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DIONGCO, PAMELA G. April 2013. Seed Yield of Five Garden Pea (*Pisum sativum*) Entries Applied with Different Organic Fertilizers. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted at Benguet State University Experimental Station from November 2012 to February 2013 to evaluate the growth and seed yield of garden pea applied with different organic fertilizers; ascertain the most effective organic fertilizer for garden pea seed production; determine the interaction effect of entries and organic fertilizer; and determine the profitability of seed production of garden pea applied with organic fertilizers.

Based on the results of the study, among the garden pea entries evaluated, DK-30 and Lapad were moderately resistant to powdery mildew. However, Semi-chinese had the highest total of yield and DK-30 has a lowest total of yield. Garden pea entries applied with Azolla Compost had the tallest plant height, longest pod and seed. There is no interaction effect of garden pea and application of different organic fertilizers. Moreover, applications of different organic fertilizers recorded positive ROCE except Chinese entry. Therefore, application of different organic fertilizers is not profitable.

Overall, Semi-chinese showed the best performance in producing seeds, and Vermi compost was the best fertilizer to be applied.

INTRODUCTION

Garden pea (*Pisum sativum* L.) which is grown extensively in tropical areas is harvested for its green pods and seeds. The crop has high demand and a top money making vegetable in the Philippines (Swiader and Ware, 2002). It is also adapted and commercially grown very well in Benguet where the climate is cold throughout the year.

Due to its importance to the vegetable industry, PCARRD-DOST identified sweet pea among others, as a priority crop under the National Vegetables R and D Program (PCARRD-DOST, 2003). However, there is a limited supply of seed to use for the next cropping season; therefore, farmers rely on imported seeds. Another problem that limits garden pea production is the cost of commercial fertilizers which may result to soil acidity and decreased fertility if used in excess (Edwin, 2003).

Producing seeds locally will definitely provide a way to lessen farmer's expenses while use of organic fertilizers will minimize or even eliminate the problems of soil infertility and low productivity (Swerdt, 2003).

Many farmers are now growing crops organically especially legumes. The reason why farmers are shifting to growing crops organically is the concern about the effect of synthetic chemicals on health soil quality and conservation (Milioti, 2010).

Thus, selection of garden pea varieties applied with different organic fertilizers is a good start in increasing garden pea production while conserving soil quality (Dela Cruz, 2004). Farmers will also be able to produce more seeds that can be used for the next cropping season. The use of good quality seeds is of paramount importance in garden pea production (Mabazza, 1997).

This study aims to find out the performance of different varieties of garden pea grown under organic production.

Specifically, the study aims to:

1. determine the growth and seed yield of garden pea applied with organic fertilizers;

2. ascertain the most effective organic fertilizer for garden pea seed production;

3. determine the interaction effect of entries and organic fertilizers; and,

4. determine the profitability of seed production of garden pea applied with organic fertilizers.

This study was conducted from November 2012 to February 2013 at Benguet State University, Experimental Station Balili, La Trinidad, Benguet.

REVIEW OF LITERATURE

Effect of Organic Fertilizer

Using organic fertilizer is a main concept in building organic soil, a key to successful organic gardening and farming. Organic fertilizers do not contain synthesized chemicals. Application of organic fertilizers is one of the favoured methods of rejuvenating depleted soils and sustaining fertility levels. In mature soils, crops respond more to the addition of organic fertilizers than of chemical fertilizers (PCARRD, 1999).

Guerzon (2002) found that application of compost and farm manure enhanced the physical, chemical and biological properties of the soil. These effects are comprehensive and extremely complex. Organic residues release essential nutrients faster by microbial decomposition when their ration of organic carbon to total nitrogen is wider of about 20% (Ebbes, 2000).

Alnus Compost

According to Ebbes (2000) alnus compost was also used as soil conditioner in replacement of the farmer's practice of applying chicken dung, to determine its effect against club root on cabbage under greenhouse conditions. Results of the study showed that plants without club root applied with alnus compost at the rate of 6 tons per hectare appear to be the tallest. In potato, it was found out that 6 tons per hectare of alnus compost applied to the soil had the least black scurf population.

