BIBLIOGRAPHY

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ABSTRACT

Eight of pigeon pea accessions namely: ICPL 88034, ICPL 88039, ICPL 20092-6, ICPL 87119-8, ICP 7035-9, ICP 8663-10, ICPL 85063-19 and PPL 160809 (check variety) were evaluated for their growth, yield and resistance to pod borer.

ICPL 88034 and ICPL 88039 were the earliest to set pod. ICPL 88034 was the tallest at 30 and 75 days after planting (DAP).

Among the different accessions ICP 7035-9 and PPL 160809 recorded the heaviest 100 seeds and the highest green and dry seed yield per plot. These accessions exhibited high and intermediate resistance to pod borer.

The other accessions evaluated were not well adapted due to their lower seed yield and are non-resistant to pod borer.

PPL 160809, the check or the traditional variety grown in Tuba, ICP 7035-9 was found out to be the highest yielder for green and dry seeds.

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INTRODUCTION

Legumes are the richest and cheapest common source of protein among all foods of plant origin. Their protein content is a cheap substitute for animal protein. Legumes are recognized as important food for human diet and supplementary feed for animals.

Pigeon pea as a leguminous crop is an important source of protein. Protein content of pigeon pea seeds ranges from 20 to 25 %. Proteins are the complex combination of amino acid which are essential for the growth of man and animal. Aside from protein, pigeon pea also provides iron and iodine. Pigeon pea seeds are important ingredients of vegetarian diet (Wallis, *et al.* 1988).

Pigeon pea is a versatile crop. It can be utilized as feed, green manure, industrial raw material and as food. The crop is also an important plant in intercropping, rotation cropping and strip cropping. It usually enriches the soil with nitrogen because of its symbiotic relationship with the nitrogen-fixing bacteria (van der Maesen, 1990).

However, maximum production of the crop cannot be attained because of various factors such as environmental and the crop itself. Degeneration of traditional varieties may have also contributed to low yields of pigeon pea. But in spite of this, the advantage of the crop lies not so much on its ability to yield under a wide range of natural and agronomic condition, but on a simple cultural management with required minimal input. One of the factors that affect the production of the crop is variety, at present, farmers in the highland still cling to their traditional varieties.

With the importance of pigeon pea as food crop, evaluation must be done to determine the performance of the developed lines or variety in terms of adaptability, yield and resistance to pest and diseases.

As stated by Wolf and Kipps (1953), maximum yield can be obtained from high yielding varieties if they are adapted to the condition where they are grown. Therefore, this study was conducted to characterize and evaluate pigeon pea accessions under Tuba, Benguet condition and identify the best performing pigeon pea accessions in terms of yield and adaptability.

The study was conducted in Ampusa, Tuba, Benguet from January 2008 to January 2009.

REVIEW OF LITERATURE

About the Crop

Arhar commonly known as Red Gram or pigeon pea has been cultivated in India (place of origin) for more than three thousand years, and is one of the most widely grown pulse in the country. After Gram, Arhar is the second most important pulse crop in the Indian country. It accounts for about 11.8 % of the total pulse area and 17 % of total pulse production of the said country (Westphal, *et al*. 1986). It is a rich source of protein and supplies a major share of the protein requirement of the vegetarian population. It is mainly eaten in the form of split as "dhal". Seeds of Arhar are also rich in Iron and Iodine. They are rich in essential Amino Acids like lysine, tyrocene, cystine and arginine. The husk of pods and leaves obtained during threshing constitute a valuable cattle feed. It is a legume crop and, consequently, possesses valuable properties as a restorer of nitrogen to the soil (Singh, 1983).

Pigeon peas are popular food in developing tropical countries. Nutritious and wholesome, the green seeds serve as a vegetable. Ripe seeds are a source of flour, used split (dhal) in soups or eaten with rice. Dhal contains as much as 22 % protein. Tender leaves are rarely used as a potherb. Ripe seeds may be germinated and eaten as sprouts. Plants produce forage quickly and can be used as a perennial forage crop or used for green manure. Often grown as a shade crop for tree crops or vanilla, a cover crop, or as a windbreak hedge. In Thailand and N. Bengal, pigeon pea serves as host for the scale insect which produces lac or sticklac. In Malagasy the leaves are used as food for silkworm. Dried stalks serve for fuel, thatch and basketry (Duke, 1988).

Other Botanical Information

As cited by Westphal, *et al.* (1986) ten maturity maybe distinguished under Indian conditions, usually combined into four categories: extra early, early, medium and late maturing cultivars (120, 145, 185, more than 200 days after sowing).

Importance of Characterization and Evaluation

Borromeo, *et al*. (1994) cited that characters are identified in order to improve or develop varieties that can be used for future improvement. Characterization is usually achieved with phenotypic traits and molecular markers to directly relate to the population fitness and their usefulness in plant breeding. Most of the characters observed in the plant are usually based on their agro-morphological characters.

Bautista and Mabesa (1977) suggested that varieties to be selected should be high yielding; insect and disease resistant, early maturing that could make possible the growing of crops with less expense, hence more production.

