistant; 2 –3 = Resistant; 4 –5 = Moderately resistant; 6 – 7 = Moderately susceptible; 8 – 9 = Susceptible.

Yield and Yield Components

Weight of Marketable Tubers per Plant

Table 7 shows the weight of marketable tubers. Among the entries 13.1.1 produced the heaviest weight of marketable tubers which was followed by 6760789. On the other hand, Ganza produced the lowest weight of marketable tubers. It was observed that the entries which produced high marketable yield had the high canopy covers and were resistant to late blight.

Weight of Non- Marketable Tuber Per Plant

No significant differences were observed among the entries evaluated. Entry 13.1.1 produced the heaviest weight of non-marketable tubers. Entry 676070 produced the lowest weight of non-marketable tubers.

Total Yield Per Plant

Significant differences in total yield per plant were observed among the entries as shown in Table 7. Entry 13.1.1 significantly produced the heaviest total yield. The high yield could be explained by their differences in canopy cover and late blight resistance. Figure 2 presents the tubers of the potato entries at harvest.

Table 7. Yield of ten potato entries in a transitional organic farm at Englandad, Atok, Benguet

ENTRY	YIELD (g/ plant)		
	MARKETABLE*	NON-MARKETABLE	TOTAL YIELD*
380251.17	36.80^{ab}	8.75	46.67^{ab}
384558.10	8.73^{c}	7.94	16.67^{bc}
676070	23.95^{bc}	2.84	26.67^{bc}
Ganza	4.79^{c}	7.21	12.00^{c}
573275	22.98^{bc}	4.75	27.67^{bc}
676089	48.10^{a}	10.75	59.00^{a}
5.19.2.2	6.19^{c}	6.56	12.67^{c}
Kennebec	10.23^{c}	4.06	14.33^{c}
575003	11.57^{c}	5.89	17.67^{bc}
13.1.1	53.76^{a}	15.94	69.67^{a}
CV (%)	39.9	24.17	27.27

*Means with common letter are not significantly different by DMRT (P>0.05).

Fig. 2. Tubers of ten potato entries at harvest

Dry Matter Content

Table 8 shows the dry matter content of tubers of the potato entries evaluated. There were no significant differences observed. Numerically, however, 13.1.1 had the highest dry matter content. Entry 676070 had the lowest dry matter content.

Table 8. Dry matter content of ten potato entries

ENTRY	DRY MATTER CONTENT (%)
380251.17	21
384558.10	17
676070	16
Ganza	21
573275	23
676089	19
5.19.2.2	20
Kennebec	19
575003	17
13.1.1	24
CV (%)	15.55

Cost and Return Analysis

The cost and return analysis on potato production in a transitional organic farm is shown in Table 9. Among the evaluated entries 13.1.1 had the highest return on cash expense (ROCE). High ROCE could be attributed to high marketable yield produced. It was observed that all entries have high return on cash expense for seed production. For table potato production, there were five entries which have negative return on cash expense. This could be due low marketable yield.

Table 9. Cost and return analysis in seed potato production (per 5 m^2 basis)

ENTRY	COST OF PROD'N* (Php)	TOTAL # OF TUBERS **	GROSS INCOME (Php)	NET INCOME (Php)	ROCE (%)
380251.17	56.60	40	80	23.4	41
384558.10	56.60	80	160	103.4	182
676070	56.60	40	80	23.4	41
Ganza	56.60	40	80	23.4	41
573275	56.60	40	80	23.4	41
676089	56.60	67	133	76.73	134
5.19.2.2	56.60	40	80	23.4	41
Kennebec	56.60	40	80	23.4	41
575003	56.60	40	80	23.4	41
13.1.1	56.60	153	266	209.4	370

*Total cost of production includes cost of compost and labor.
* *Tubers were sold at P2.00 per piece. (NPRCRTC, 2005).

Table 10. Cost and return analysis in table potato production (per 5 m^2 basis)

ENTRY	COST OF PROD'N* (PhP)	WEIGHT OF POTATO** (kg)	GROSS INCOME (Php)	NET INCOME (Php)	ROCE (%)
380251.17	56.60	4.42	176.8	120.2	212.37
384558.10	56.60	1.05	4.0	-14.6	-25.80
676070	56.60	2.87	114.8	58.2	102.83
Ganza	56.60	0.57	22.8	-33.8	-59.71
573275	56.60	2.76	110.4	53.8	95.05
676089	65.60	5.77	230.8	174.2	307.77
5.19.2.2	56.60	0.74	29.6	-27	-47.70
Kennebec	56.60	1.23	49.2	-74	-13.07
575003	56.60	1.39	55.6	-1	-1.77
13.1.1	56.60	6.45	258	201.4	355.8

*Total cost of production includes cost of compost and labor.
**Tubers were sold at P40.00 per kg.

