BIBLIOGRAPHY

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Adviser: Guerzon A. Payangdo, MSc.

ABSTRACT

The study was conducted to; determine the growth and yield of the different entries of mungbean; identify the best entries of mungbean based on seed yield in Tuba, Benguet and characterize the mungbean entries to be used in study.

Among the ten entries evaluated, *Sileng* produced the highest total and computed yield and had the highest return on cash expense followed by *Dutlet* entry under Tuba, Benguet condition.

Based on morphology, all entries had a light green to green in color, pale yellow to yellow flowers and green to shiny green seed color except for China entry with yellow seeds.

INTRODUCTION

Mungbean (*Vigna radiata* L.) is one of the important food crops that is widely grown in the Philippines. It is well adapted to the country's soil and climatic conditions and it is also easily cultivated (Catipon, 1986). This is probably one reason why mungbean is one of the cheapest source of protein in the Filipino diet

However, mungbean production has not been adequate to meet the demand of food and manufacturing industries in the Philippine due to the low yield of most of the available varieties. Therefore, evaluation of different mungbean varieties to improve yield should be considered (Punto and Lantican, 1982).

In Camp One, Tuba, Benguet, farmers are planting only one variety of mungbean, locally named as "kusapo". It was observed that this variety produces unusually small seeds with distinct long pods and low yield which is not desirable. Hence, this study aims to evaluate new entries of mungbean to find out which are adaptable in the area and which may provide adequate yield. Morphological characteristics of these mungbean entries will also be determined to distinguish one entry from the other entries. These morphological characteristics will also serve as basis of selection by the farmer.

With the help of this study, adequate information to farmers about other possible entries of mungbean, theire different morphological characteristics and productivity if grown in Tuba, Benguet will be provided. The best entry may also be recommended in the locality to increase production without increasing the cost of productivity.

The study aimed to determine the growth and yield of the different entries of mungbean; to identify the best entry of mungbean based on seed yield in Tuba, Benguet and to characterized the mungbean entries to be used in the study.

The study was conducted at Dungon Camp One, Tuba, Benguet from October 2012 to February 2013.

REVIEW OF LITERATURE

Varietal Evaluation

Improving crop performance, productivity, plant breeding and using new developments in agricultural biotechnology will allow increased in crop yields and maintenance of yield stability without increasing land usage (Reddy and Hodge, 2000).

Characteristics of good variety should be high yielding, pest and diseases resistance, good pest harvest characteristics, eating quality and must be early maturity so that production would entail less expense and ensure more profit. Selecting the right variety will minimize problems associated with water and fertility management (Bautista and Mabesa, 1986).

Varietal evaluation is a part of a process of crop breeding program which compare promising line development by a breeders. In this process the breeder must observed the yield, quality, adaptability, insect pest and disease resistant and stress tolerance of a particular crop (Regmi, 1990).

Variety Characterization

Is the process of documenting variety traits that can be used to distinguish one variety from other varieties. Some of these traits are not only useful in judging the worth of a variety for identification but also for evaluation. Traits that are use for characterization are generally more stable than other traits and need not be taken repetitively in the various stages of variety evaluation (Rasco and Amante, 1994).

Varietal Adaptability

The adaptability and introduction of new varieties in particular location is important for a successful production. It serves two purposes where in, if it is proven that it is suitable under local condition it can be propagated and released for commercial production, also important sources of variability and source of desirable genes which can be use in hybridization work (Bao-an, 2002).

Variety must be adapted to the area in which it is grown. When grown under the same method of culture there is a great variation in the yielding ability of the different varieties. It is not a guarantee that a variety that yield best in one region will perform well in another region (Rely and Shry, 1991). Good performance and high yield of a crop in an area could convince and encourage farmers to grow legumes.

Environmental Requirements

Mungbean is a warm season crop requiring 90 to 120 days of front-free conditions from planting to maturity but this depends on the variety planted. Adequate rainfall is required from flowering to late pod fill in order to reassure good yield. Late planting which result in flowering during the high temperature low moisture period in July and August will reduce yield. High humidity and excess rainfall late in the season can result in disease problem and harvesting losses due to the delayed maturity (Thompson and Kelly, 1975).

