

BIBLIOGRAPHY

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ABSTRACT

The study evaluated the performance of six chickpea varieties in Bila, Bokod, Benguet November 2007 to March 2008. Specifically, the study aimed to determine the growth and yield of chickpea under Bila, Bokod, Benguet condition.

After five months of growth, plants of the Kabuli type variety were the tallest with an average height at flowering of 41.70 cm, average number of seeds per pod of 17.08 g average seed yield per plant of 27.11 g; weight of 1000 seeds was 415.75g; and germination test using the petri dish method was 64.00% while in rag doll method it was 85.25%; and with an average seed diameter of 0.88 cm.

As to the percentage emergence, ICCV 93954 had the highest percentage emergence followed by ICCV 94954, while ICCV 95334 had the lowest percentage emergence. In terms of yield, ICCV 940154 attained the highest total yield per hectare of 883.75 kg of seeds and total seed yield per plot 1.768 kg. ICCV 95332 was the earliest to produce flowers with a mean of 37.25 days from sowing the seeds to flowering. Results showed that the earliest varieties to produce flowers were also the earliest to reach harvesting stage.

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INTRODUCTION

The municipality of Bokod belongs to the type 1 classification of climate characterized by distinct wet and dry seasons. The dry season begins on November and ends in April. The rest of the year is wet or rainy season. The coldest months are in December, January and February with temperature as low as 12°C. The hottest months are in April and May especially in the low areas like Poblacion proper and Ambuclao. It has an elevation ranging from 2000 to 3,150 meter above sea level. Bokod is bounded by Kabayan (municipal boundary), Nueva Vizcaya, Itogon and Atok and about 57 km northeast of Baguio.

The land used for Agriculture is 1,567 hectares and 3.21% of their means of livelihood are rice farming and cattle raising. Other main source of income are lumbering and fruit and vegetable growing.

Chickpea is an annual cool season legume or pulse crop or as a green vegetable with the former use being the most common. It has one of the highest nutritional compositions of many dry edible legumes or is valued for its nutritive seeds with high protein content. Chickpea seeds are eaten fresh as green vegetables, parched, fruit roasted and boiled; as snack food, sweet and condiments; seed are ground in the flour can be used as soup, dhal, and to make bread, prepared with pepper, salt and lemon it is served as a side dish. A small chickpeas are said to have a very low glycemic index making them suitable for many people with blood sugar problems.

However, chickpea which had been introduced and cultivated in the cordilleras especially in Benguet even the agro climatic condition is suitable have very low production due to lack of information and no available planting materials. With the



introduction of new highbred ICRISAT cultivars of Chickpea coupled with the generation of location specific technologies for the highlands of CAR, chickpea could become a major cash earner. Moreover, the supply of chickpea in the Philippines depends mainly on importation from chickpea producing countries like Canada, Australia, Mexico, Iran, Pakistan, Turkey and India.

Sustaining the domestic demand, introducing chickpea in the highlands of Cordillera like in Benguet and increasing yield per area through the selection of adoptable varieties is the cheapest and easiest technology intervention.

Objectives of the Study

This study was conducted to: 1) Introduce adaptable and high yielding varieties of chickpea that could be productively grown in Bila Bokod, Benguet; 2) Promote and fast track the adoption of suitable chickpea varieties in the province of Benguet; and 3) Reduce importation of chickpea.

Time and Place of the Study

This study was conducted from October 2007 to January 2008 at Bila, Bokod, Benguet.



REVIEW OF LITERATURE

Description of Chickpea

Chickpea is a cool season food legumes crop in tropical, sub-tropical and temperate regions. It is annual plant with ranging between 30-70 cm, but all types with >1.0 m in height are cultivated in the east while USSR. The foliage is covered with glandular hairs with secrete highly acidic exudates, and is considered important in conferring tolerance to insect pests, such as the pod borer, leaves are compound, arranged in an alternative phyllotary and generally in paripinnate with 11 to 15 leaflets. Flowers are axillary, solitary or inflorescence of two to three. There are white, pink, purplish or blue in color. The plant has a deep root system and is considered a hardy crop. One seedpod contains two or three peas. Chickpeas need a subtropical or tropical climate and more that 400 mm annual rain (Anonymous, 2007).

