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ABSTRACT

Seven pigeon pea lines from Batac, Ilocos Norte and from Tuba and Kapangan, Benguet were used in the study.

The study aimed to determine the growth and yield of different pigeon pea lines and to select the best line suited at Taloy Sur, Tuba, Benguet.

ICPL 7035-9 is the best performing line in terms of yield, resistance to disease and ROCE at Taloy Sur, Tuba, Benguet.

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INTRODUCTION

Pigeon pea (*Cajanus cajan* (L.) Millsp) belongs to the family *Leguminoseae*. It is a perennial legume shrub and locally called "cadios or cardis". It is a grain legume of considerable importance in India and is grown in many other tropical countries from 30^{o} north to 30^{o} south (Saxena *et al.,* 1983).It is known for its many uses. Pigeon pea pods are for human consumption, pod husk and leaves for animal fodder, and sticks for firewood (Rocheleau *et al*., 1988). Clearly, pigeon pea is a major pulse crop.

In the Philippines, pigeon pea is found in settled areas, being cultivated and semi cultivated. It is regarded as a "poor man's crop" and it is used both as food and forage or cover crop. However, the development of new processed products from pigeon pea may jumpstart its utilization as an affordable alternative to meat-based protein and as a source of additional income for small holder farmers and rural households.

As cited by PCARRD (1999) pigeon pea is commonly known as a source of seeds for food and it is popular in Northern Luzon as an essential ingredient in "pinakbet". Its seeds contain 20% to 25% protein, rich in carbohydrates and minerals (Saxena *et al*., 1983). However, cultivation is limited to home gardens, backyards or hilly areas (PCARRD, 1999).

According to some studies, the principal constraint in growing pigeon pea as a major crop is low yield (Saxena *et al.,* 1983). Recently developed extra-short duration cultivars are relatively less sensitive to photoperiod which enables their cultivation up to 45^{o} north latitude (ICRISAT, 2008).

Dar (2008) cited that in this time of threatened food security, particularly at this time of rice shortage, harnessing the potentials of dry land areas is most appropriate. To

mitigate this problem, the source of carbohydrates and protein in our diet should be diversified. Root crops which could provide additional carbohydrates and legumes like pigeon pea which is rich in protein could be grown in many parts of the country. In this case, it is needed to reinvigorate the legumes industry in the Philippines through large scale production of suitable and high yielding pigeon pea lines to improve productivity and income of the farmers. However, local growers cannot exactly identify a variety which gives high quality seed yield and give good profit to farmers. It is therefore, important to evaluate some of the available varieties of the crop that could suit the conditions in a certain locality.

Some farmers in Taloy Sur, Tuba, Benguet are planting pigeon pea in their farms especially in "kaingin" farms. However, this is not for commercial purposes but for food. In view of this situation, it is very challenging to undertake this study to evaluate different pigeon pea lines to promote this crop in the locality in order that the farmers will plant pigeon pea not only for food but also for income.

The study was conducted to determine the growth and yield of different pigeon pea lines and to select the best pigeon pea line suited at Taloy Sur, Tuba, Benguet condition.

The study was conducted at Taloy Sur, Tuba, Benguet from October 2008 to May 2009.

REVIEW OF LITERATURE

Soil and Water Requirement

The crop can be grown on a wide range of soil type from lighter loams to the heavy clay with soil pH range from 5.0 to 7.0 and is sensitive to salinity. Above 29^{o}C, soil moisture and fertility need to be adequate. Pigeon pea has an optimum rainfall ranging from 600 to 1000 mm per year and water logging is harmful (CGPRT, 1990).

Climatic Requirements

Pigeon pea is very heat tolerant and prefers hot moist conditions. This crop thrives in an area with a temperature ranges from 18^{o}C to 30^{o}C but can grow at temperature above 35^{o}C under adequate soil moisture and fertility (CGPRT, 1990). Pigeon pea can grow between latitudes 30^{o} south and 30^{o} north at elevations ranging from sea level to 2000 meters and it is mainly grown in developing countries in areas prone to growth on degraded soils (ICRISAT, 2008)

According to PAGASA Baguio as cited by Carbonel (2008) the elevation of Taloy Sur, Tuba is 600 meters above sea level with temperature ranging from 18^{o}C to 30^{o}C and having a relative humidity of 54-71%.

Varietal Evaluation

To determine the high yielding varieties, varietals evaluation is important because varieties had different potentials (Shresta, 1989).