Azolla Compost

Use of azolla compost enhances biological activities, improves physio-chemical conditions and subsequently from the soil underneath. National Azolla Action Program

(1991) reported that azolla either dried or decomposed should be mixed with the soil to improve its deficiency as a fertilizer. If utilized as organic fertilizer for vegetable it is best to follow localized application, it should be mixed with the soil at the spot where seedlings will be planted. According to Masillem (1995) organic matter and pH content of the soil were improved by the application of azolla and organic fertilizer.

Vermicompost

It is the product of process of composting using various worms, usually red wigglers, white worms, and earthworms. To create a heterogeneous mixture of decomposing vegetable or food waste, bedding materials, and vermicast. Vermicompost can be mixed directly into the soil or seeped in water and made into a worm tea by mixing some vermicompost in water. The pH, nutrient, and microbial content of these fertilizers varies upon the fed to worms. Pulverized limestone or calcium carbonate can be added to the system to raise the pH (Guerzon, 2002).

Effect of Organic Matter

Donahue (1971), as cited by Mabazza (1997), stated that the organic matter supplies some or all nutrients needed by growing plants, as well as many hormones and antibiotics. These nutrients are released in harmony with the needs of plants when environmental conditions are favourable for rapid growth and the same condition favours a rapid release of nutrients from the organic matter.

Organic matter when added to the soil have numerous beneficial effect which include increased soil fertility, balanced supply of nutrients, and build up of organic materials, their nutrient content and process of decomposition in the soil. Soils with

moderate amounts of organic matter are well aggregated and possess good tilt, water infiltration and retention (PCARRD, 2006).

In addition, it is essential in building and maintaining good soil structure, especially in fine textured soils. It increases cation capacity, serves as reservoir for soil nitrogen, and improves water relations that supplying nitrogen, phosphorous, sulphur to the crop (Alconaba, 1997).

Importance of Organic Fertilizer on the Soil

According to Balaoing as cited by Kudan (1999), there are basic processes in decomposition. First is to convert organic materials into soil humus: second, the organic materials are partly decomposed and converted by microorganisms; third, soil animals contribute considerably to the decomposition of organic materials through their activities; and fourth, certain additives such as soil, lime, fertilizer and microorganisms can help speed up conversion and improve the final product.

Using organic fertilizer has many beneficial effects on the physiological, biological and chemical properties of soil. It enhances plant growth, yield and quality. The soil structure, water-holding capacity, aeration are improved and soil temperature increases (Kinoshita,1970).

Seed Production

As mentioned by Joseph and George (1978), good seeds must have high vitality. A high percentage of germination is essential to effective production. Charles-Edwards (1982) described the production of seed yield very simply as the production of dry matter by a crop community and the partitioning or allocation of some portion of the dry matter to the harvested fraction, for purposes, the seed.

MATERIALS AND METHODS

An area of 225 square meters was thoroughly cleaned and prepared. The area was divided into 3 blocks containing 15 plots each measuring 1 meter by 5 meters.

The study was laid out using the split-plot design and was replicated three times.

Two to three seeds were sown in each hill to a depth of 2-5 cm with the distance of 30 cm between hills and 25 cm between rows. All other recommended cultural practices such as weeding, irrigation and pest control were done to maintain good growth of the plants.

Treatments

The treatments were:

Main Plot: Fertilizer (F)

F_1 – Azolla Compost

F_2 – Alnus Compost

F_3 – Vermi Compost

Sub Plot: Garden Pea Entries (G)

Code	Entry
G1	Chinese
G2	DK-30
G3	Semi-chinese
G4	Taichung
G5	Lapad

Data Gathered

The following data were gathered:

1. Meteorological data. The temperature, relative humidity, rainfall and sunshine duration were taken from the Benguet State University Philippine Atmospheric Geophysical and Astronomical Service Administration (PAGASA) Agronomical Meteorological Station.

2. Soil analysis. Soil samples were taken before planting and after harvesting Soil pH, organic matter, nitrogen, phosphorus and potassium was analyzed by the Department of Agriculture, Regional Field Unit I, San Fernando City, La Union.