Importance of the Chickpea

Chickpea have one of the highest nutritional compositions of any dry edible legume. On an average, chickpea seed contains 23% protein, 47% starch, 56% fat, 6% crude fiber, 6% soluble and 3% ash. It is often used as an alternative protein product with vegetarians and vegans and is on the plants within the highest amount of protein.

It produces modules in common with other legumes, and is efficient in fixing Atmosphere Nitrogen (N) in a plant usable from through biological nitrogen fixation (BNF) potassium and certain micronutrients which are recommended for anti nutritional factors preset were low and did not influence pig performance (Singh, 1983).



If properly inoculated with the right strain of *Rhizobium*, nitrogen fertilizer was not necessary (Giller 2001). Some growers apply 15 to 30 lbs of nitrogen using the broadcast method to enhance early seedling development, however, excessive amounts of nitrogen application can reduce nitrogen fixation and delay maturity (Giller 2001).

Climatic Requirements

Chickpea is grown mostly as a rainfed, post-rainy season, winter crop in subtropical South East Asia, parts of Africa and Australia. It is typically adapted to cooler seasons after the monsoon at highest latitudes and subtropical (Anonymous, 2007).

Chickpea can grow in a medium and high altitude of more than 800 m. The drought-resistant species with stands the largest temperature aptitudes. Bright sunshine is essential for growth and fertilization of semi-acid, a cloudy weather is harmful especially during pod setting of chickpeas (Maessan and Somaat Madja, 1990).

A small proportion of chickpea is also used in Turkey and Latin America, and to ferment food. Animal food is another use of chickpea in many developing countries. An adhesive may also be prepared, although not water-resistant, it is suitable for plywood. Gram husks, and green dried stems and leaves are used for stock feeds. Leaves are said to yield an indigo-like dye. Acid exudates from the leaves can be applied medically or used as vinegar. In Chile, a cooked chickpea-milk (4) mixture was good for feeding infants and effectively controlling diarrhea. Chickpeas yield 21% starch suitable for textile sizing, giving a light finish to silk, and cotton cloth (Anonymous, 2007).



Water Requirement

Chickpea require a fertile sandy loam soils with good interval drainage, good drainage is also necessary for short periods of water-logged fields reduce growth and increase susceptibility to root and stems

Soil Fertility and lime Requirement

Soil characteristics are important in controlling root growth and the soil moisture regime, soil bulk density, aeration, soil strength and soil temperature. The effect of soil water deficit on plant growth is well recognized such that other legumes can fix large amount of nitrogen (Wallis and Byth, 1986).

Chickpea requires well drained and not too heavy. One dry and light soils, such that soil chosen from its cultivation should be free from excessive soluble salts and near neutral reaction. It is suited to soils having a ph higher than 8.5 soil texture suited from chickpea is not well known, but the crop will likely require the amount of phosphorus.



MATERIALS AND METHODS

Materials

The materials used in this study were six varieties of chickpea seeds from ICRISAT, 480 sq. m. land area, growing media, insecticides, fungicides, fertilizers and other farm tools and equipment.

Methods

This study was conducted in Bila, Bokod, Benguet having a temperature of 18-20 °C and elevation of 1265 meter above sea level.

The experiment was laid out using Randomized Complete Block Design (RCBD) with six treatments and four replications.

Each treatment was assigned in two (1 x 1 m) plot or a total of 480 sq. m. The seeds were planted at a distance of 30 cm between rows and 30 cm between hills. Two furrows were made in the plot at 30 cm apart where the inorganic 914-14-14) fertilizer of ½ kg and 1 kerosene can of chicken dung were applied and mixed with the soil before sowing the seeds. The different Chickpea varieties which served as treatments were as follows:

<u>Desi Type</u>	<u>Kabuli Type</u>
T ₁ - ICCV 93952	T ₄ – ICCV 2
T ₂ – ICCV 93954	T ₅ – ICCV 95332
T ₃ – ICCV 944954	T ₆ – ICCV 95334

Data Gathered

The data gathered were the following:



A. Vegetative Growth

1. Emergence percentage (%). This was recorded 15 days from sowing seeds.

$$\text{Germination} = \frac{\text{Number of germinant}}{\text{Number of seeds sown}} \times 100$$

2. Days from planting to flowering. This was taken by counting the number of days from planting to flowering.
3. Average height at flowering (cm). This was taken at first flowering stage from 20 sample plants per treatment.
4. Days from planting to first harvest. This was noted by counting the days from planting to first harvest of seeds.
5. Average number of lateral branches at flowering. This was taken at first flowering stage from sample plants selected from each treatment.
6. Total number of harvest. This was the total number of harvesting done for one cropping season.