Mungbean is primarily grown in a rain fed crop in the Philippines and essentially regarded as secondary crop. In 1986, it accounted to only 0.31% of the total agricultural area of 12,237,238 ha. (Navarro *et al*., 1988).

Mungbean is often planted during dry season to utilized residual soil moisture still present after the rain crop such us corn and rice. It can be planted not only as a monocrop

but also in cropping rotation, relay cropping and inter cropping with coconut, corn and other long maturing crops. It is suited to low input farming due to its ability to fix nitrogen given the right condition (Regmi, 1988).

Effect of Temperature

Fernandez and Shanmugasundaran (1988) identified that the low yield potential, lack of yield stability, susceptible in pest and diseases, narrow adaptability were due to photoperiod and temperature sensitivity, susceptibility to a biotic stresses, non synchronous pod maturity, pod shattering and yield weathering are the most serious constraints of the local mungbean cultures in the tropics.

Soil Requirement

Catipon (1986) reported that an experiment range yield of 0.28 to 1.87 t/ha in the dry season and 0.37 to 2.41 t/ha in wet season for mungbean traits in the Philippines. Soil and environment factors exert considerable influence on this variability. She also added that mungbean could be grown in a wide range soil type from clay loam to silt loam for optimum bean yield, soil of the depth of at least 50 cm, well drained and pH of 5.8 to 6.2 are preferred. Soils that are too acidic affect the growth of rhizobial bacteria and the availability of same nutrient. In such soil the pH maybe corrected by liming.

Effect of Insect Pest and Diseases

The major insect pests in the Philippines are the bean fly, aphids, pod borers and pulse beetle. Important diseases include powdery mildew which causes 40% yield loss and cescospora leaf spot which yield causes yield up to 58% (Work and Carew, 1955).

MATERIALS AND METHODS

A total area of 240 square meters was thoroughly cleaned by removing all unnecessary materials like weeds and stones. After which, the area was cultivated and formed raised beds .The area was divided into 3 blocks containing 10 plots each measuring 1m x 10m. The experiment was laid out in a randomized complete block design (RCBD) with three replications.

Two seeds were sown in each hill at a depth of 2-5 cm with a distance of 30 cm x 25cm in between hills and rows. All other recommended cultural practices in bean production such as weeding, irrigation and pest management were done from planting to maturity to maintain good growth and yield of the plants. The different entries of mungbean were collected from different sources and served as treatment as follows:

Code	Entry	Place of collection
V_1	*Maligkung*	Sadanga
V_2	*Nagbunga*	Apayao
V_3	*Gunugon*	Bontoc
V_4	*Sileng*	Pangasinan
V_5	*La Paz*	Tarlac
V_6	*Dutlet*	Isabela
V_7	*Emelda*	Laoag
V_8	*Kosapo*	La Union
V_9	*Lusero*	Dagupan
V_{10}	*China*	China

Data Gathered

The following data were gathered:

1. Meteorological data. Temperature and relative humidity was taken by using the compact psychrometer. Rainfall was taken by placing cans in the field to collect water when precipitation occurs. The volume of water to be collected was measured using a graduated cylinder and was recorded by getting the average volume of the water from the cans.

2. Number of days from sowing to emergence. The days of emergence was recorded at least 80 % of the seeds sown had emerged from the soil.

3. Number of days from emergence to flowering. This was recorded by counting the days from emergence to the days when at least 50% of the plants have fully flowered.

4. Number of days from emergence to harvesting. This was taken by counting the number of days from emergence to harvesting.

5. Plant height (cm). The final height of the plant was measured just before harvesting. Measurement was done from the soil surface up to the tip of the plant.

6. Leaf color. The color of the leaves was recorded as light green, green and dark green.

7. Flower characteristics.

a. Flower color. The color of the flower was recorded based on visual observation.

b. Number of flower clusters per plant. This was taken by counting the flowers presents in a cluster from ten random sample plants per plot.

c. Number of flower per plant. This was taken by counting the flower present in a cluster per plant from ten random samples per plot.