3. Number of days from planting to emergence. This was taken by counting the number of days from planting to the time when 80% of the seed sown will emerge.

4. Number of days from planting to flowering. This was taken when at least 50% of the plants in the plot had fully opened flower.

5. Number of days from planting to harvesting. This was taken by counting the number of days from planting to harvesting.

6. Final plant height (cm). This was measured after the last harvest from the sample plants in each treatment from ground level to the tip of the youngest shoot.

7. Pod length (cm). Ten samples were randomly selected from each treatment and will be measured from the end to the pedicel of the pod.

8. Length of seed (mm). The length of seed was measured at harvest using 10 sample seeds selected at random.

9. Weight of two hundred seeds (g). The weight of 200 seeds per treatment was recorded after five days of continuous sun drying.

10. Total seed yield per plot (kg/5 sq. m.). This was the total yield of seeds harvested per plot taken after five days of continuous sundry.

11. Computed seed yield (ton/ha). This was computed by the formula:

$$\text{Yield (t/ha)} = \frac{\text{Yield per Plot}}{\text{Size of Plot}} \times 2$$

12. Powdery mildew infestation. This was determined by using the following scale (Teng, 1987):

Scale	Description	Remarks
1	no damage	highly resistant
2	1-25% infection	mildly resistant
3	26-50% infection	moderately resistant
4	51-75% infection	moderately susceptible
5	76-100% infection	very susceptible

13. Leaf miner infestation. This was determined by using the following scale (Teng, 1987):

Scale	Description	Remarks
1	no damage	highly resistant
2	1-25% infestation	mildly resistant
3	26-50% infestation	moderately resistant
4	51-75% infestation	moderately susceptible
5	76-100% infestation	very susceptible

14. Return on investment (%). This was computed by using the formula:

$$ROI = \frac{\text{Gross Income-Production Cost}}{\text{Production Cost}} \times 100$$

Data Analysis

The data gathered were analyzed using Analysis of Variance (ANOVA) for Split plot Design with three replications in Randomized Complete Block Design (RCBD). The significance of difference among the treatment was tested using the Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Meteorological Data

The temperature, amount of rainfall, sunshine duration and relative humidity during the conduct of the study from November 2012 to February 2013 are shown in Table 1. Temperature range from 13.7^{0}C to 24.3^{0}C, amount of rainfall is 1.41mm to 0.10mm, sunshine duration also range from 12258 min during November to 10634 min in February while relative humidity is 70% to 84%.

Garden pea grows best in areas with temperatures between 10^{0}C-18^{0}C. In addition, Ware and Swiader (2002) reported that the growth of garden pea is generally affected by temperature, humidity and soil conditions. Different varieties may respond to the climate, which involve temperature, moisture and light. Thus, the observed agrometeorological data was favorable for garden pea production.

Table 1.Temperature, amount of rainfall, sunshine duration and relative humidity from November 2012 to February 2013

MONTH	TEMPERATURE (^{o}C)		RAINFALL AMOUNT (mm)	SUNSHINE DURATION (min)	RELATIVE HUMUDITY (%)
	Min	Max			
November	15.20	24.20	1.41	12258	80
December	14.50	24.20	0.10	11710	84
January	18.30	23.70	0.50	11162	80
February	13.70	24.30	0.10	10634	70

Soil Analysis

Table 2 shows the pH, organic matter, nitrogen, phosphorus and potassium content of the soil. Soil pH before experiment was 5.28 and increased to 5.63 after the experiment which favours the growth of garden pea. Purseglove (1972) stated that the garden pea grows best in soil pH range 5.5 to 6.0 that is friable, fertile, well drained and free from pests and diseases. The percent organic matter before planting was 2.0% and increased to 2.5% after planting. When applied with azolla and vermi compost the nitrogen content on the other has (0.15%) and decreased from 0.10% after harvesting. The phosphorus and potassium contents of the soil considerably increased after the experiment clearly showing that azolla, alnus and vermi compost are very good sources of the two elements.