Farmer's Selection

Tables 11 shows the entries selected by the transitional organic farmer. Entries 380251.17,676070,573275,676089 and 13.1.1 were the best entries selected by the farmers. The reasons are; adaptability in the locality, resistance to late blight and high yield. According to Lesoc (2005) resistant and adapted entries in the locality usually produce high yield if planted under favorable condition.

Table 11. Farmer's selection and reasons for choice

ENTRY	REASON
380251.17	Large tubers produced with smooth skin and more eyes
676070	High yield, tubers have smooth skin, good shape and good color
573275	High yield, tubers have smooth skin and good shape
676089	High yield, tubers have good shape, smooth skin and more marketable tubers produced
13.1.1	High yield and tubers have good shape, smooth skin, less non-marketable tubers produced

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

This was conducted to: determine the agronomic characters of ten different potato entries in a transitional organic farm at Englandad, Atok, Benguet; determine the best potato entries in terms of yield and resistance to pest and diseases; determine the economic benefits of growing different potato entries organically and determine which of entries will be selected by the organic farmer.

Among the ten potato entries evaluated, there were significant differences observed for the height, canopy cover and weight of marketable tubers produced. Entry 380251.17 produced the tallest plants. Entry 13.1.1 had the highest canopy cover and produced the highest weight of marketable tubers and total yield and is the most resistant to late blight. In terms of ROCE, entries 13.1.1 676089 and 676070 obtained the highest for both seed production and table potatoes.

Conclusion

Entries 13.1.l, 676070 and 676o89 had the best performance in terms of canopy cover, resistance to late blight and high yield under transitional organic farm at Englanadad, Atok, Benguet. Entries 13.1.1, 384558.10 and 676089 are profitable for seedtuber production and table potatoes. Yield and quality of the tubers are the main basis for selection of the transitional organic farmer as exhibited by entries 13.1.1, 380251.17 and 676070.

Recommendation

Entries 13.1.1, 676070 and 676089 are recommended for organic production at Englandad, Atok Benguet.

Potatoes produced from stem cuttings were more profitable if sold as seed tubers. The different potato entries can be further evaluated in other organic farms and other planting months so as to verify their adaptation and profitability.

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APPENDICES

APPENDIX TABLE 1. Plant vigor of ten potato entries at 35 DAP

ENTRY	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	5	5	5	15	5
384558.10	5	5	5	15	5
676070	5	5	5	15	5
Ganza	5	4	5	14	5
573275	5	5	5	15	5
676089	5	5	5	15	5
5.19.2.2	5	5	5	15	5
Kennebec	5	5	5	15	5
575003	5	5	4	14	5
13.1.1	5	5	5	15	5
TOTAL	50	49	49	148	50

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.067	0.33			
Treatment	9	28.000	3.111	4.44^{ns}	2.44	3.60
Error	18	1.267	0.070			
TOTAL	29	1.867				

^{ns} = Not Significant

Coefficient of Variance = 5.38%

APPENDIX TABLE 2. Plant vigor of ten potato entries at 65 DAP

ENTRY	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	1	2	2	5	2ab
384558.10	0	1	2	3	1bc
676070	1	2	2	5	2ab
Ganza	1	2	1	4	1bc
573275	0	2	1	3	1bc
676089	4	3	3	10	3a
5.19.2.2	2	2	1	5	2ab
Kennebec	0	0	0	0	0c
575003	3	1	1	5	2ab
13.1.1	4	2	4	10	3a
TOTAL	16	17	17	50	16.67

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.067	0.33			
Treatment	9	28.000	3.111	4.44**	2.44	3.60
Error	18	1.267	0.070			
TOTAL	29	1.867				

** = Highly Significant Coefficient of Variance = 20.82%

APPENDIX TABLE 3. Plant canopy cover of ten potato entries in a transitional organic farm at 30 DAP

ENTRY	REPLICATION I	II	III	TOTAL	MEAN
380251.17	27	26	26	79	26
384558.10	18	28	18	64	21
676070	21	22	16	59	20
Ganza	16	19	21	56	19
573275	23	22	21	66	22
676089	21	23	22	66	22
5.19.2.2	18	18	19	55	18
Kennebec	21	23	19	58	19
575003	19	23	19	61	20
13.1.1	31	21	20	72	24
TOTAL	215	225	196	636	211

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Replication	2	43.400	21.700			
Treatment	9	170.133	18.904	1.78^{ns}	2.44	3.60
Error	18	191.267	10.626			
TOTAL	29	404.800				