Bautista and Mabesa (1977) suggested that variety to be selected should be high yielding, resistant to pest and disease, early maturing and there traits could make possible the growing of the crop less expensive and more production. In addition, Cagampang and

Lantican (1977) observed that the choice of variety is important. They further suggested that many instance, the wise use of improved variety has resulted to tremendous increase in yield. Rasco and Amante (1994) reported that farmers already accept new improved variety because it fits in their traditional variety, but it may stop growing if the consumers are not willing to buy it.

Sugui, Rasalan, and Tadena of MMSU did an evaluation on field performance of eight pigeon pea lines at Ilocos Norte from 1996 to 1997 (PCARRD, 1999). Differences were observed in terms of seed yield per hectare, width of seeds, pod length, days to flowering and days to maturity. It was observed that ICPL 87 a locally grown variety was the earliest to flower and to mature than the other pigeon pea varieties evaluated.

A characterization and evaluation on pigeon pea accessions at Datakan, Kapangan, Benguet was done by Tonged (2008). Significant differences were observed on the morphological characters of the eight pigeon pea accessions. It was observed that the different pigeon pea accessions differed in the number of days to flowering, pod setting, seed weight and yield, raceme number and initial and final plant height.

"Seng-ewan" a locally grown variety was observed to be the best performing accession in terms of growth and yield performance among the eight pigeon pea accessions that were characterized and evaluated.

Fertilization

Fertilizers are not applied to pigeon pea in traditional systems, perhaps due to the wrong belief that it does not respond to fertilizers. Fertilizers are usually applied to pigeon pea at sowing. Pigeon pea seedlings depend on soil-nitrogen in its early stages. So pigeon peas do respond to a "starter dose" of 15 to 20 kg N/ha. Phosphorus is the most

frequently limiting nutrient and application of 17 to 26 kg P/ha gave higher yield than no application. Placement of P fertilizer at a depth of 10 to 15 cm increase in yield by 35% over broadcast application.

Insects and Diseases

In the characterization and evaluation of pigeon pea accessions at Datakan, Kapangan, Benguet by Tonged (2008), legume pod borer and bean rust was the common pest and diseases observed. Legume pod borer was noted to be mild resistant to some pigeon pea accessions and bean rust was recorded susceptible and moderately resistant.

Postharvest Practices

After harvest, mature pods are threshed usually by hand as practice by small growing farmers. In large producing areas, threshing is usually done by animals or machines. Processing includes dhal making, either wet or dry by milling (CGPRT, 1990). Dhal is a thick Indian stew made from pulses, onions and spices.

MATERIALS AND METHODS

An area of 210 square meters was properly prepared and divided into 21 plots, each plot measuring 1m x 10m. The experiment was laid out using randomized complete block design (RCBD) with three replications.

The seeds were sown in a single row plot following a distance of 1m x 1m between plants at 3 seeds per hill.

Treatment

The pigeon pea lines used in the study were the following:

	LINES	SOURCE
T_1	"Taloy 1" (check)	Taloy Sur, Tuba, Benguet
T_2	"Seng-ewan	Datakan, Kapangan, Benguet
T_3	ICPL 87034	MMSU
T_4	ICPL 88039	MMSU
T_5	ICPL 8863-10	MMSU
T_6	ICPL 7035-9	MMSU
T_7	ICPL 87119-8	MMSU

To ensure good growth and yield, cultural management practices such as irrigation, weeding, side dressing, hilling-up and insect and disease control were strictly observed. Compost was applied at the rate of three tons per hectare before planting.

Irrigation was done two times a week from planting until the vegetative stage and also the weeds were removed during vegetative stage because they were competitive on the nutrients taken by the plants. No control measures were done on diseases because the plants were resistant to rust while cutworms were removed manually.

Data Gathered

1. Climatic data. Temperature, relative humidity, sunshine and rainfall were taken from PAGASA, Baguio.

2. Plant height at 35 days after planting (cm). The initial and final plant height was measured from the cotyledon scar to the tip of the plant from three sample plant in each plot. Initial plant height will be measured 5 weeks after planting

3. Plant height to flowering (cm). This was taken by measuring three sample plants in each plot when at least 50% of the total plant per plot had developed flowers.

4. Days to flowering. This was recorded by counting the number of days from

6. Number of flowers per cluster. This was recorded by counting the number of planting when at least 50% of plant per plot had fully opened flowers.

5. Number of flower cluster per plant. This was recorded by counting the n umber of flower cluster in three random sample plants per plot. flowers per cluster of three random sample plants per plot.

7. Days to pod setting. This was recorded by counting the number of days from planting until flower petals fell and pods began to show.

8. Number of seeds zone. The number of seeds per pod (developed or undeveloped) was counted from ten random sample pods per plot.