Table 2. Soil physical properties before and after harvesting

	pH	ORGANIC MATTER (%)	NITROGEN (%)	PHOSPHORUS (ppm)	POTASSIUM (ppm)
Before Planting	5.28	2.00	0.15	265	152
After Harvesting	5.63	2.50	0.10	490	332
With Azolla	5.49	2.00	0.10	485	307
With Alnus	5.66	2.50	0.15	530	385
With Vermi					

Figure 1. Land preparation and application of different organic fertilizers

Figure 2. Planting of garden pea entries applied with different organic fertilizer

Days from Planting to Emergence

Effect of fertilizer .There was no significant differences on the number of days from planting to emergence observed among the garden pea entries applied with different organic fertilizers (Table 3). The garden pea entries emerged 6 days after planting.

Effect of entry. Most of the garden pea seeds emerged eight days from planting except Lapad which emerged nine days after planting.

Table 3. Number of days from planting to emergence, flowering and harvesting of five garden pea entries applied with different organic fertilizers

TREATMENT	NUMBER OF DAYS FROM PLANTING TO		
	EMERGENCE	FLOWERING	HARVESTING
Fertilizers (F)			
Azolla	8	37	196
Alnus	8	37	196
Vermi	8	37	196
Entries (E)			
Chinese	8	39	188
DK-30	8	33	208
Semi-chinese	8	41	183
Taichung	8	37	196
Lapad	9	35	203
F x E	ns	ns	ns
CV_f (%)	1.82	0.40	0.80
CV_e (%)	1.82	0.40	0.80

Interaction effect. No significant interaction effect of garden pea entries and application of different organic fertilizers on the number of days from planting to emergence was noted.

Days from Planting to Flowering

Effect of fertilizer. There was no significant differences on the number of days from planting to flowering. All plants applied with different organic fertilizers uniformly started to flower at 37 days from planting (Table 3).

Effect of entry. Statistically there were no significant differences observed on the number of days from planting to flowering. However, DK-30 produced the first flower at

2-8 days eralies than the other entries emplying that it is an early maturing variety. This means that the variety will be used to take advantage of better prices when planted at the right time.

Interaction effect. No interaction effect was observed between the garden pea entries and application of different organic fertilizers on the number of days from planting to flowering.

Days from Planting to Harvesting

Effect of fertilizer. There were no significant differences on the number of days from planting to harvesting the different organic fertilizers used (Table 3). The garden pea plants were harvested at 196 days from planting.

Effect of entry. No significant differences observed among the garden pea entries but Semi-chinese was harvested at least 5-15 days earlies than the others. This alone makes Semi-chinese a variety with a very good potential for garden pea seed production. It could be considered an early maturing variety.

Interaction effect. No significant interaction effect was observed between the garden pea entries and the application of different organic fertilizers on the number of days from planting to harvesting.

Plant Height

Effect of fertilizer. There were no significant differences on plant height (Table 4). Mean height range from 115.87 to 117.31 cm.

Effect of entry. There was a significant difference observed on the plant height of garden pea entries. Entry Taichung is significantly taller compared to other garden pea

Table 4.Plant height of five garden pea entries applied with different organic fertilizers

TREATMENT	PLANT HEIGHT (cm)
Fertilizers (F)	
Azolla	117.31
Alnus	115.87
Vermi	116.71
Entries (E)	
Chinese	115.87[b]
DK-30	116.36[b]
Semi-chinese	117.47[b]
Taichung	120.09[a]
Lapad	113.37[b]
F x E	ns
CV_f (%)	3.19
CV_e (%)	4.07

Means with the same letter are not significantly different at 5% level of significance using DMRT.

entries of 120.09 cm. These differences in height were may be due to the genetic make-up of entries.

Interaction effect. There was no interaction effect of garden pea entries and application of different organic fertilizers of garden pea.

Pod and Seed Length

Effect of fertilizer. Statistically, result showed that there were no significant differences was observed on the pod and seed length of the garden pea entries applied with different organic fertilizers (Table 5). This emplies that this character is more of genetics rather than environmental factors.