Cagampang and Lantican (1977) observed that the choice of variety is important. They further suggested that in many instances, the wise use of improve variety has resulted to tremendous increase in yield.

Studies Done on Pigeon Pea

Agro- Morphological Characteristics on Pigeon pea worked out by Tonged (2008), differences were observe on days of emergence to flowering, pod setting and seed filling, ICP 7035-9 was the first to be filled with seeds, ICPL 20092-6 was the latest it took 150 days after emergence. On the initial and final plant height, Seng- ewan is the tallest at 35 DAP with 10.2 ICPL 85063-19 is the shortest among the eight accessions.

It was observe that the eight pigeon pea accessions differed on the weight of 100 seeds, Seng- ewan and ICPL 7035-9 produce the heaviest weight with 14.60g, next is the ICPL 8863-10 with 10.53g but this accession is comparable to the other accessions. On the dry seed yield Seng- ewan and ICPL 87119-8 produce the highest yield, ICPL 88039 produce low yield on the dry seed yield.

Silim, *et. al* (2003), characterized landraces of pigeon pea collected in Tanzania. They found out that most landraces of pigeon pea were long duration and medium duration. The seed traits varied considerably, but frequently the landraces seeds are relatively large white or cream and also bears large pods. This accessions are highly significant to fusarium wilt, bruchids and pod borers.

Manyasa, *et. al*, characterized 123 pigeon pea landraces in Northern Tanzania. It was observe that the base flower color, pod color, flowering pattern, streak pattern, seed color and seed shape has no difference.

Reddy, *et. al*, worked on evaluation showing significant differences on plant height, number of primary branches, days to 75 maturity and 100 seed weight.

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MATERIALS AND METHODS

A total land area of 250 square meters was properly cleaned and prepared. The area was divided into three blocks, consisting of eight plots with a dimension of 1 m x 10 m. The experimental area was laid out using Randomized Complete Block Design (RCBD) with three replications. One local variety from Tuba, Benguet and seven accessions of pigeon pea acquired from MMSU, Batac Ilocos Norte were used in the study. Two seeds were sown per hill at a planting distance of 1 m x 1 m between hills. All the necessary cultural management practices for the crop were strictly employed to ensure good growth of the plants. With this 1 x 10 m plot, $5m^2$ were used for green seed yield while the other half ($5m^2$) for dry seed yield.

The following accessions of pigeon pea were used as treatments:

CODE	ACCESSION
T_1	ICPL- 88039
T_2	ICPL- 87119- 8
T_3	ICPL- 85063- 19
T_4	ICPL- 20092- 6
T_5	ICPL- 88034
T_6	ICP- 8663- 10
T_7	ICP- 7035- 9
T_8	PPL 160809 (check variety)

Data Gathered

All descriptors were based on the list by IBPGR, (1993).

1. Maturity

a. Number of days from emergence to flowering. This was recorded by counting the number of days from emergence to the time when at least 50% of plants per plot had fully opened flowers.

b. Number of days from emergence to pod setting. This was recorded by counting the number of days from emergence until the pods were fully develop.

c. Number of days to first harvesting. This was taken by counting the number of days from emergence when at least 50% of the pods were ready to harvest.

2. Growth habit. This was recorded using the following scale:

SCALE	DESCRIPTION
1	Erect and compact
2	Semi-spreading
3	Spreading
4	Trailing

3. Stem characters

a. Initial plant height (cm). The initial plant height was measured 30 days after planting (DAP) from ten sample plants.

b. 75 DAP plant height. The height of the plants at 75 DAP was measured from the ground level to the tip of plants using tape measure from ten sample plants.

c. Stem thickness (mm). The stem thickness was recorded using the following scale:

SCALE	DESCRIPTION
3	Thin (<5 mm)
5	Intermediate (5-13 mm)
7	Thick (>13 mm)

d. Number of branches. The number of branches were recorded as primary, secondary and tertiary.

4. Leaf characters

a. Leaflet shape. The shape of the leaf was recorded using the following scale:

SCALE	DESCRIPTION
1	Lanceolate
2	Narrow-elliptic
3	Broad-elliptic
4	Obcordate

b. Leaf hairiness. This was measured from lower surface of the leaves and was recorded as glabrous or pubescent.

5. Flower characteristics

a. Base flower color. The color of the flower petals was observed when the flowers opened and was recorded using the following scale:

SCALE	DESCRIPTION
1	Ivory (green-yellow group)
2	Light yellow (yellow group)
3	Yellow (yellow-orange group)
4	Orange-yellow (orange-red group)

b. Second flower color. The color of flowers was observed at the dorsal side of the flag and the wings and keel as red (red group) and purple (grayed-purple group)

c. Pattern of streaks. The pattern of streaks was observed on the dorsal side of the standard petal and will be recorded using the following scale:

SCALE	DESCRIPTION
3	Sparse streaks
5	Medium amount of streaks
7	Dense streaks
9	Uniform coverage of second flower color

d. Flowering pattern. This was recorded using the following scale:

SCALE	DESCRIPTION
1	Determinate
2	Semi-determinate
3	Indeterminate

6. Pod characteristics

a. Pod color. The main pod color was observed and was recorded using the following scale:

SCALE	DESCRIPTION
1	Green (yellow-green group)
2	Purple (grayed-purple group)
3	Mix green and purple
4	Dark purple (grayed-purple group)

b. Pod form. The pod form was observed during harvest and was recorded as flat and cylindrical.

c. Pod hairiness. The pod hairiness was observed when pods were fully expanded and rated as glabrous or pubescent.

d. Length of pods at harvest (cm). The length of ten sample pods per accession was recorded. Pod length was measured using foot rule from the pedicel end to distal end.

e. Width of pods at harvest (cm). The width of ten sample pods used in data # 6d was measured using a foot rule.

7. Seed characteristics

a. Number of seeds per pod. This was obtained by getting the average of 10 randomly chosen ripe per pods.

b. Seed color pattern. This was taken and recorded using the following scale:

SCALE	DESCRIPTION
1	Plain
2	Mottled
3	Speckled
4	Mottled and speckled
5	Ringed

c. Seed shape. This was observed and recorded using the following scale:

SCALE	DESCRIPTION
1	Oval (egg shape)
2	Globular (pea shape)
3	Square (angular)
4	Elongate

8. Yield and yield components

a. Weight of 100 seeds (g). The seed yield was obtained by weighing 100 seeds.

b. Green shelled seed yield (g). This was recorded by determining the weight of green shelled seeds of ten sample plants

c. Dry seed yield (g). This was taken by weighing the weight of dry seeds of ten sample plants.

9. Harvest Index (HI). This was obtained from the different accessions using the following formula:

$$HI = \frac{\text{Economic yield (SDW)}}{\text{Biological yield (SDW+ PDW+ LDW+ SsDW+ RDW)}}$$

Where: Economic yield is the seeds and the biological yield include the total herbage yield and pods.

SDW- Seed dry weight

PDW- Pod shell dry weight

LDW- Leaf dry weight

SsDW – Stem dry weight

RDW – Root dry weight

10. Occurrence of pest and diseases

a. Reaction to pod borer. The reaction of infestation to pod borer was obtained using the following rating scale (IBPGR, 1993).

SCALE	REMARKS
1	Very low or no visible sign of susceptibility
3	Low
5	Intermediate
7	High
9	Very high

b. Reaction to yellow mosaic virus. The reaction to infection to yellow mosaic was obtained using the following scale:

SCALE	REMARKS
1	Very low or no visible sign of susceptibility
3	Low
5	Intermediate
7	High
9	Very high

Analysis of Data

All quantitative data was analyzed using analysis of variance (ANOVA) for RCBD. The significance of difference among treatment means was tested using the Duncan's Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Number of Days from Emergence to Flowering,
Pod Setting and First Harvest

Differences were observed on the number of days from emergence to flowering, pod setting and first harvest. ICPL 88034 and ICPL 88039 took 56 days to flower and were the earliest to mature, followed by accession ICP 7035-9. The latest to flower was PPL 160809. This significant differences could be attributed to their varietal characteristics as noted that different accessions differ in yield performance and adaptability to the locality.

Table 1. Number of days from emergence to flowering, pod setting and first harvest of the eight pigeon pea accessions

ACCESSION	NUMBER OF DAYS FROM EMERGENCE TO:		
	FLOWERING	PODSETTING	1st HARVEST
ICPL 88034	56[e]	71[e]	90[e]
ICPL 88039	56[e]	71[e]	90[e]
ICPL 20092-6	279[b]	308[b]	325[b]
ICPL 87119-8	279[b]	308[b]	325[b]
ICP 7035-9	63[d]	78[d]	92[d]
ICP 8633-10	279[b]	308[b]	325[b]
ICPL 85063-19	265[c]	273[c]	293[c]
PPL 160809 (check)	326[a]	335[a]	350[a]
CV %	0	0	0

* Means with the same letter are not significantly different at 0.05 level by DMRT.

Growth Habit

All of the accessions have an erect type of growth.

Plant Height at 30 and 75 DAP

Statistical analysis shows significant differences among the accessions. ICPL 88034 was recorded to have the tallest plants at 30 and 75 DAP, which is comparable with ICPL 88039 and ICPL 8663-10 (Table 2). The height of the accessions were attributed to their genetic make-up.

Table 2. Plant height at 30 and 75 DAP and stem thickness of the eight pigeon pea accessions

ACCESSION	HEIGHT (cm)		STEM THICKNESS
	30 DAP	75 DAP	
ICPL 88034	23.36[a]	66.25[a]	3.6[c]
ICPL 88039	19.95[ab]	58.8[ab]	3.6[c]
ICPL 20092-6	14.20[d]	35.7[c]	5[bc]
ICPL 87119-8	17.86[bcd]	47.3[bc]	5.6[ab]
ICP 7035-9	18.72[bc]	42.2[b]	6.3[bc]
IPC 8663-10	21.01[ab]	54.11[ab]	5[bc]
ICPL 85063-19	15.34[cd]	48.86[b]	5[bc]
PPL 160809 (check)	17.1[bcd]	51.8[b]	7[a]
CV%	11.09	13.36	16.63

*Means with the same letter are not significantly different at 0.05 level by DMRT.