9. Length of pods (cm). Ten sample pods from the largest fully expanded immature pods were picked at random from each plot and they were measured from the base to the tip of the pod.

10. Weight of hundred seeds (g). The seed yield was obtained by weighing the weight of 100 seeds at 12-14% moisture content.

11. Fresh seed yield. This was recorded by determining the weight of all seeds of ten sample plants.

12. Dry seed yield. This was recorded by determining the weight of all dry seeds of ten sample plants.

13. Return on cash expenses (ROCE). This was computed using the following formula:

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

14. Pest and Disease Rating

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

Rating scale	Description	Remarks
1	No infestation	highly resistant
2	25% of the total plants were infested	Mild resistant
3	26-50% of the total plants was infested	moderately resistant
4	51-75% of the total plants was infested	Susceptible
5	76-100% of the total plant was infested	very susceptible

b. Reaction to bean rust. The reaction of infestation of bean rust was obtained using the following rating scale (ICRISAT/IBPGR, 1993):

Rating scale	Description	Remarks
1	No infection	highly resistant
2	25% of the total plants were infected	Mild resistant
3	26-50% of the total plants was infected	moderately resistant
4	51-75% of the total plants was infected	Susceptible
5	76-100% of the total plant was infected	very susceptible

Analysis of Data

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

RESULTS AND DISCUSION

Agroclimatic Data

Table 1 shows the temperature, relative humidity and rainfall during the conduct of the study. Temperature ranged from 25.5°C to 27°C. Highest temperature was recorded in March (27°C) and the lowest was on April and November (25.5°C). On relative humidity, April has the highest at 90% and the lowest was on the month of December with 82% relative humidity. The highest amount of rainfall was recorded also on the month of May and April and the lowest was on the month of January. High amount of rainfall makes the plants robust and have good flowering performance.

Table 1. Temperature, relative humidity, and rainfall during the conduct of the study from October 2008 to May 2009

MONTH	TEMPERATURE (°C)	RELATIVE HUMIDITY (%)	RAINFALL (mm)
October	25.70	89.00	178.11
November	25.50	86.00	86.64
December	26.30	82.00	23.70
January	26.40	85.00	12.16
February	26.80	85.25	64.53
March	27.00	88.00	82.91
April	25.50	90.00	407.33
May	26.70	88.00	436.43
MEAN	26.90	86.75	161.47

The temperature during the conduct of the study is favorable for growing pigeon pea since the plants can thrive in areas where temperature ranges from 18 to 30^{o}C (CGPRT, 1990).

Plant height at 35 DAP and at Flowering

Table 2 shows the height of the plants at 35 DAP and at flowering. Among the different pigeon pea lines, “Seng-ewan” and “Taloy 1” significantly had the tallest plants at 35 DAP (10.06 cm and 9.99 cm, respectively). ICPL 87034 produced the shortest plants at 6.99 cm. On the plant height at flowering, the local pigeon pea line from Kapangan (Seng-ewan) were the tallest plants at flowering (134.35 cm) while “Taloy 1” turned to be one of the shortest (57.46 cm) together with ICPL 87034 (58.60 cm).

Table 2. Plant height at 35 DAP and at flowering of seven pigeon pea lines

LINE	HEIGHT (cm)	
	35 DAP	FLOWERING
Taloy 1	9.99[a]	57.46[c]
Seng-ewan	10.06[a]	134.5[a]
ICPL 87034	6.99[b]	58.60[c]
ICPL 88039	7.12[b]	80.45[b]
ICPL 8863-10	7.35[b]	97.33[b]
ICPL 7035-9	7.40[b]	59.25[c]
ICPL 87119-8	7.96[b]	100.74[b]
CV (%)	6.72	14.5

*Means with common letters are not significantly different at 0.05 by DMRT

The differences in plant height at flowering of the plants could be attributed to the varietal characteristics of the lines and their adaptability to the locality.

Number of Days from Planting to Flowering

Among the seven pigeon pea lines observed, ICPL 87034 was the earliest to bear flowers at 92 days after planting while "Seng-ewan" and ICPL 87119-8 were observed to be the latest to bear flowers (Table 3).

The differences on the number of days from planting to flowering of the accessions could be attributed to their varietal characteristics.

Number of Days from Planting to Pod Setting

The pods of "Seng-ewan", "Taloy 1" and ICPL 7035-9 became visible in four days from flowering while the rest of the lines took only three days to produce pods (Table 3).