Effect of entry. There were significant differences observed on pod length and seed of the garden pea entries. Entry Lapad and semi-chinese had the significantly longest pod and seed with 7.07cm and 67.33mm and 6.94 cm and 67.22mm. On the seed length, Chinese, DK-30 and Taichung had shortest pod of garden pea entries. This result

Table 5.Pod and seed length and length of seed of the five garden pea entries applied with different organic fertilizers

TREATMENT	LENGTH OF	
	POD (cm)	SEED (mm)
Fertilizers (F)		
Azolla	6.72	66.80
Alnus	6.66	65.53
Vermin	6.68	65.73
Entries (E)		
Chinese	6.36[b]	64.89[b]
DK-30	6.50[b]	65.22[b]
Semi-chinese	6.94[a]	67.22[a]
Taichung	6.57[b]	65.44[b]
Lapad	7.07[a]	67.33[a]
F x E	ns	Ns
CV_f (%)	5.94%	4.34%
CV_e (%)	4.77%	5.39%

Means with the same letter are not significantly different at 5% level of significance using DMRT.

does not actually mean that Lapad is better than the others since consumers prefer the shorter and narrower type.

Interaction effect. There was no significant interaction effect on the garden pea entries and application of different organic fertilizers observed on the pod and seed length of garden pea.

DK-30 CHINESE …..LAPAD

Figure 3. Pod length of garden pea applied with different organic fertilizers

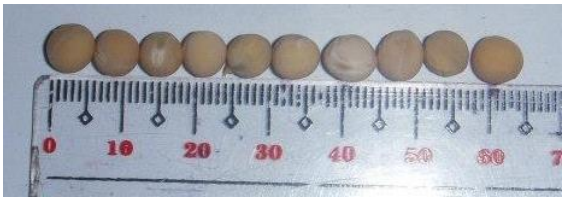

Figure 4. Length of seeds of garden pea applied with different organic fertilizers