8. Pod characteristics.

a. Number of pods per plant. The number of pods per cluster per plant was recorded from ten random sample per plot.

b. Percentage of pod set. This was determined with the use of this formula.

$$\% \text{ Pod set} = \frac{\text{Total number of pod per plant}}{\text{Total number of flower per plant}} \times 100$$

c. Pod length (cm). This was taken by measuring the pod length from the base to the tip of the pod.

d. Pod width (cm). Pod width was taken by measuring the mid-point of the pod using a ruler.

e. Pod color. Pod color was recorded as light brown, brown, dark brown and black.

9. Seed characteristics.

a. Number of seed per pod. The number of seeds per pod (developed) was counted from ten random plants.

b. Seed color. The color of the seed was recorded based on visual observation.

c. Seed dimension.

c.1. Seed width (mm). Seed width was taken by measuring the mid-portion of the seed using a ruler.

c.2. Seed length (mm). This was obtained by measuring the seeds parallel to the hilum.

10. Weight of 200 seeds. The seed yield was obtained by weighing the weight of 200 seeds.

11. Insect pest and disease occurrences. This was determined by assessing the degree of damage caused by specific insect pest and diseases to the crop using the following scale.

a. Bean flies was rated using the following scale by Catipon (1986)

Scale	Description	Remarks
0	No infestation	Highly resistant
1	1-24% of the plants per plot are infested.	Resistant
2	25-50% of the plants per plot are infested.	Moderate resistant
3	51-75% of the plants per plot are infested.	Susceptible
4	76-100% of plants per plot are infested.	Very susceptible

b. Bean rust was rated using the following scale by Catipon (1986)

Scale	Description	Remarks
1	No infection	Highly resistant
2	10-20% infection per plot	Moderate resistant
3	30-40% infection per plot	Resistant
4	50-60% infection per plot	Susceptible
5	Greater than 60% infection	Very susceptible

12.Total yield per plot (kg).The total weight of the seed per plot was recorded.

13.Computed yield per hectare (t/ha). This was analyzed using the formula:

$$\text{Yield (t/ha)} = \frac{\text{Total Yield}}{10} \times 100$$

14. Return on Cash Expense (ROCE). This was analyzed using this formula:

$$\text{ROCE} = \text{Gross sale} - \frac{\text{Total expense}}{\text{Total expenses}} \times 100$$

RESULTS AND DISCUSSION

Meteorological Data

The temperature, amount of rainfall and relative humidity during the conduct of the study from November 2012 to February 2013 are shown in Table 1. The Temperature range during the conduct of study is 25.40 °C to 30 °C. The temperature is within the range that favors the growth of mungbean. The relative humidity ranges from 73% to 79%. The total amount of rainfall recorded declined from 10 mm in December to 3 mm in February 2013. Irrigation was done during low rainfall period.

Number of Days to Emergence, Flowering and to Harvesting

Results revealed that all the mungbean entries emerged 3 to 4 days after planting (DAP) under Camp One, Tuba, Benguet condition (Table 2). The earliest to produce flowers were *Nagbunga, Dutlet* and *Lusero* (30 days), while *Maligkung, Emelda* and *Kosapo* bloom after 34 days. All of the entries of mungbean were harvested at 78 days after planting. The earliest flowering of *Nagbunga Dutlet* and *Lusero* could be

Table 1. Meteorological data during the conduct of the study

MONTH	TEMPERATURE (°C)		RELATIVE HUMIDITY (%)	RAINFALL AMOUNT (mm)
	MIN	MAX		
NOVEMBER	26.50	30.00	76	--
DECEMBER	26.25	28.75	75	10
JANUARY	25.40	29.31	79	20
FEBRUARY	25.90	29.10	73	3

advantageous when the commodity is needed in specific time such as in the case of contract growing.

Plant Height

The height of mungbean was measured before harvesting. Result showed no significant differences. However, numerically *Sileng* and *Emelda* were the tallest among the entries of 54.00 cm.

Differences in height could be due to inherent characteristics like narrow adaptability to photoperiod and susceptibility to major pest and diseases.