Table 3. Number of days from planting to flowering and pod setting of seven pigeon pea lines

LINE	NUMBER OF DAYS TO	
	FLOWERING	POD SETTING
Taloy 1	105	109
Seng-ewan	147	151
ICPL 87034	92	95
ICPL 88039	95	98
ICPL 8863-10	142	145
ICPL 7035-9	97	101
ICPL 8119-8	139	142

Number of Flower Cluster per Plant

Highly significant differences were observed among the pigeon pea lines on the number of flower cluster per plant. “Seng-ewan” was observed to have the highest number of flower cluster (108) while “Taloy 1” had the lowest (21). The differences on the number of flower cluster were due to the growth performance of the plants. More flower cluster per plant produced would potentially mean more pods and high yield.

Number of Flower per Cluster

As shown in Table 4, the two local lines “Taloy 1” and “Seng-ewan” produced the highest number of flowers per cluster followed by ICPL 7035-9 which produced 10 flowers per cluster.

Table 4. Number of flower cluster per plant and flower per cluster of seven pigeon pea lines

LINE	NUMBER OF FLOWER	
	CLUSTER PER PLANT	PER CLUSTER
Taloy 1	21[c]	11[a]
Seng-ewan	108[a]	11[a]
ICPL 87034	32[c]	9[b]
ICPL 88039	51[b]	9[b]
ICPL 8863-10	73[b]	9[b]
ICPL 7035-9	26[c]	10[b]
ICPL 87119-8	81[b]	8[b]
CV (%)	23.11	3.28

*Means with common letters are not significantly different at 0.05 by DMRT

The other lines were also comparable to each other with a mean ranging from 8 to 9 flowers per cluster. Differences on the number of flower per cluster could be attributed to the varietal characteristics and on the adaptability of the lines in the place of study.

Length of Pods

Highly significant differences were observed among the pigeon pea lines on the length of pods as presented in Table 5. ICPL 7035-9 significantly had the longest pod (8.04 cm), followed by “Taloy 1” and “Seng-ewan” (7.53 and 7.39 cm, respectively). ICPL 87119-8 produced the shortest pod (5.28 cm) but comparable to ICPL 8863-10 (5.43 cm). Figure 1 presents the pods of four pigeon pea lines.

Number of Seed Zone

Highly significant differences were observed on the number of seed zones of seven pigeon pea lines (Table 6). “Taloy 1” significantly had the highest number of seed zones with mean of 5.33 followed by ICPL 7035-9 and “Seng-ewan” with means of 4.63 and 4.50, respectively. Having high number of seed zones would potentially mean more seeds and higher weight of pods.

Table 5. Length of pods and number of seed zones of the seven pigeon pea lines

LINE	LENGTH OF POD (cm)	NUMBER OF SEED ZONE
Taloy 1	7.53[a]	5.33[a]
Seng-ewan	7.39[a]	4.50[b]
ICPL 87034	6.51[b]	3.60[c]
ICPL 88039	6.60[b]	3.50[c]
ICPL 8863-10	5.43[c]	3.40[c]
ICPL 7035-9	8.04[a]	4.63[b]
ICPL 87119-8	5.28[c]	3.30[c]
CV (%)	5.98	6.97

*Means with common letters are not significantly different at 0.05 by DMRT

ICPL 7035-9

TALOY 1

ICPL 88039

ICPL 87034

Figure 1. Pods of four pigeon pea lines

Reaction to Bean Rust

As shown in Table 7, "Taloy 1", "Seng-ewan", ICPL 88039, ICPL 7035-9 and ICPL 87119-8 had high resistance to bean rust at 90 DAP and 120 DAP. ICPL 87034 and ICPL 8863-10 exhibited mild resistance at 90 DAP and became moderately resistant at 120 DAP.

Reaction to Pod Borer

"Taloy 1" was observed to be moderately resistant to pod borer while ICPL 87034, ICPL 88039 and ICPL 7035-9 showed mild resistance to pod borer.

Table 6. Bean rust and pod borer rating of seven pigeon pea lines

LINE	BEAN RUST RATING AT		POD BORER RATING AT 120 DAP
	90 DAP	120 DAP	
Taloy 1	1[b]	1[c]	3[a]
Seng-ewan	1[b]	1[c]	-
ICPL 87034	2[a]	3[a]	2[b]
ICPL 88039	1[b]	2[b]	2[b]
ICPL 8863-10	2[a]	3[a]	-
ICPL 7035-9	1[b]	1[c]	2[b]
ICPL 87119-8	1[b]	1[c]	-
CV (%)	46.52	13.09	16.37

*Means with common letters are not significantly different at 0.05 by DMRT

- No pods at 120 days after planting

Legend: 1- highly resistant
2- Mildly resistant
3- Moderately resistant
4- susceptible
5- very susceptible

Fresh Seed yield

As shown in Table 7, ICPL 7035-9 produced the heaviest fresh seed yield at 141.67g. "Taloy1" produced the lowest fresh seed yield having a weight of 49.67g. The differences on the fresh seed yield of the plants could be attributed to the growth performances of the plant like short height, number of flowers, size of the seeds (Figure 2), and number of seeds per pod of the plants. Low fresh seed yield could also be attributed to the shedding of flowers that resulted to small number of pods developed. No seeds were harvested from "Seng-ewan", ICPL 87119-8 and ICPL 8863-10 because the plants were destroyed by typhoon "Emong" during pod and seed development.