^{ns} = not significant Coefficient of Variance = 15.38%

APPENDIX TABLE 4. Plant canopy cover of ten potato entries in a transitional organic farm at 45 DAP

ENTRY	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	25	32	24	81	27
384558.10	12	29	13	54	18
676070	26	27	16	69	23
Ganza	13	17	16	46	15
573275	28	17	27	72	24
676089	22	28	30	80	27
5.19.2.2	19	20	24	63	21
Kennebec	9	16	5	30	10
575003	17	14	11	42	14
13.1.1	51	23	18	92	31
TOTAL	222	223	184	629	209.67

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	98.867	49.433			
Treatment	9	1156.967	128.552	2.23^{ns}	2.46	3.60
Error	18	1039.133	57.730			
TOTAL	29	2294.967				

^{ns} = not significant

Coefficient of Variance = 16.90%

APPENDIX TABLE 5. Plant canopy cover of ten potato entries at 60 DAP

ENTRY	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	9	10	0	19	6[c]
384558.10	4	10	3	17	6c
676070	8	24	14	46	15[bc]
Ganza	12	10	26	48	16[abc]
573275	18	8	21	47	16[abc]
676089	18	21	37	76	25[ab]
5.19.2.2	15	18	13	46	15[bc]
Kennebec	3	10	3	16	5[c]
575003	11	10	20	41	14[bc]
13.1.1	41	19	27	87	29[a]
TOTAL	139	140	164	443	147

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	40.067	20.033			
Treatment	9	1684.267	187.115	3.41*	2.46	3.60
Error	18	987.267	54.848			
TOTAL	29	2711.367				

* = Significant Coefficient of Variance = 33.98 %

APPENDIX TABLE 6. Plant height (cm) of ten potato entries at 30 DAP

ENTRY	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	24.93	18.69	21.78	65.4	21.80[a]
384558.10	13.55	13.43	8.75	35.73	11.91[def]
676070	16	13.2	14.04	43.24	14.41[cd]
Ganza	9.96	7.41	10.28	27.65	9.22[f]
573275	10.67	10.75	11.03	32.45	10.82[ef]
676089	21.2	17.7	17.91	56.81	18.94[b]
5.19.2.2	17.37	17.39	16.92	51.68	17.23[bc]
Kennebec	15.76	10.44	11.3	37.5	12.50[dc]
575003	16.7	18.67	15.03	50.4	16.80[bc]
13.1.1	20.58	18.3	15.67	54.55	18.18[b]
TOTAL	166.72	145.98	142.71	455.41	151.81

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	33.911	16.955			
Treatment	9	440.500	48.944	16.76**	2.46	3.60
Error	18	52.565	2.920			
TOTAL	29	526.976				

** = Highly Significant   Coefficient of Variance = 11.26 %

APPENDIX TABLE 7. Late blight incidence of ten potato entries at 45 DAP

ENTRY	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	4	6	3	13	4^{cd}
384558.10	6	6	5	17	6^{ab}
676070	5	4	3	12	4^{cd}
Ganza	6	7	5	18	6^{ab}
572375	4	6	2	12	4^{cd}
676089	3	4	1	8	3^{d}
5.19.2.2	5	5	1	11	4^{cd}
Kennebec	7	6	7	20	7^{a}
575003	6	5	4	15	5^{bc}
13.1.1	2	4	2	8	3^{d}
TOTAL	48	53	33	134	44.68

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	21.667	10.833			
Treatment	9	49.467	4.496	6.06**	2.46	3.60
Error	18	16.333	0.907			
TOTAL	29	87.467				

** = Highly Significant Coefficient of Variance = 21.33 %

APPENDIX TABLE 8. Late blight incidence of ten potato entries at 60 DAP

ENTRY	REPLICATION			TOTAL	MEAN
	I	II	III		
38251.17	7	6	5	18	6[b]
384558.10	9	8	6	23	8[a]
676070	7	6	5	18	6[b]
Ganza	8	8	8	24	8[a]
573275	7	6	4	17	6[b]
676089	6	5	4	15	5[bc]
5.19.2.2	7	5	4	16	5[bc]
Kennnebec	9	9	9	27	9[a]
575003	6	6	7	19	6[b]
13.1.1	5	5	3	13	4[c]
TOTAL	71	64	55	190	63

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	12.867	6.433			
Treatment	9	57.333	6.370	10.96**	2.46	3.60
Error	18	10.467	0.581			
TOTAL	29	80.667				