Remarks: 3-Thin, 5- intermediate, 7-Thick

Stem Thickness

Table 2 shows that PPL 160809 had the thickest stem and statistically comparable with ICP 7035-9 and ICPL 87119-8 and the thinnest stem was obtained from ICPL 88034 and ICPL 88039. This stem thickness was also noted to their varietal differences.

Leaflet Shape

All of the accessions have lanceolate leaf shape.

Leaf Hairiness

All of the accessions have pubescent leaves.

Base Flower Color

The base flower color of the accession were mostly yellow except for ICP 7035-9 which was red.

Second Flower Color

All of the accessions have medium amount of streaks.

Flowering Pattern

Most of the accessions have determinate flowering pattern except for ICPL 20092-6 which is semi-determinate.

Pod Color

All of the accessions have mixed, green and purple pod except for ICP 7035-9 which has a dark purple color (Fig. 1).

Pod Form

Most of the accessions have cylindrical pods while ICP 7035-9 and PPL 160809 have exhibited flat pods.

Pod Hairiness

All of the accessions have pubescent pods.

Pod Length

Statistical analysis show significant differences among the accessions. PPL 160809 had the longest pods with 9.0 cm, followed by ICP 7035-9 with 6.8 cm, while ICPL 20092-6 had the shortest pods although comparable with ICPL 85063-19, ICPL 87119-8, ICP 8663-10, ICPL 88039 and ICPL 88034.

.Pod Width

PPL 160809 significantly had the widest pods with 1.38 cm and next was ICP 7035-9. The narrowest pods were observed from ICPL 88039. This noted widest pods from this two accessions was the effect of its flat pods while the thinner pods was due to the cylindrical width of the pods.

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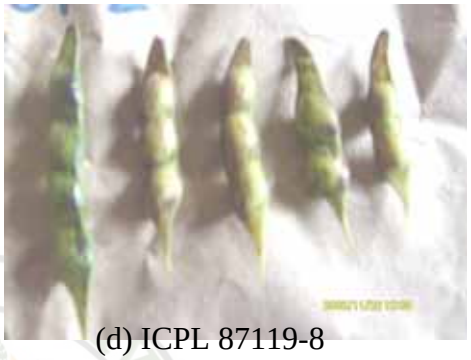
(a) ICPL 88034

(b) ICPL 88039

(c) ICPL 20092-6



(d) ICPL 87119-8

(e) ICP 7035-9

(f) ICP 8663-10

(g) ICPL 85063-19

(h) PPL 160809 (check)

Figure 1. Green pods of the eight pigeon pea accessions.

Table 3. Pod characters of the eight pigeon pea accessions

ACCESSION	POD FORM	POD LENGTH (cm)	POD WIDTH (cm)
ICPL 88034	Cylindrical	5.7[c]	0.86[de]
ICPL 88039	Cylindrical	5.6[c]	0.82[e]
ICPL 20092-6	Cylindrical	5.1[c]	0.92[cd]
ICPL 87119-8	Cylindrical	5.4[c]	0.97[c]
ICP 7035-9	Flat	6.8[b]	1.29[b]
ICP 8663-10	Cylindrical	5.6[c]	0.92[cd]
ICPL 85063-19	Cylindrical	5.2[c]	0.97[c]
PPL 160809 (check)	Flat	9.0[a]	1.38[a]
CV (%)		6.33	4.37

* Means with the same letter are not significantly different at 0.05 level by DMRT.

Number of Seeds per Pod

As shown in Table 4, PPL 160809 produced the most number of seeds per pod followed by ICP 7035-9 and the least was ICPL 88034.The number of seeds commensurates with the length of pods; the longer the pods, the more seeds were noted.

Seed Color Pattern

ICP 7035-9 has speckled and mottled seeds while PPL 160809 and the other accessions have no speckles.

Seed Shape

Globular seed shape were observed from ICP 7035-9, ICPL 20092-6 and PPL 160809. The other accessions exhibited square seed shape.

Table 4. Seed characters of the eight pigeon pea accessions

ACCESSION	NUMBER OF SEEDS PER POD	SEED SHAPE
ICPL 88034	2.6[c]	Square
ICPL 88039	3.3[bc]	Square
ICPL 20092-6	3.6[bc]	Globular
ICPL 87119-8	3.3[bc]	Square
ICP 7035-9	4.3[b]	Globular
ICP 8663-10	3.3[bc]	Square
ICPL 85063-19	3.3[bc]	Square
PPL 160809 (check)	5.6[a]	Globular
CV (%)	16.51	

* Means with the same letter are not significantly different at 0.05 level by DMRT.