Dry Seed Yield

Highly significant differences were observed on the dry seed yield of the seven pigeon pea lines. ICPL 7035-9 significantly had the highest dry seed yield with a mean weight of 34.50g. "Taloy 1" had the lowest dry seed yield (21.47 g). Low dry seed yield could be attributed to the size of the seeds, resistance to pod borer and the weather condition during production.

Weight of 100 Seeds

Highly significant differences were observed on the weight of 100 seeds. "Taloy 1" significantly produced the heaviest 100 dry seed weight of 13.07g but comparable to ICPL 7035-9 (13.00g). The weight of 100 seeds from ICPL 87034 and ICPL 88039 are also comparable to each other. The other lines were not able to produce dry seeds because the plants were destroyed by typhoon "Emong". Bad weather condition can obviously lead to some experimental failure.

Table 7.Fresh and dry seed yield and weight of 100 seeds of seven pigeon pea lines

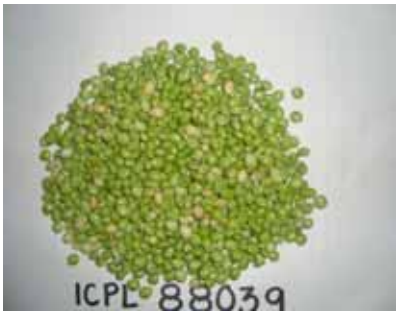
LINE	FRESH SEED YIELD (g)	DRY SEED YIELD (g)	WEIGHT OF 100 SEEDS (g)
Taloy 1	49.67[b]	21.47[b]	13.07[a]
Seng-ewan	-	-	-
ICPL 87034	123.33[a]	26.17[b]	11.13[b]
ICPL 88039	111.67[a]	25.03[b]	11.90[b]
ICPL 8863-10	-	-	-
ICPL 7035-9	141.67[a]	34.50[a]	13.00[a]
ICPL 87119-8	-	-	-
CV (%)	48.86	20.54	1.07

* Means with common letters are not significantly different at 0.05 by DMRT

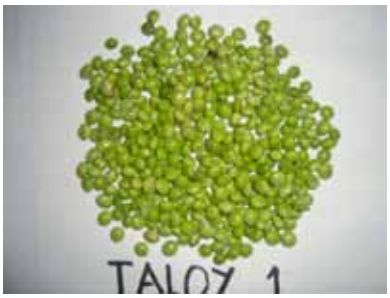
- Destroyed by typhoon “Emong” during pod and seed development

ICPL 7035-9

ICPL 87034



ICPL 88039



TALOY 1

Figure 2. Fresh seeds of four pigeon pea lines

Return on Cash Expense (ROCE)

The return on cash expenses of seven pigeon pea lines is shown in Table 8. ICPL 7035-9 have the highest ROCE of 86.35% followed by ICPL 87034 and ICPL 88039. On the other hand, “Taloy 1” had the lowest ROCE of -34.38%. Low gross sale and yield in “Taloy 1” resulted to negative ROCE. ”Seng-ewan”, ICPL 87119-8 and ICPL 8863-10 have zero ROCE since they did not have seed yield. It appears that the moderate resistance of the different lines to pod borer reduced seed yield resulting to low ROCE.

Table 8. Return on cash expenses of seven pigeon pea lines

LINE	TOTAL YIELD OF FRESH SEED (kg)	VARIABLE COST (Php)-	GROSS SALE(Php)+	NET INCOME	ROCE %
Taloy 1	0.50	3.81	2.5	-1.31	-34.38
Seng-ewan	-	3.81	-	-	-
ICPL 87034	0.123	3.81	6.15	2.34	61.41
ICPL 88039	0.112	3.81	5.6	1.79	46.98
ICPL 8863-10	-	3.81	-	-	-
ICPL 7035-9	0.142	3.81	7.1	3.29	86.35
ICPL 87119-8	-	3.81	-	-	-

-Variable cost include only compost fertilizer used

+ Sales was based on the average of P50.00 per kilo

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at Taloy Sur, Tuba, Benguet from October 2008 to May 2009 to determine the growth and yield of different pigeon pea lines and to select the best line suited at Taloy Sur, Tuba, Benguet condition.