B. Yield

1. Average weight of pods produced per plant. This was the total number of pods produced by sample plants divided by the number of same plants.

$$\text{Average weight of pods produced per plant (g)} = \frac{\text{Total yield of sample per plants}}{\text{Number of samples}}$$

2. Average yield per plant. This was taken by using the formula.

$$\text{Average yield per plant} = \frac{\text{Total yield of sample plants}}{\text{Number of samples}}$$

3. Total yield per plat (kg). This was the total yield of the experimental plot.
4. Total yield per hectare (t/ha) (20m x 500m).



5. Average number of seeds/pod = $\frac{\text{Number of seed produced/plant}}{\text{Number of pods/plant}}$

6. Weight of 1000 seeds (g)

7. Average seed diameter (cm). This was taken by measuring the seed diameter using venire caliper

8. Germination test. This was conducted one month from seed storage using the Petri dish and the rag doll method.

D. Varietal Characterization

1. Leaf. The shape, color and other plant characteristics was recorded.

2. Flower. The color of the flower was recorded at flowering and at first harvesting stage.

3. Seed. The color, shape and size was recorded at harvesting together with weight seeds.

E. Incidence of insect Pest and Disease

1. Insect pests. Insect that infest the plant during cropping season was noted and identified during the vegetative and reproductive stages of plant growth.

2. Diseases. Plant diseases observed during the cropping season was recorded and the causal organism was identified including the degree of infestation.

F. Meteorological Data

1. Temperature (°C)

2. Relative Humidity (RH%)

3. Day length (hours)

4. Fog (small time or occurrence, density)



G. Documentation. This was taken through pictures of the experiment



Figure 1. Overview of the experiment at Bila, Bokod, Benguet



Figure 2. Chickpea plants at flowering stage



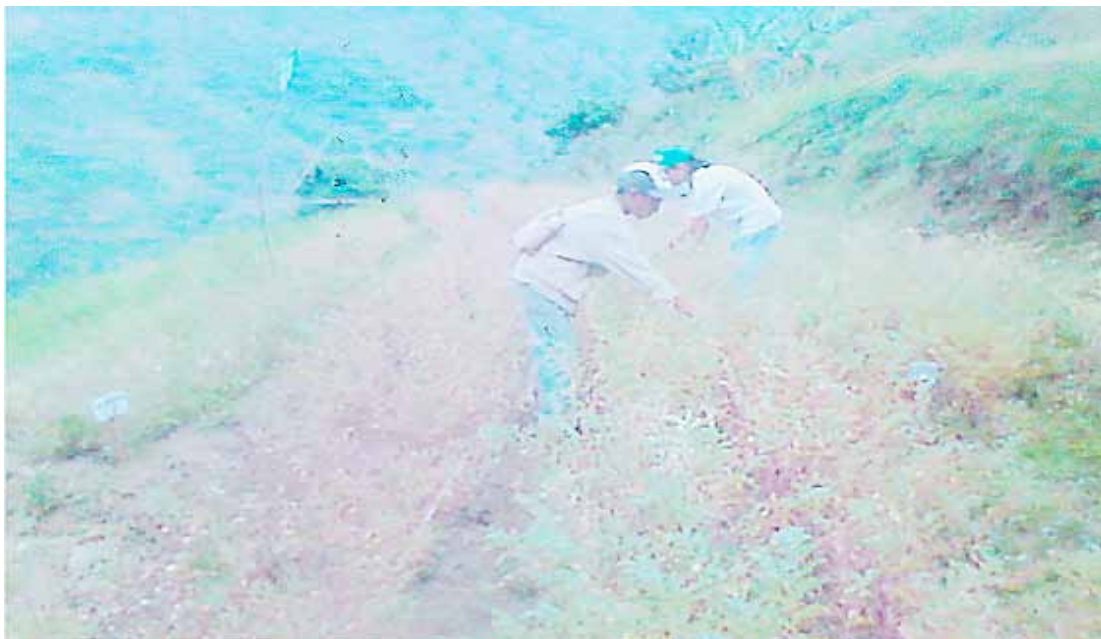


Figure 3. Harvesting of chick pea pods



Figure 4. Disease caused by wet root rot



RESULTS AND DISCUSSION

Percentage Field Emergence (%)