Weight 100 Green Seeds

ICP 7035-9 and PPL 160809 significantly produced the heaviest seeds 100 seeds with 29.26 g, and 27.26 g, respectively. The lightest was observed from accession ICPL 88034 with a mean of 13.76g. The high weight of seeds may due to the genetic make-up of the accessions and also the bigger size of the seeds.

Seed Yield per Plot

On green seeds, ICP 7035-9 and PPL 160809 produced the heaviest green seeds. The dry seed yield are not significantly different among the accessions. However, ICP 7035-9 numerically was the high yielder among the accessions studied (Table 5 and Fig. 2).

This agrees with the findings of Tonged (2008 that "Seng-ewan" (check variety) and ICP 7035-9 produced the heaviest weight of green seeds at Kapangan, Benguet.

Table 5. Weight of 100 seeds and yield of green and dry seeds of the eight pigeon pea accessions

ACCESSION	WEIGHT OF 100 SEEDS (g)	YIELD (g/5m^2)	
		GREEN SEEDS	DRY SEEDS
ICPL 88034	13.76^{c}	53.46^{b}	38.5^{a}
ICPL 88039	16.1^{bc}	42.70^{b}	57.56^{a}
ICPL 20092-6	16.46^{bc}	191.26^{b}	67.36^{a}
ICPL 87119-8	16.36^{bc}	145.13^{b}	49.6^{a}
ICP 7035-9	29.26^{a}	375.13^{a}	89.96^{a}
ICP 8663-10	17.3^{b}	84.2^{b}	32.76^{a}
ICPL 85063-19	16.56^{bc}	115.1^{b}	75.1^{a}
PPL 160809 (check)	27.26^{a}	369.03^{a}	87.96^{a}
CV (%)	80.52	47.54	498.8

* Means with the same letter are not significantly different at 0.05 level by DMRT.

(a) ICPL 88034

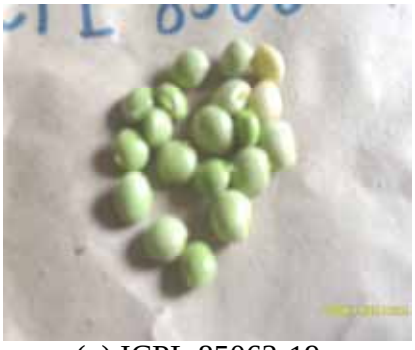
(b) ICPL 88039

(c) ICPL 20092-6

(d) ICPL 87119-8

(e) ICP 7035-9

(f) ICP 8663-10



(g) ICPL 85063-19

(h) PPL 160809 (check)

Figure 2. Green seeds of the eight pigeon pea accession

Harvest Index

Table 6 that ICPL 20092-6 has the highest harvest index, followed by ICPL 87119-8, and the least was obtained from ICPL 88034.

Table 6. Harvest Index of the eight pigeon pea accession

ACCESSION	HARVEST INDEX
ICPL 88034	0.18[c]
ICPL 88039	0.20[bc]
ICPL 20092-6	0.24[a]
ICPL 87119-8	0.21[b]
ICP 7035-9	0.19[c]
ICP 8663-10	0.18[bc]
ICPL 85063-19	0.19[bc]
PPL 160809 (check)	0.20[bc]
CV (%)	6.73

* Means with the same letter are not significantly different at 0.05 level by DMRT.

Reaction to Pod Borer

Among the eight accessions evaluated, ICP 7035-9 was the most infested with pod borer. ICPL 88034 and ICPL 88039 have low infestation (Table 7). Pod borer infestation maybe attributed to the varietal taste which some are sweet and others are astringent.

Reaction to Yellow Mosaic Virus

As shown in Table 8, accession ICPL 20092-6 was highly infected with yellow mosaic virus while accession ICPL 88034 has low infection and the rest of the accessions showed no visible signs of infection.

Table 7. Reaction to pod borer of the eight pigeon pea accessions

ACCESSION	SCALE	DESCRIPTION
ICPL 88034	3	Low
ICPL 88039	3	Low
ICPL 20092-6	5	Intermediate
ICPL 87119-8	5	Intermediate
ICP 7035-9	7	High
ICP 8663-10	5	Intermediate
ICPL 85063-19	5	Intermediate
PPL 160809 (check)	5	Intermediate

* Means with the same letter are not significantly different at 0.05 level by DMRT.

Remarks: 1- no visible sign of susceptibility; 3- Low; 5- Intermediate; 7- High;
9- very high

Table 8. Reaction to yellow mosaic virus of the eight pigeon pea accessions

ACCESSION	SCALE	DESCRIPTION
ICPL 88034	3	Low
ICPL 88039	1	No visible sign
ICPL 20092-6	9	Very high
ICPL 87119-8	1	No visible sign
ICP 7035-9	1	No visible sign
ICP 8663-10	1	No visible sign
ICPL 85063-19	1	No visible sign
PPL 160809 (check)	1	No visible sign

Remarks: 1- no visible sign of susceptibility; 3- Low; 5- Intermediate; 7- High; 9- very high

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

Eight accessions of pigeon pea were planted and evaluated in Ampusa, Tuba, Benguet from January 2008 to January 2009.