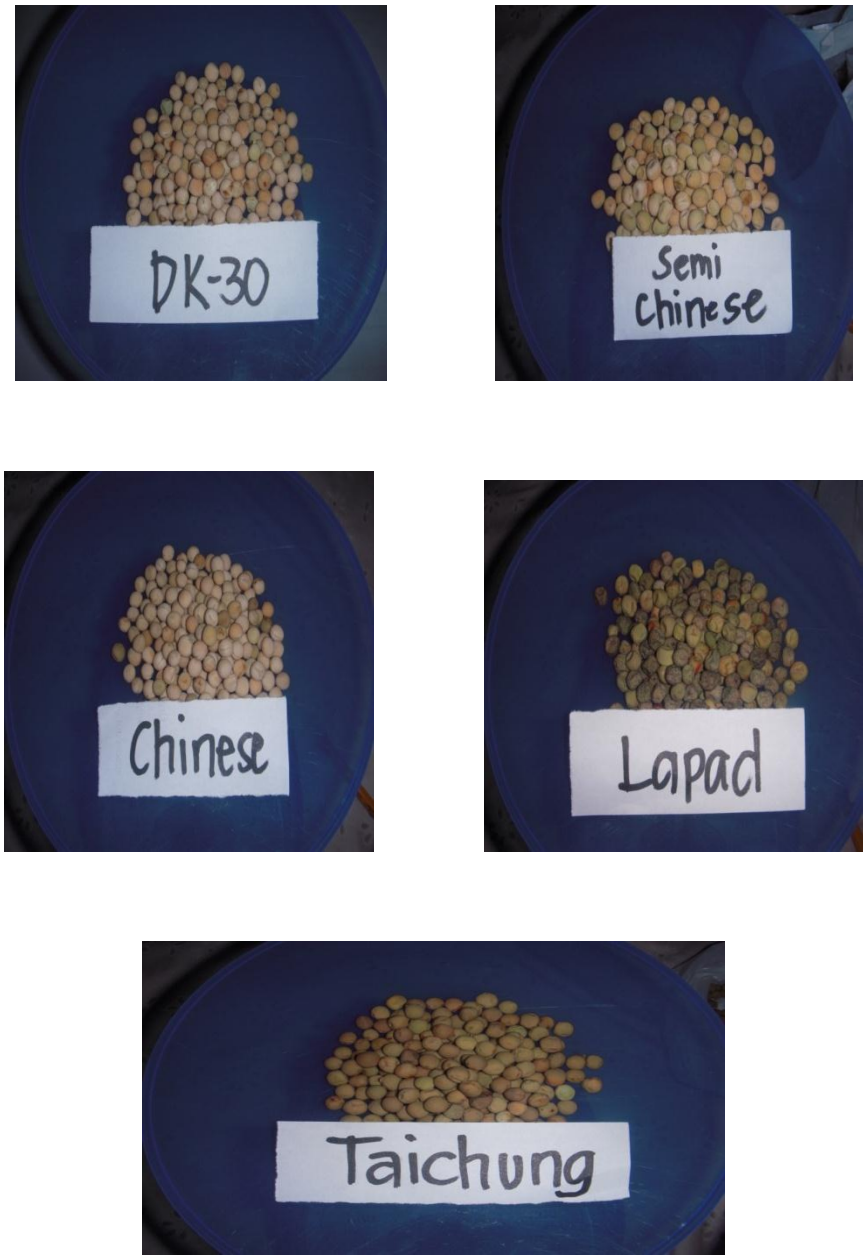

Figure 5. Weight of 200 seeds applied with different organic fertilizers

Reaction to Leaf Miner

Effect of fertilizer. There was no significant differences on the reaction to leaf miner observed among the garden pea entries applied with different organic fertilizers.

Effect of entry. Most of the garden pea entries were mildly resistant of leaf miner except Lapad which is moderately resistant to leaf miner (Table 6).

Table 6.Reaction to leaf miner and powdery mildew infestation of five garden pea entries applied with different organic fertilizers

TREATMENT	REACTION TO	
	LEAF MINER	POWDERY MILDEW
Fertilizers (F)		
Azolla	Mildly resistant	Moderately resistant
Alnus	Mildly resistant	Moderately resistant
Vermi	Mildly resistant	Moderately resistant
Entries (E)		
Chinese	Mildly resistant	Mildly resistant
DK-30	Moderately resistant	Moderately resistant
Semi-chinese	Mildly resistant	Moderately resistant
Taichung	Mildly resistant	Moderately resistant
Lapad	Moderately resistant	Mildly resistant
F x E	Ns	ns
CV_f (%)	6.15	5.68
CV_b (%)	6.15	5.68

Interaction effect. No significant interaction effect of garden pea entries and application of different organic fertilizers on the reaction of leaf miner of garden pea.

Reaction to Powdery Mildew

Effect of fertilizer. There was no significant differences on the reaction of powdery mildew were observed among the garden pea entries applied with different organic fertilizers.

Effect of entry. Most of the garden pea entries had moderate resistant to powdery mildew except. Chinese and Lapad entries were mildly resistant.

Interaction effect. No significant interaction effect of garden pea entries and application of different organic fertilizers on the reaction of powdery mildew.

Total and Computed Yield

Effect of fertilizer. There was no significant differences observed on the total and computed yield of the garden pea applied with different organic fertilizers.

Effect of entry. There were significant differences among the garden pea entries on total and computed yield. Semi-chinese entry significantly exhibited the highest yield compared to other entries showed the lowest yield. This result is may be due to the high percentage of germination.

Interaction effect. There was no significant interaction effect on the garden pea entries and application of different organic fertilizers on the yield of garden pea.

Weight of 200 seeds

Effect of fertilizer. There was no significant differeces on the weight of 200 sample seeds observed among the garden pea entries applied with different organic fertilizers (Table 7) Garden pea weighted 32g of both different treatments.

Effect of entry. Statistically, results showed that most of the garden pea entries weighted 30 g except Semi-chinese and Lapad which is 35 g.

Interaction effect. No significant interaction effect of garden pea entries and application of different organic fertilizers on the weight of 200 seeds of garden pea.