Table 2. Number of Days to Emergence, Flowering and Harvesting of ten mungbean entries

ENTRY	DAYS TO EMERGENCE	DAYS TO FLOWERING	DAYS TO HARVESTING
Maligkung	3	34	78
Nagbunga	4	30	78
Gunugon	3	32	78
Sileng	3	32	78
La Paz	4	32	78
Dutlet	4	30	78
Emelda	4	34	78
Kosapo	3	34	78
Lusero	4	30	78
China	3	32	78
CV%	0	0	0

Means with the same letter are not significantly different by DMRT (P≥0.05)

Table 3. Plant height of ten mungbean entries grown under Tuba, Benguet condition

ENTRY	PLANT HEIGHT (cm)
Maligkung	52.67
Nagbunga	43.67
Gunugon	36.67
Sileng	54.00
La Paz	48.67
Dutlet	39.33
Emelda	46.67
Kosapo	54.00
Lusero	46.67
China	46.67
CV%	3.30

Means with the same letter are not significantly different by DMRT (P≥0.05)

Number of Flower Clusters per Plant and Flower per Plant

Table 4 shows a significant differences on the number of flower cluster per plant. Result showed that *Sileng* had the highest number of flower clusters with 11.3, followed by *Dutlet* and *Lusero* produced 9.7 and 9.3 flower clusters, respectively. The lowest was *China* with 6.0 flower clusters per plant.

In terms of the number of flower per cluster, no significant differences were noted with mean number of 9.00 to 14.6 (Table 4).

Table 4. Number of flower cluster and flowers per plant of ten mungbean entries

ENTRY	NUMBER OF FLOWER CLUSTERS PER PLANT	NUMBER OF FLOWERS PER CLUSTER
Maligkung	7.7^{def}	13.0
Nagbunga	8.7^{bcd}	9.6
Gunugon	7.3^{ef}	11.6
Sileng	11.3^{a}	14.6
La Paz	8.0^{cde}	10.6
Dutlet	9.7^{b}	13.0
Emelda	6.7^{fg}	11.3
Kosapo	9.0^{bc}	11.3
Lusero	9.3^{b}	11.6
China	6.0^{g}	9.0
CV%	7.87	17.42

Means with the same letter are not significantly different by DMRT (P≥0.05)

Number of Pods per Plant and
Percentage Pod Set

Table 5 shows the result of number of pods per plant and percentage of pod set per plant with no significant differences. Although numerically, *Sileng* produced the numerous pods per plant and also high in terms of pod set percentage per plant of 13.3 and 90.7%

These differences could be due to various factors such as inherent varietal potential and planting distance (Regmi, 1988).

Table 5. Number of pods per plant and percentage of pod set per plant of ten mungbean entries

ENTRY	NUMBER OF PODS PLANT	PERCENTAGE POD SET
Maligkung	11.3	87.1
Nagbunga	8.3	83.4
Gunugon	9.6	83.6
Sileng	13.3	90.7
La Paz	8.6	81.9
Dutlet	10.6	82.3
Emelda	9.0	80.5
Kosapo	9.0	79.3
Lusero	9.6	81.2
China	7.3	80.3
CV%	21.53	8.37

Means with the same letter are not significantly different by DMRT (P≥0.05)

Pod Length and Width

Table 6 shows the result of the pod width and length of the ten mungbean entries. On pod width, significant differences were observed which *Sileng* and *Kosapo* had the widest pod (7.0 mm) followed by *Maligkung*, *Nagbunga* and *Gunugon* entries (6.0 mm). The narrowest pod was in china *La Paz* entries (4.0 mm).

In terms of the pod length of the ten mungbean entries, *Sileng* had the significantly longest pod of 13.3 cm followed by *Dutlet* and *Lusero* (11.3 and 10.7 cm, respectively). The shortest was noted from entries *China* and *Kosapo*. On the wider spacings which caused

by death of plant in between the hills not replanted enhanced increase pod length, while narrow spacings decrease pod length (Catipon, 1986).

Seed Width and
Seed Length

Table 7 shows the results of the seed width and length of the ten mungbean entries. Significant differences were observed on seed width, *Sileng* had the widest and longest seed of 4.50 mm and 6.52 mm, respectively followed by *Maligkung, Nagbunga* and *Gunugon* entries. The narrowest was *China* with 3.50 and 4.47 seed width and length.