The study was conducted to determined the performance of the different pigeon pea accessions in terms of its growth, yield, adaptability and resistance to pest and diseases under Ampusa, Tuba, Benguet.

Significant differences were noted for the following characters; number of days from emergence to flowering, pod setting and first harvest; height at 30 and 75 DAP; weight of 100 seeds and green seed yield.

ICPL 88034 and ICPL 88039 were the earliest to pod set. ICPL 88034 was the tallest at 30 and 75 DAP. ICP 7035-9 and PPL 160809 produced the highest green seeds, and dry seed yield and weight of 100 seeds. All of the accessions have pubescent leaf and pods.

PPL 160809 had the longest and widest pods, ICPL 20092-6 had the shortest pods and ICPL 88039 had the narrowest pods. Most of the accessions have cylindrical pods, while ICP 7035-9 and PPL 160809 have flat pods.

Most of the accessions were resistant to yellow mosaic virus except for ICPL 20092-6 which was highly infected.

Conclusion

The eight pigeon pea accessions differ significantly for morphological characters such as number of days from emergence to flowering, number of days from emergence to pod setting, pod width and length, and weight of 100 seeds.

Results showed that all the accessions performed well which indicate their adaptation in the locality. ICP 7035-9 is the highest yielder, early maturing and resistant to yellow mosaic virus.

Recommendation

ICP 7035-9 and PPL 130809 (check variety) are recommended due to their relatively higher yield and resistance to yellow mosaic virus.

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APPENDICES

APPENDIX TABLE 1. Number of days from emergence to flowering

ACCESSION	REPLICATION			TOTAL	MEAN
	I	II	III		
ICPL 88034	56	56	56	168	56
ICPL 88039	56	56	56	168	56
ICPL 20092-6	279	279	279	837	279
ICPL 87119-8	279	279	279	837	279
ICP 7035-9	63	63	63	189	63
ICP 8663-10	279	279	279	837	279
ICPL 85063-19	265	265	265	795	265
PPL 160809 (check)	326	326	326	978	326
TOTAL	1, 603	1, 603	1, 603	4, 809	1, 603

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF ERRORS	COMPUTED F	TABULAR F 0.05	0.01
Treatment	7	297191.62		∞**	2.76	4.28
Replication	2	0	0			
Error	14	0	0			
Total	23	297191.62				

**highly significant

Coefficient of Variance = 0%
Standard Error = 0

APPENDIX TABLE 2. Number of days from emergence to pod setting

ACCESSION	REPLICATION I	II	III	TOTAL	MEAN
ICPL 88034	71	71	71	213	71
ICPL 88039	71	71	71	213	71
ICPL 20092-6	308	308	308	924	308
ICPL 87119-8	308	308	308	924	308
ICP 7035-9	78	78	78	234	78
ICP 8663-10	308	308	308	924	308
ICPL 85063-19	273	273	273	819	273
PPL 160809 (check)	335	335	335	1, 005	335
TOTAL	1, 752	1, 752	1, 752	5, 253	1, 752

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF ERRORS	COMPUTED F	TABULAR F 0.05	0.01
Treatment	7	311472	44496	∞**	2.76	4.28
Replication	2	0	0			
Error	14	0	0			
Total	23	311472				

**highly significant

Coefficient of Variance = 0%
Standard Error = 0

APPENDIX TABLE 3. Number of days to first harvest

ACCESSION	REPLICATION I	II	III	TOTAL	MEAN
ICPL 88034	90	90	90	270	90
ICPL 88039	90	90	90	270	90
ICPL 20092-6	325	325	325	975	325
ICPL 87119-8	325	325	325	975	325
ICP 7035-9	92	92	92	276	92
ICP 8663-10	325	325	325	975	325
ICPL 85063-19	293	293	293	879	293
PPL 160809 (check)	350	350	350	1, 050	350
TOTAL	1, 890	1, 890	1, 890	5, 670	1, 890

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF ERRORS	COMPUTED F	TABULAR F 0.05	0.01
Treatment	7	310126.5	44303.78	∞**	2.76	4.28
Replication	2	0	0			
Error	14	0	0			
Total	23	310126.5				

**highly significant

Coefficient of Variance = 0%
Standard Error = 0

APPENDIX TABLE 4. Initial plant height (30 DAP) (cm)

ACCESSION	REPLICATION			TOTAL	MEAN
	I	II	III		
ICPL 88034	24.94	21.95	23.19	70.08	23.36
ICPL 88039	19.89	19.3	20.67	59.86	19.95
ICPL 20092-6	12.29	13.55	16.78	42.62	14.20
ICPL 87119-8	18.63	19	15.96	53.59	17.86
ICP 7035-9	18.92	18	19.25	56.17	18.72
ICP 8663-10	23.25	18.34	21.45	63.04	21.01
ICPL 85063-19	14.93	14.25	16.85	46.03	15.34
PPL 160809 (check)	12.85	19.05	19.4	51.3	17.1
TOTAL	145.7	143.44	153.55	442.69	