** = Highly Significant

Coefficient of Variance = 12.04 %

APPENDIX TABLE 9. Late blight incidence of ten potato entries at 75 DAP

ENTRY	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	9	9	8	26	9[a]
384558.10	9	9	9	27	9a
676070	9	8	8	25	8[b]
Ganza	9	9	9	27	9[a]
573275	9	9	8	26	9[a]
676089	7	7	7	21	7[c]
5.19.2.2	9	8	9	26	9[a]
Kennebec	9	9	9	27	9[a]
575003	8	8	8	24	8[b]
13.1.1	6	8	7	21	7[c]
TOTAL	84	84	84	250	84

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.267	0.133			
Treatment	9	16.000	1.778	7.27**	2.46	3.60
Error	18	4.400	0.244			
TOTAL	29	20.667				

** = Highly Significant Coefficient of Variance = 5.93 %

APPENDIX TABLE 10. Weight of marketable tubers (g) of ten potato entries in a transitional organic farm

ENTRY	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	32.35	39.47	38.57	110.39	36.80[ab]
384558.10	11.90	11.36	2.94	26.20	8.73[c]
676070	14.52	31.25	26.09	71.86	23.95[bc]
Ganza	8.57	2.94	2.86	14.37	4.79[c]
573275	23.61	8.57	36.76	68.94	22.98[bc]
676089	33.33	36.84	74.14	144.31	48.10[a]
5.19.2.2	2.94	8.06	7.58	18.58	6.19[c]
Kennebec	12.00	10.00	8.70	30.70	10.23[c]
675003	10.00	15.00	9.72	34.72	11.57[c]
13.1.1	75.68	15.91	69.70	161.29	53.76[a]
TOTAL	224.9	179.4	277.06	681.36	227.1

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.200	0.100			
Treatment	9	16.033	1.781	3.79**	2.46	3.60
Error	18	8.467	0.470			
TOTAL	29	24.700				

** = Highly Significant

Coefficient of Variance = 13.91 %

APPENDIX TABLE 11. Weight of non - marketable tubers (g) of ten potato entries in a transitional organic farm

ENTRY	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	32.35	39.47	38.57	110.39	36.80[ab]
384558.10	11.90	11.36	2.94	26.20	8.73[c]
676070	14.52	31.25	26.09	71.86	23.95[bc]
Ganza	8.57	2.94	2.86	14.37	4.79[c]
573275	23.61	8.57	36.76	68.94	22.98[bc]
676089	33.33	36.84	74.14	144.31	48.10[a]
5.19.2.2	2.94	8.06	7.58	18.58	6.19[c]
Kennebec	12.00	10.00	8.70	30.70	10.23[c]
575003	10.00	15.00	9.72	34.72	11.57[c]
13.1.1	75.68	15.91	69.70	161.29	53.76[a]
TOTAL	224.9	179.4	277.06	681.36	227.1

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	4.736	2.368			
Treatment	9	383.571	42.619	2.91ns	2.46	3.60
Error	18	263.339	14.630			
TOTAL	29	651.646				

[ns] = Not significant

Coefficient of Variance = 24.17 %

APPENDIX TABLE 12. Total yield of ten potato entries in a transitional organic production

ENTRY	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	37	51	49	137	45.67[ab]
384558.10	21	23	6	50	16.67[bc]
676070	18	34	28	80	26.67[bc]
Ganza	16	10	10	36	12[c]
573275	28	16	40	83	27.67[bc]
676089	42	49	86	177	59[a]
5.19.2.2	10	11	17	38	12.67[c]
Kennebec	18	14	11	43	14.33[c]
575503	16	22	15	53	1767[bc]
13.1.1	100	23	86	209	69.67[a]
TOTAL	306	253	348	906	302

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	452.600	226.300			
Treatment	9	11627.467	1291.941	4.80**	2.46	3.60
Error	18	4842.733	269.041			
TOTAL	29	16922.800				

** = Highly Significant

Coefficient of Variance = 27.27 %

APPENDIX TABLE 13. Dry matter content of different potato entries in a transitional organic farm

ENTRY	REPLICATION			TOTAL	MEAN
	I	II	III		
380251.17	20	26	17	63	21
384558.10	17	17	17	51	17
676070	15	16	16	47	16
Ganza	17	17	28	62	21
573275	24	23	22	69	23
676089	20	19	18	57	19
5.19.2.2	19	21	20	60	20
Kennebec	23	20	15	58	19
575003	17	16	17	50	17
13.1.1	24	22	25	71	24
TOTAL	196	197	195	588	196

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.200	0.100			
Treatment	9	187.867	20.874	2.25ns	2.46	3.60
Error	18	167.133	9.285			
TOTAL	29	355.200				

ns - Not significant

Coefficient of Variance =15.55 %