Table 6. Pod width and length of ten mungbean entries

ENTRY	POD WIDTH (cm)	POD LENGTH (cm)
Maligkung	6.0^{b}	9.7^{c}
Nagbunga	6.0^{b}	9.3^{c}
Gunugon	6.0^{b}	9.0^{cd}
Sileng	7.0^{a}	13.3^{b}
La Paz	4.0^{e}	9.3^{c}
Dutlet	5.7^{bc}	11.3^{b}
Emelda	5.3^{cd}	8.3^{de}
Kosapo	7.0^{a}	8.0^{e}
Lusero	5.0^{d}	10.7^{b}
CV%	4.48	5.49

Means with the same letter are not significantly different by DMRT (P≥0.05)

Table 7. Seed width and length of ten mungbean entries

ENTRY	SEED WIDTH (mm)	SEED LENGTH (mm)
Maligkung	4.22^{cd}	5.77^{bc}
Nagbunga	4.13^{e}	5.53^{bc}
Gunugon	4.28^{bc}	5.51^{bc}
Sileng	4.50^{a}	6.52^{a}
La Paz	3.77^{g}	5.53^{bc}
Dutlet	4.33^{b}	5.86^{b}
Emelda	3.94^{f}	4.47^{c}
Kosapo	4.19^{de}	5.58^{bc}
Lusero	3.81^{g}	5.14^{d}
China	3.50^{h}	4.47^{e}
CV%	0.09	3.43

Means with the same letter are not significantly different by DMRT (P≥0.05)

Number of Seeds per Pod and
Weight of 200 Seeds

Table 8 presents the number of seeds per pod and weight of 200 seeds of the different entries used in the study.

As to the number of seeds per pod, *Sileng* had the significantly most number of seeds per pod (13) followed by *China* and Dutlet (12). The lowest seed produced were obtained from Kosapo (7).

In terms of weight of 200 seeds, *Sileng* produced the heaviest (18g) followed by *Kosapo* (15.00 g), *Dutlet* (15 g), *Nagbunga* (15.7 g) and *Gunugon* (14.7 g) and lightest was

China. The weights of 200 seeds were taken when the seed reaches 10% moisture content after drying.

Reaction to Bean Flies and Bean Rust

The reaction of the different mungbean entries to bean flies and bean rust mild resistant to bean flies and on the bean rust infection the rating was moderately resistant.

Table 8. Number of seeds per pod and weight of 200 seeds of ten mungbean entries

ENTRY	NO. OF SEEDS PER POD	WEIGHT OF 200 SEEDS (g)
Maligkung	11[c]	14.3[bc]
Nagbunga	11[c]	15.7[b]
Gunugon	10[d]	14.7[b]
Sileng	13[a]	18.0[a]
La Paz	9[e]	13.0[cd]
Dutlet	12[b]	15.0[b]
Emelda	9[e]	14.3[bc]
Kosapo	7[f]	15.0[b]
Lusero	10[d]	12.0[d]
China	12[b]	9.0[e]
CV%	4.17	5.76

Means with the same letter are not significantly different by DMRT (P≥0.05)

This result coincides with the finding of Catipon (1986) that as the mungbean plant matured, they become more susceptible to the diseases. This indicates that there was a decrease on the resistance of mungbean as nutrients or elements are diverted to the reproductive processes.

Leaf , Flower, Pod and Seed Colors

The leaf color of mungbean entries used in the study were mostly green except *La Paz, Dutlet* and *China* with light green.

The flower colors of mungbean entries used in the study were pale yellow to yellow.

For the pod color of the ten mungbean entries used studied all are black except *Nagbunga* and *Sileng* with brown color and *Gunugon* with light brown.

In terms of seed color, most of them were green, while *Nagbunga* and *Gunugon* have shiny green color. *Dutlet* has shiny brown seeds, *La Paz* has dark green seeds and *China* has yellow seeds.

Total Yield per Plot and Computed
Yield per Hectare

The entries differ significantly in the total seed yield per plot (Table 10). *Sileng* produced the highest yield of 0.25 kg per plot followed by *Dutlet* with 0.19kg while *China* produced the lowest yield of 0.07 kg per plot. According to Catipon (1986) there is always a variation on the yield and yield components among varieties during evaluation.

The computed yield per hectare differed significantly among the entries studied as presented in Table 10. The highest computed yield was observed from *Sileng* with 2.45 tons per hectare while the lowest computed yield was obtained from *China* with 0.67 tons per hectare.