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF ERRORS	COMPUTED F	TABULAR F 0.05	0.01
Treatment	7	188.5118	26.9303	6.43**	2.76	4.28
Replication	2	7.0393	3.5196			
Error	14	58.6185	4.1870			
Total	23	254.1696				

**highly significant

Coefficient of Variance = 11.09%
Standard Error = 1.181

APPENDIX TABLE 5. Plant height (cm) at 75 days after planting

ACCESSION	REPLICATION I	II	III	TOTAL	MEAN
ICPL 88034	59.9	57.85	81	198.75	66.25
ICPL 88039	59.85	56.85	59.7	176.4	58.8
ICPL 20092-6	29.75	30.2	47.15	107.1	35.7
ICPL 87119-8	47.5	49.35	45.05	141.9	47.3
ICP 7035-9	48.75	53.85	54	156.6	52.2
ICP 8663-10	54.55	48.05	59.75	162.35	54.11
ICPL 85063-19	41.95	40.85	63.8	146.6	48.86
PPL 160809 (check)	38.55	58.65	58.2	155.4	51.8
TOTAL	380.8	395.65	468.65	1, 245.1	

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF ERRORS	COMPUTED F	TABULAR F 0.05	0.01
Treatment	7	1654.03	236.29	4.92**	2.76	4.28
Replication	2	552.79	276.39			
Error	14	672.57	48.04			
Total	23	2879.39				

**highly significant

Coefficient of Variance = 13.36%
Standard Error = 4.002

APPENDIX TABLE 6. Stem thickness (mm)

ACCESSION	REPLICATION I	II	III	TOTAL	MEAN
ICPL 88034	3	5	3	11	3.6
ICPL 88039	3	3	5	11	3.6
ICPL 20092-6	5	5	5	15	5
ICPL 87119-8	5	5	7	15	5.6
ICP 7035-9	7	7	5	21	6.3
ICP 8663-10	5	5	5	15	5
ICPL 85063-19	5	5	5	15	5
PPL 160809 (check)	7	7	7	21	7
TOTAL	40	42	42	124	41.1

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF ERRORS	COMPUTED F	TABULAR F 0.05	0.01
Treatment	7	0.33	0.16	5.55**	2.77	4.28
Replication	2	28.66	4.09			
Error	14	10.33	0.73			
Total	23	39.33				

**highly significant

Coefficient of Variance = 16.63%
Standard Error = 0.49

APPENDIX TABLE 7. Length of pods at harvest (cm)

ACCESSION	REPLICATION			TOTAL	MEAN
	I	II	III		
ICPL 88034	5.6	5.7	5.8	17.1	5.7
ICPL 88039	5.5	6.1	5.2	16.8	5.6
ICPL 20092-6	5.0	5.4	4.9	15.36	5.1
ICPL 87119-8	5.4	5.5	5.2	16.1	5.4
ICP 7035-9	7.4	6.2	6.9	20.5	6.8
ICP 8663-10	5.7	5.3	5.9	16.9	5.6
ICPL 85063-19	5.4	4.9	5.3	15.6	5.2
PPL 160809 (check)	8.6	9.0	9.5	27.1	9.0
TOTAL	48.6	48.1	48.7	145.4	

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF ERRORS	COMPUTED F	TABULAR F 0.05	0.01
Treatment	7	36.3117	5.1874	35.24**	2.76	4.28
Replication	2	0.0258	0.0129			
Error	14	2.0608	0.1472			
Total	23	38.3983				

**highly significant

Coefficient of Variance = 6.33%
Standard Error = 0.222

APPENDIX TABLE 8. Width of pods at harvest (cm)

ACCESSION	REPLICATION I	II	III	TOTAL	MEAN
ICPL 88034	0.88	0.85	0.87	2.6	0.86
ICPL 88039	0.83	0.86	0.79	2.48	0.82
ICPL 20092-6	0.93	0.93	0.91	2.77	0.92
ICPL 87119-8	0.96	0.96	0.98	2.9	0.97
ICP 7035-9	1.34	1.22	1.32	3.88	1.29
ICP 8663-10	.095	0.86	0.96	2.77	0.92
ICPL 85063-19	1.03	0.93	0.96	2.92	0.97
PPL 160809 (check)	1.36	1.31	1.48	4.15	1.38
TOTAL	8.28	7.92	8.27	24.47	

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF ERRORS	COMPUTED F	TABULAR F 0.05	0.01
Treatment	7	0.8740	0.1249	62.82**	2.76	4.28
Replication	2	0.0105	0.0053			
Error	14	0.0278	0.0020			
Total	23	0.9123				

**highly significant

Coefficient of Variance = 4.37%
Standard Error = 0.026

APPENDIX TABLE 9. Number of seeds per pod

ACCESSION	REPLICATION			TOTAL	MEAN
	I	II	III		
ICPL 88034	3	2	3	8	2.6
ICPL 88039	3	4	3	10	3.3
ICPL 20092-6	4	4	3	11	3.6
ICPL 87119-8	4	3	3	10	3.3
ICP 7035-9	4	5	4	13	4.3
ICP 8663-10	4	3	3	10	3.3
ICPL 85063-19	3	3	4	10	3.3
PPL 160809 (check)	5	6	6	17	5.6
TOTAL	30	30	29	89	