Table 1 showed no significant differences noted among the six chickpea varieties in terms of emergence percentage. Variety ICCV93954 numerically, was the highest emergence percentage followed by the variety ICCV 94954, ICCV 2, ICCV 95332 and ICCV 93952 and ICCV 95334 had the lowest percentage emergence.

Days from Planting to Flowering Stage

As presented in Table 2 ICCV2 was the earliest to produce flowers which had almost similar days from planting to flowering. While ICCV 93984 were the latest to lower. Differences on the days to flowering could be the varietal characteristics of the plant were the Desi type are the late maturing cultivars while Kabuli type are early maturing varieties.

Table 1. Percentage field emergence (%)

VARIETY	MEAN
Desi Type	
ICCV 93952	81.863 ^a
ICCV 93954	86.735 ^a
ICCV 94954	85.500 ^a
Kabuli Type	
ICCV2	85.205 ^a
ICCV 95332	85.022 ^a
ICCV 95334	73.418 ^a

Means with the same letter are not significantly different at 5% level by DMRT.



Table 2. Days from planting to flowering stage

VARIETY	MEAN
Desi Type	
ICCV 93952	53.00 ^b
ICCV 93954	56.75 ^a
ICCV 94954	54.00 ^{ab}
Kabuli Type	
ICCV2	38.00 ^c
ICCV 95332	37.25 ^c
ICCV 95334	38.00 ^c

Means with the same letter are not significantly different at 5% level by DMRT.

Average Height at Flowering (cm)

Table 3 shows significantly difference were obtained on the average height at flowering stage. As shown in Table 3, ICCV 95334 was the tallest among the varieties while ICCV 94954 was the shortest with a mean of 32.1625 cm. Generally, Kabuli type varieties are taller than Desi type at following stage.

The observed differences among the chickpea varieties further indicated their differential adaptability to local conditions.

Average Number of Lateral Branches at Flowering

Results shows significant differences on the average number of lateral branches at flowering as presented in Table 4. It was obtained that ICCV 94954 variety produced higher number of lateral branches followed by ICCV 93954, ICCV 9395S, ICCV 95334 while ICCV 95332 and ICCV2 varieties had the lesser number or lateral branches produced.



Table 3. Average height at flowering (cm)

VARIETY	MEAN
Desi Type	
ICCV 93952	31.725 ^c
ICCV 93954	31.350 ^c
ICCV 94954	32.162 ^c
Kabuli Type	
ICCV2	36.600 ^b
ICCV 95332	37.000 ^b
ICCV 95334	41.700 ^a

Means with the same letter are not significantly different at 5% level by DMRT

Table 4. Average number of lateral branches at flowering

VARIETY	MEAN
Desi Type	
ICCV 93952	2.913 ^{abc}
ICCV 93954	3.050 ^{ab}
ICCV 94954	3.150 ^a
Kabuli Type	
ICCV2	2.625 ^c
ICCV 95332	2.700 ^c
ICCV 95334	2.700 ^{bc}

Means with the same letter are not significantly different at 5% level by DMRT



Days from Planting to First Harvest

There were no significant differences observed on the days from planting to first harvest among the six varieties tested were ICCV 95332 were the earliest to mature and reach harvesting stage. The differences in the days of planting to first harvest seems to be directly related to the days from planting to flowering, where it follows the same trend that the first to produce flowers were also the first to have a pod harvest. Bautista et. Al. 1983 mentioned that each variety contains a set of genetic make-up which determines earliness of bearing and maturity.