Table 9. The leaf color, flower pod and seed of ten mungbean entries

ENTRY	COLOR OF			
	LEAF	FLOWER	POD	SEED
Maligkung	Green	Pale yellow	Black	Green
Nagbunga	Green	Pale yellow	Brown	Shiny green
Gunugon	Green	Pale yellow	Light brown	Shiny green
Sileng	Green	Yellow	Brown	Green
La Paz	Light green	Pale yellow	Black	Dark green
Dutlet	Light green	Yellow	Black	Shiny brown
Emelda	Green	Pale yellow	Black	Green
Kosapo	Green	Yellow	Black	Green
Lusero	Green	Yellow	black	Green
China	Light green	Yellow	Black	Yellow

Table 10. Total yield per plot and computed yield per hectare of ten mungbean entries

ENTR	TOTAL SEED YIELD PER PLOT (kg/10m2)	COMPUTED YIELD PER HECTARE (tlha)
Maligkung	0.13^{cd}	1.27^{cd}
Nagbunga	0.16^{bc}	1.57^{bc}
Gunugon	0.11^{d}	1.07^{d}
Sileng	0.25^{a}	2.47^{a}
La Paz	0.10^{d}	1.00^{d}
Dutlet	0.19^{b}	1.87^{b}
Emelda	0.09^{de}	0.93^{de}
Kosapo	0.10^{d}	1.03^{d}
Lusero	0.14^{c}	1.40^{c}
China	0.07^{e}	0.67^{e}
CV%	14.09	14.09

Means with the same letter are not significantly different by DMRT (P≥0.05)

Return on Cash Expense (ROCE)

The return on cash expense of the different mungbean entries showed positive ROCE. Entry *Sileng* had the highest return on cash expense (ROCE) of 196 % followed by *Dutlet* (164 %) and the lowest was *China* with negative ROCE.

Table 11. Return on Cash Expense (ROCE) of ten mungbean entries

ENTRY	MARKETABLE SEEDS (kg/10m^2)	GROSS SALE (PhP)	TOTAL EXPENSES (PhP)	NET INCOME (PhP)	ROCE (%)
Maligkung	0.38	11.40	7.50	11.1	52
Nagbunga	0.47	14.1	7.50	8.4	88
Gunugon	0.32	9.6	7.50	12.9	28
Sileng	0.74	22.2	7.50	0.3	196
La Paz	0.30	9	7.50	13.5	20
Dutlet	0.56	16.8	7.50	5.7	164
Emelda	0.28	8.4	7.50	14.1	12
Kosapo	0.31	9.3	7.50	13.2	24
Lusero	0.42	12.6	7.50	9.9	68
China	0.02	6	7.50	16.5	-20

Selling price: 120 pesos per 1 kg

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The study was conducted to determine the growth and yield performance of the different mungbean entries, identify the entry that is best adapted in Tuba, Benguet condition and to determine the profitability of growing different entries of mungbean in Tuba Benguet freom November 2012 to February 2013.

Result shows that *Nagbunga, Dutlet* and *Lusero* flowered earlier at 30 days after planting (DAP) than the other entries. *Maligkung Emelda* and *Kosapo* entries required 34 days to blooming from emergence. *Sileng* produced the highest number of flower cluster, number of flowers per plant, and number of pods per plant than the rest of the entries, while *China* produced the lowest number of flower, number of flower per cluster and number of pods per plant.

China had the lowest percent pod set while *Sileng* recorded the highest percent pod set.

Sileng produced the heaviest weight of 200 seeds with. It also gave the highest yield per hectare. *Sileng* and *Dutlet* produced the longest pods ranging from while *China* recorded the shortest pods.

Sileng had the highest percentage of return of cash expense followed by *Dutlet, Nagbunga, Lusero* and *Maligkung.*

Conclusions

Based on the result, *Sileng* produced the highest number of flowers, pods and seeds per plant and the highest total computed yield and return on cash expense (ROCE). Differences on the morphological characters were varied such as leaf, flower, pod and seed color.

Recommendations

For mungbean production under Tuba, Benguet condition, all the entries are recommended except entry *China,* with negative return on cash expense (ROCE). For high profit, *Sileng* is recommended.

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