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF ERRORS	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Treatment	7	17.6250	2.5179	6.71**	2.76	4.28
Replication	2	0.0833	0.0417			
Error	14	5.2500	0.3750			
Total	23	22.9583				

**highly significant

Coefficient of Variance = 16.51%
Standard Error = 0.354

APPENDIX TABLE 10. Weight of 100 green seeds (g)

ACCESSION	REPLICATION I	II	III	TOTAL	MEAN
ICPL 88034	13	13.5	14	41.3	13.76
ICPL 88039	16.1	16.1	16.1	48.3	16.1
ICPL 20092-6	16.6	16.5	16.3	49.4	16.46
ICPL 87119-8	16.5	16.3	16.3	49.1	16.36
ICP 7035-9	25.2	34.1	28.5	87.8	29.26
ICP 8663-10	17.2	17.2	17.2	51.9	17.3
ICPL 85063-19	16.6	16.8	16.3	49.7	16.56
PPL 160809 (check)	27.3	26.9	27.6	81.8	27.26
TOTAL	149.6	157.4	152.3	459.3	

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF ERRORS	COMPUTED F	TABULAR F 0.05	0.01
Treatment	7	649.6563	99.2366	37.35**	2.76	4.28
Replication	2	3.9225	1.9613			
Error	14	37.1975	2.6570			
Total	23	22.9583				

**highly significant

Coefficient of Variance = 8.52%
Standard Error = 0.941

APPENDIX TABLE 11. Green seeds yield per plot (g/5m^2)

ACCESSION	REPLICATION I	II	III	TOTAL	MEAN
ICPL 88034	41.4	37.9	81.1	160.4	53.46
ICPL 88039	32.5	53.5	42.1	128.1	42.70
ICPL 20092-6	288.2	178.5	107.1	573.8	191.26
ICPL 87119-8	236.7	71.3	127.4	435.4	145.13
ICP 7035-9	318	270.5	536.9	1, 125.4	375.13
ICP 8663-10	48.4	56	148.2	252.6	84.2
ICPL 85063-19	81.4	101.7	162.2	345.3	115.1
PPL 160809 (check)	277.8	469.5	359.8	1, 107.1	369.03
TOTAL	30	30	29	89	

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF ERRORS	COMPUTED F	TABULAR F 0.05	0.01
Treatment	7	368680.19	52668.59	7.88**	2.76	4.28
Replication	2	7138.0508	3569.02			
Error	14	93617.5625	6686.96			
Total	23	469435.80				

**highly significant

Coefficient of Variance = 47.54%
Standard Error = 47.212

APPENDIX TABLE 12. Dry seed yield per plot (g/5m2)

ACCESSION	REPLICATION			TOTAL	MEAN
	I	II	III		
ICPL 88034	26.2	36.5	52.8	115.5	38.5
ICPL 88039	60.2	56.9	55.6	172.7	57.56
ICPL 20092-6	65.3	115.4	21.4	202.1	67.36
ICPL 87119-8	42.1	65.2	41.5	148.8	49.6
ICP 7035-9	90.2	96.6	82.7	269.5	89.83
ICP 8663-10	30.6	26.2	41.5	98.3	32.76
ICPL 85063-19	70.4	48.8	106.1	225.3	75.1
PPL 160809 (check)	84.8	63	116.1	263.9	87.96
TOTAL	469.8	508.6	517.7	1, 496.1	498.67

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF ERRORS	COMPUTED F	TABULAR F 0.05	0.01
Treatment	7	9686.1429	1383.7347	2.33^{ns}	2.76	4.28
Replication	2	161.7775	80.8888			
Error	14	8319.3958	594.2426			
Total	23	18167.3163				

ns - not significant

Coefficient of Variance = 39.11%
Standard Error = 14.074

APPENDIX TABLE 13. Harvest Index

ACCESSION	REPLICATION I	II	III	TOTAL	MEAN
ICPL 88034	0.18	0.17	0.20	0.55	0.18
ICPL 88039	0.19	0.22	0.20	0.61	0.20
ICPL 20092-6	0.24	0.24	0.25	0.73	0.24
ICPL 87119-8	0.23	0.22	0.20	0.65	0.21
ICP 7035-9	0.19	0.17	0.18	0.54	0.18
ICP 8663-10	0.19	0.21	0.19	0.59	0.20
ICPL 85063-19	0.18	0.22	0.19	0.59	0.19
PPL 160809 (check)	0.20	0.21	0.20	0.61	0.20
TOTAL	1.6	1.66	1.61	4.87	1.60

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF ERRORS	COMPUTED F	TABULAR F 0.05	0.01
Treatment	7	0.0003	0.0001	6.46**	2.77	4.28
Replication	2	0.0084	0.0012			
Error	14	0.0026	0.0002			
Total	23	0.0113				

** highly significant

Coefficient of Variance = 6.73%
Standard Error = 0.0079