Table 7.Total and computed yield of seed of five garden pea entries applied with different organic fertilizers

TREATMENT	TOTAL YIELD ($g/5m^2$)	COMPUTED YIELD(t/ha)	WEIGHT OF 200 SEEDS (g)
Fertilizers (F)			
Azolla	131.00	0.261	32
Alnus	115.00	0.231	32
Vermi	134.00	0.267	32
Entries (E)			
Chinese	93.00^b	0.186^b	30
DK-30	99.00^b	0.199^b	30
Semi-chinese	203.00^a	0.407^a	35
Taichung	132.00^b	0.264^b	30
Lapad	105.00^a	0.210^a	35
F x E	ns	ns	ns
CV_f (%)	0.0%	12.59%	0.47
CV_e (%)	18.53%	18.53%	0.47

Means with the same letter are not significantly different at 5% level of significance using DMRT.

Return on Cash Expenses (ROCE)

The return on cash expenses of garden pea entries applied with different organic fertilizers as shown in Table 9. Entries applied with the different compost showed positive return on cash expenses except the Chinese entry. The application of the different organic fertilizers on Semi-chinese realized the highest ROCE of 132.87 to 138.60%. The Chinese entry obtained a negative ROCE in all the orgnic fertilizers applied with -62.67 to -55.20%.

Table 8.Return on Cash Expenses (ROCE) of five garden pea entries applied with different organic fertilizers

TREATMENT	MARKETABLE SEEDS ($kg/5m^2$)	GROSS SALE (Php)	TOTAL EXPENSES (Php)	NET INCOME (Php)	ROCE (%)
F1					
Chinese	0.30	68.40	152.67	-84.27	-55.20
DK-30	0.37	222.00	152.67	69.33	45.41
Semi-chinese	0.59	354.00	152.67	201.33	132.87
Taichung	0.41	246.00	152.67	93.33	61.13
Lapad	0.30	174.00	152.67	21.33	13.97
Mean					39.44
F2					
Chinese	0.27	61.56	142.00	-80.44	-56.65
DK-30	0.25	150.00	142.00	8.00	5.63
Semi-chinese	0.56	336.00	142.00	194.00	136.62
Taichung	0.33	198.00	142.00	56.00	39.44
Lapad	0.33	191.40	142.00	49.40	34.79
Mean					31.97
F3					
Chinese	0.28	63.84	171.00	-107.16	-62.67
DK-30	0.29	174.00	171.00	3.00	1.75
Semi-chinese	0.68	408.00	171.00	237.00	138.60
Taichung	0.45	270.00	171.00	99.00	57.89
Lapad	0.32	185.60	171.00	14.00	8.19
Mean					28.75

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Seed yield of five garden pea entries applied with different organic fertilizers was conducted in La Trinidad, Benguet in an open field condition from November 2012 to February 2013. The study aimed to determine the growth and seed yield of garden pea applied with different organic fertilizers; ascertain the most effective organic fertilizer for garden pea seed production; determine the interaction effect of entries and organic fertilizers; and determine the profitability of seed production of garden pea applied with organic fertilizers.

There were no significant differences observed among garden pea entries applied with different organic fertilizers. Among the fertilizers applied, the Azolla compost had the tallest plant height, longest pod and seed length. On the other hand, Vermi compost had the highest total and computed yield. All entries have mildly resistant to leaf miner and moderately resistant to powdery mildew.

There were significant differences observed among the garden pea entries. Semi-chinese is significantly taller compared to all entries. Lapad had significantly longest pod and seed length followed by Semi-chinese. Semi-chinese produced the highest total and computed yield. Chinese and Lapad are mildly resistant to leaf miner and powdery mildew infestation.

On the interaction effect, there were no significantly differences among the garden pea entries and application of different organic fertilizers.

All entries applied with different organic fertilizers have a positive ROCE except Chinese. This result is may be due to the low seed yield produced.

Conclusions

Based on findings, Taichung had the tallest plants while semi-chinese had the highest ROCE. Therefore, application of Azolla, Alnus and Vermi compost increased plant height, net income and ROCE.

There is no interaction effect of garden pea entries and application of different organic fertilizers on seed yield of garden pea.

Recommendations

From the results of the study, entries Taichung is recommended in terms of plant height and yield. But, in terms of yield, Semi-chinese is the best entry and the Vermi compost is the best fertilizer to be applied.

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