During the conduct of the study, temperature ranged from 25.5 to 27^{o}C which was favorable for growing pigeon pea.

Highly significant differences were observed among the lines in terms of plant height at 35 DAP and at flowering, weight of 100 seeds and dry and fresh seed yield. The two local lines produced the tallest plants at 35 DAP. However, because "Seng-ewan" is the latest to bear flowers at 147 days, it produced the tallest plants at flowering. "Taloy 1" was the shortest plant but comparable to ICPL 87034 and ICPL 7035-9. ICPL 87034 and ICPL 7035-9 were the earliest to bear flowers at more than 92 days.

Only four pigeon pea lines have produced dry and fresh seed yield. These are ICPL 7035-9, ICPL 87034, ICPL 88039 and "Taloy 1". On the other hand, "Seng-ewan", ICPL 87119-8 and ICPL 8863-10 were not able to produce yield due to the typhoon that occurred during pod and seed development. ICPL 7035-9 produced high dry and fresh seed yield as well as ROCE followed by ICPL 87034 and ICPL 88039. On the other hand, "Taloy 1" produced the lowest dry and fresh seed yield as well as ROCE.

In terms of the reaction to pests and diseases, pigeon pea lines "Seng-ewan", "Taloy 1", ICPL 88039, ICPL 7035-9 and ICPL 87119-8 had high resistance to bean rust at 90 to 120 DAP while the rest exhibited mild resistance at 90 DAP and became moderately resistant at 120 DAP. However, "Taloy 1" was observed to be moderately

resistant to pod borer at 120 DAP while ICPL 7035-9, ICPL 87034 and ICPL 88039 had mild resistance against the same pest.

Conclusion

Based on the results, ICPL 7035-9 is the best performing line in terms of yield, resistant to pest, and ROCE. Thus ICPL 7035-9 is suited at Taloy Sur, Tuba, Benguet.

Recommendation

Short duration pigeon pea lines like ICPL 7035-9 could be recommended to farmers at Taloy Sur, Tuba but for more yield and profit the plants should be planted as early as July or August.

"Seng-ewan" could be a potential alternative if no strong typhoon occurs in the area during pod-filling stage.

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APPENDICES

Appendix Table 1. Plant height at 35 DAP (cm)

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	9.83	10.10	10.03	29.96	9.99[a]
Seng-ewan	10	10.03	10.16	30.19	10.06[a]
ICPL 87034	6.43	7.10	7.43	20.96	6.98[b]
ICPL 88039	6.83	7.20	7.33	21.36	7.12[b]
ICPL 8863-10	7.28	7.36	7.46	22.05	7.35[b]
ICPL 7035-9	7.53	7.30	7.36	22.19	7.39[b]
ICPL 87119-8	7.26	9.53	7.10	23.89	7.96[b]
TOTAL	55.16	58.62	56.87	170.65	8.12

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	32.058	5.343	17.92 **	2.996	4.821
Block	2	0.880	0.440	1.48ns	3.885	6.927
Error	12	3.577	0.298			
TOTAL	20	36.515				

ns -not significant CV= 6.72%
** -highly significant

Appendix Table 2. Plant height at flowering (cm)

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	57.36	53.43	61.60	172.39	57.46[c]
Seng-ewan	106.76	170.46	125.83	403.05	134.35[a]
ICPL 87034	50.73	74.10	50.96	175.79	58.59[c]
ICPL 88039	72.63	88.33	80.40	241.36	80.45[b]
ICPL 8863-10	84.86	99.60	107.53	291.99	97.33[b]
ICPL 7035-9	48.56	66.33	62.86	177.75	59.25[c]
ICPL 87119-8	88.33	107.60	106.30	302.23	100.74[a]
TOTAL	509.23	659.85	595.48	1764.56	84.02

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	14903.433	2483.906	17.56**	2.996	4.821
Block	2	1631.854	815.927	5.77*	3.885	6.927
Error	12	1697.182	141.432			
TOTAL	20	18232.469				

* -significant
** -highly significant

CV= 14.15%

Appendix Table 3. Number of days to flowering

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	105	105	105	315	105[a]
Seng-ewan	147	147	147	441	147[a]
ICPL 87034	92	92	92	276	92[a]
ICPL 88039	95	95	95	285	95[a]
ICPL 8863-10	142	142	142	426	142[a]
ICPL 7035-9	97	97	97	291	97[a]
ICPL 87119-8	139	139	139	417	139[a]
TOTAL	817	817	817	2451	116.71