Total Number of Pod Picking

Table 6 shows highly significant on the total number of picking as affected by the different varieties evaluated. Results shows that ICCV 93954 and ICCV 94954 had more number of harvest produced followed by ICCV2 and ICCV 95332 which had almost similar total number of picking while the lowest number of harvest was recorded from ICCV 95334.

Table 5. Days from planting to first harvest

VARIETY	MEAN
Desi Type	
ICCV 93952	105.00 ^a
ICCV 93954	103.00 ^a
ICCV 94954	105.00 ^a
Kabuli Type	
ICCV2	105.50 ^a
ICCV 95332	100.00 ^a
ICCV 95334	103.50 ^a

Means with the same letter are not significantly different at 5% level by DMRT.



Table 6. Total number of pod picking

VARIETY	MEAN
Desi Type	
ICCV 93952	3.00 ^{ab}
ICCV 93954	3.50 ^a
ICCV 94954	3.50 ^a
Kabuli Type	
ICCV2	2.50 ^{bc}
ICCV 95332	2.50 ^{bc}
ICCV 95334	2.00 ^c

Means with the same letter are not significantly different at 5% level by DMRT

Average Weight of Pods Produced per Plant (g)

In Table 7 there were no significant differences on the average weight of pods produced per plant were ICCV 94954 and ICCV 2 had the highest percentage average weight of pods produced followed by ICCV 95332, ICCV 93954 and ICCV 95334 while ICCV 93952 attain the lowest weight of pods produced. The result may be due to the differential responses of those cultivars to the existing environment of the locality.

Average Number of Seeds per Pod

There were no significant differences observed on the average number of seeds per pod. In terms of seed count per pod were ICCV2 and ICCV 95334 attain the highest number of seeds per pod. This was followed by ICCV 93952 ICCV 95332 and ICCV 93954. ICCV 94954 was the lowest number of seed per pod.



Table 7. Average weight of pods produced per plant (g)

VARIETY	MEAN
Desi Type	
ICCV 93952	39.665 ^a
ICCV 93954	45.840 ^a
ICCV 94954	48.568 ^a
Kabuli Type	
ICCV2	47.685 ^a
ICCV 95332	46.223 ^a
ICCV 95334	42.390 ^a

Means with the same letter are not significantly different at 5% level by DMRT

Table 8. Average number of seeds per pod

VARIETY	MEAN
Desi Type	
ICCV 93952	1.067 ^a
ICCV 93954	1.032 ^a
ICCV 94954	1.037 ^a
Kabuli Type	
ICCV2	1.075 ^a
ICCV 95332	1.055 ^a
ICCV 95334	1.078 ^a

Means with the same letter are not significantly different at 5% level by DMRT



Table 9. Percentage pod setting (%)

VARIETY	MEAN
Desi Type	
ICCV 93952	15.138 ^a
ICCV 93954	17.075 ^a
ICCV 94954	15.823 ^a
Kabuli Type	
ICCV2	14.962 ^a
ICCV 95332	16.813 ^a
ICCV 95334	17.088 ^a

Means with the same letter are not significantly different at 5% level by DMRT

Percentage Pod Setting

This result may be attributed to their varietal characteristics which Kabuli type are usually one seeded while Desi type consists of two to three seeds per pod.

As to the percentage pod setting it was observed that ICCV 95334 had the highest percentage pod setting produced as compared to other varieties, however ICCV 2 had the lowest percentage pod setting.

Average Seed Yield per Plant (g)

Table 10 shows the average seed yield per plant as recorded from ICCV2 which did not markedly differ from ICCV 94954 and ICCV 95332 followed by ICCV 95334 and ICCV 93954. ICCV 93952 had the lowest yield per plant. Decrease in yield per plant was due to occurrence of pod borer and rodents wherein they usually infest young and matured pods.



Table 10. Average seed yield per plant (g)

VARIETY	MEAN (g)
Desi Type	
ICCV 93952	17.475 ^b
ICCV 93954	21.650 ^{ab}
ICCV 94954	24.275 ^a
Kabuli Type	
ICCV2	27.113 ^a
ICCV 95332	23.137 ^a
ICCV 95334	22.275 ^{ab}

Means with the same letter are not significantly different at 5% level by DMRT

Total Yield per Plot (kg)

The total yield per plot follows the trend of total yield per hectare where ICCV 94954 had the highest computed yield followed by ICCV 93954, ICCV2, ICCV 95332 had the lowest yield. The lowest yield of these varieties due to occurrence of pod borer and rodents specially ICCV 95334 and ICCV 93952.