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	10984.286	1830.714	0.00ns	2.996	4.821
Block	2	0.000	0.000	0.00ns	3.885	6.927
Error	12	0.000	0.000			
TOTAL	20	10984.286				

ns –not significant CV= 0.00%

Appendix Table 4. Number of flower cluster per plant

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	17.33	17.67	29.33	64.33	21.44[c]
Seng-ewan	105.33	122.67	95.67	323.67	107.89[a]
ICPL 87034	15.67	57.67	22.33	95.67	31.89[c]
ICPL 88039	39.67	66.33	47.33	153.33	51.11[b]
ICPL 8863-10	46.67	74.67	97.67	219.01	73.00[b]
ICPL 7035-9	15.67	31.33	31.33	78.33	26.11[c]
ICPL 87119-8	62	88.33	92.67	243	81.00[b]
TOTAL	302.34	458.67	416.33	1177.34	56.06

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	18898.309	3149.718	18.76**	2.996	4.821
Block	2	1867.879	933.940	5.56*	3.885	6.927
Error	12	2014.784	167.899			
TOTAL	20	22780.972				

* -significant
** -highly significant

CV= 23.11%

Appendix Table 5. Number of flower per cluster

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	11	11	11	33	11.00[a]
Seng-ewan	11	11	11	33	11.00[a]
ICPL 87034	8.67	9	9.33	27	9.00[b]
ICPL 88039	8.67	9	9	26.67	8.89[b]
ICPL 8863-10	9	9	9	27	9.00[b]
ICPL 7035-9	9.67	10.63	11.33	31.33	10.44[a]
ICPL 87119-8	7.33	8	8	23.33	7.78[c]
TOTAL	65.34	67.33	68.66	201.33	9.58

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	27.536	4.589	46.32**	2.996	4.821
Block	2	0.798	0.399	4.03*	3.885	6.927
Error	12	1.189	0.099			
TOTAL	20	29.523				

* -significant
** -highly significant

CV= 3.28%

Appendix Table 6. Number of days to pod setting

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	109	109	109	327	109[a]
Seng-ewan	151	151	151	453	151[a]
ICPL 87034	95	95	95	285	95[a]
ICPL 88039	98	98	98	294	98[a]
ICPL 8863-10	145	145	145	435	145[a]
ICPL 7035-9	101	101	101	303	101[a]
ICPL 87119-8	142	142	142	426	142[a]
TOTAL	841	841	841	2523	120.14

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	10982.5714	1830.429	0.000ns	3.00	4.82
Block	2	0.000	0	0.000ns	3.89	6.93
Error	12	0.000	0			
TOTAL	20	29.523				

ns –not significant CV= 0.00%

Appendix Table 7. Number of seed zone

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	5.30	5	4.90	15.7	5.23[a]
Seng-ewan	4.80	4.80	3.90	13.5	4.50[b]
ICPL 87034	3.50	3.50	3.80	10.8	3.60[c]
ICPL 88039	3.40	3.60	3.60	10.6	3.53[c]
ICPL 8863-10	3.10	3.40	3.70	10.2	3.40[c]
ICPL 7035-9	4.60	4.60	4.70	13.9	4.63[b]
ICPL 87119-8	3.30	3.30	3.30	9.9	3.30[c]
TOTAL	28	28.7	27.9	84.6	4.02

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	10.183	1.697	21.53**	2.996	4.821
Block	2	0.054	0.027	0.34[ns]	3.885	6.927
Error	12	0.946	0.079			
TOTAL	20	11.183				

ns- not significant CV= 6.97%
** -highly significant

Appendix Table 8. Length of pods (cm)

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	7.42	7.82	7.34	22.58	7.53[a]
Seng-ewan	8.35	7.14	6.67	22.16	7.38[a]
ICPL 87034	6.27	6.59	6.67	19.53	6.51[b]
ICPL 88039	6.37	6.70	6.72	19.79	6.59[b]
ICPL 8863-10	5.65	5.32	5.32	16.29	5.43[c]
ICPL 7035-9	7.89	7.92	8.31	24.12	8.04[a]
ICPL 87119-8	5.38	5.29	5.17	15.84	5.28[c]
TOTAL	47.03	46.78	46.2	140.31	6.68

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	19.872	3.212	20.75**	2.996	4.821
Block	2	0.091	0.046	0.29[ns]	3.885	6.927
Error	12	1.915	0.160			
TOTAL	20	21.879				

ns –not significant CV= 5.98%
** -highly significant

Appendix Table 9. Weight of hundred seeds

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	13.0	13.0	13.2	39.2	13.06[a]
Seng-ewan	0	0	0	0	0.00[c]
ICPL 87034	11.1	11.1	11.2	33.4	11.13[b]
ICPL 88039	12.0	12.0	12.0	35.9	11.9[b]
ICPL 8863-10	0	0	0	0	0.00[c]
ICPL 7035-9	13.0	13.0	13.0	39	13.00[a]
ICPL 87119-8	0	0	0	0	0.00[c]
TOTAL	49.1	48.8	49.4	147.5	7.01

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	782.692	130.449	23150.06**	2.996	4.821
Block	2	0.026	0.013	2.28ns	3.885	6.927
Error	12	0.068	0.006			
TOTAL	20	782.786				

ns –not significant CV= 1.07%
** -highly significant

Appendix Table 10. Dry seed yield

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	21.30	17.0	26.10	64.4	21.46[b]
Seng-ewan	0	0	0	0	0.00[c]
ICPL 87034	19.10	27.40	32.0	78.5	26.16[b]
ICPL 88039	23.0	26.10	26.0	75.1	25.03[b]
ICPL 8863-10	0	0	0	0	0.00[c]
ICPL 7035-9	31.20	38.30	34.0	103.5	34.50[a]
ICPL 87119-8	0	0	0	0	0.00[c]
TOTAL	94.6	108.8	118.1	321.5	15.30

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	3965.278	660.880	66.81**	2.996	4.821
Block	2	40.018	20.009	2.02[ns]	3.885	6.927
Error	12	1118.702	9.892			
TOTAL	20	4123.998				

ns –not significant CV= 20.54%
** -highly significant

Appendix Table 11. Fresh seed yield

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	50	43	56	149	49.67[b]
Seng-ewan	0	0	0	0	0.00[c]
ICPL 87034	42	153	175	370	123.33[a]
ICPL 88039	75	150	110	335	117.66[a]
ICPL 8863-10	0	0	0	0	0.00[c]
ICPL 7035-9	110	180	135	425	141.66[a]
ICPL 87119-8	0	0	0	0	0.00[c]
TOTAL	277	526	476	1279	60.90

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	72753.143	12125.524	13.69**	2.996	4.821
Block	2	4957.238	2478.619	2.80[ns]	3.885	6.927
Error	12	10625.429	885452			
TOTAL	20	88335.810				

ns –not significant CV= 48.86%
** -highly significant

Appendix Table 12. Bean rust at 90 DAP

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	1	1	1	3	1[b]
Seng-ewan	1	1	1	3	1[b]
ICPL 87034	3	1	3	7	2.33[a]
ICPL 88039	1	1	1	3	1[b]
ICPL 8863-10	1	3	3	7	2.33[a]
ICPL 7035-9	1	1	1	3	1[b]
ICPL 87119-8	1	1	1	3	1[b]
TOTAL	9	9	11	29	1.38

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	7.619	1.270	3.08*	2.996	4.821
Block	2	0.381	0.190	0.46[ns]	3.885	6.927
Error	12	4.952	0.413			
TOTAL	20	12.952				

ns –not significant
*-significant

CV= 46.52%

Appendix Table 13. Bean rust at 120 DAP

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	1	1	1	3	1.00[c]
Seng-ewan	1	1	1	3	1.00[c]
ICPL 87034	3	3	3	9	3.00[a]
ICPL 88039	2	2	1	5	1.67[b]
ICPL 8863-10	3	3	3	9	3.00[a]
ICPL 7035-9	1	1	1	3	1.00[c]
ICPL 87119-8	1	1	1	3	1.00[c]
TOTAL	12	12	11	35	1.67

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	16.000	2.667	56.00**	2.996	4.821
Block	2	0.095	0.048	1.00[ns]	3.885	6.927
Error	12	0.571	0.048			
TOTAL	20	16.667				

ns –not significant CV= 13.09%
** - highly significant

Appendix Table 14. Legume pod borer at 120 DAP

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
Taloy 1	3	3	3	9	3.00[a]
Seng-ewan	0	0	0	0	0.00[c]
ICPL 87034	2	3	2	7	2.33[b]
ICPL 88039	2	2	2	6	2.00[b]
ICPL 8863-10	0	0	0	0	0.00[c]
ICPL 7035-9	2	2	1	3	1.00[b]
ICPL 87119-8	0	0	1	3	1.00[c]
TOTAL	9	10	9	28	1.33

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	TABULATED F 0.05	0.01
Treatment	6	30.000	5.000	105.00**	2.996	4.821
Block	2	0.095	0.048	1.00ns	3.885	6.927
Error	12	0.571	0.048			
TOTAL	20	30.667				

ns –not significant CV= 16.37%
** - highly significant