Computed Yield per Hectare (kg/ha)

The result clearly supports the statement of Edmund and Andrews (1957) that varieties differ in productivity as expression of the hereditary genes influenced by the environment the variety best adopted to the environment reflects the high yield potential according to Villareal (1969). Furthermore, Wolfe and Kipps (1953) stated that before maximum yield can be obtained a variety must be adopted to the section in which it was grown.



Table 11. Total yield per plot (kg)

VARIETY	MEAN (kg)
Desi Type	
ICCV 93952	1.420 ^b
ICCV 93954	1.735 ^a
ICCV 94954	1.768 ^a
Kabuli Type	
ICCV2	1.627 ^{ab}
ICCV 95332	1.557 ^{ab}
ICCV 95334	1.485 ^b

Means with the same letter are not significantly different at 5% level by DMRT

Table 12. Computed yield per hectare (kg/ha)

VARIETY	MEAN (kg)
Desi Type	
ICCV 93952	705.50 ^c
ICCV 93954	867.50 ^a
ICCV 94954	883.75 ^a
Kabuli Type	
ICCV2	873.75 ^{ab}
ICCV 95332	778.75 ^{abc}
ICCV 95334	742.50 ^{bc}

Means with the same letter are not significantly different at 5% level by DMRT



Weight of 1000 Seeds (g)

Table 13 shows the weight of 1000 seeds. It was observed that ICCV 95334 had the heaviest weight of 1000 seeds with a mean of 415.75 g while ICCV 93952 had the highest weight having a mean of 231.00g.

The differences in weight of 1000 seeds are determined by their different varietal characteristic such as sizes. Thus, Kabuli type had bigger seed size which attributed to its weight while Desi type has smaller seed size.

Average Seed Diameter (cm)

The widest seed diameter was significantly measured from ICCV 95334 and ICCV 95332 which did not differ from ICCV2 and ICCV 94954. The smallest seed was measured from ICCV 93952 and ICCV 93954. Results show that seed diameter was directly related to the size and weight of a seed. The differences in seed diameter reflect the varietal characteristic and genetic make-up (Bautista et. al., 1983).

Table 13. Weight of 1000 seeds (g)

VARIETY	MEAN (g)
Desi Type	
ICCV 93952	231.00 ^f
ICCV 93954	242.25 ^e
ICCV 94954	260.75 ^d
Kabuli Type	
ICCV2	270.75 ^c
ICCV 95332	317.25 ^b
ICCV 95334	415.75 ^a

Means with the same letter are not significantly different at 5% level by DMRT



Table 14. Average seed diameter (cm)

VARIETY	MEAN (cm)
Desi Type	
ICCV 93952	0.730 ^d
ICCV 93954	0.705 ^d
ICCV 94954	0.755 ^{cd}
Kabuli Type	
ICCV2	0.805 ^{bc}
ICCV 95332	0.858 ^{ab}
ICCV 95334	0.880 ^a

Means with the same letter are not significantly different at 5% level by DMRT

Germination Test

The table shows that there was a highly significant difference in germination test done in rag doll method. ICCV 2 had the highest percentage emergence followed by ICV 93952, ICCV 95332, ICCV 95334 and ICCV 93954 while ICCV 93954 attain the lowest percentage emergence. As shown by the results that all the varieties of chickpea evaluated could survive under Bila, Bokod, Benguet.

Petri dish results shows that ICCV 2 had the highest germination test followed by ICCV 93954, ICCV 94954, ICCV 93952 and ICCV 95334 while the ICCV 95332 had the least percentage emergence.

The low percentage germination in Petri dish maybe only one side of the seeds absorbs water while in rag doll germination the whole seeds were completely wrapped with cheese cloth provided the moisture to absorb by the seeds during germination.



Table 15. Germination test (rag doll method and Petri dish method)

VARIETY	MEAN (%)	
	RAGDOLL METHOD	PETRI DISH METHOD
Desi Type		
ICCV 93952	64.50 ^b	31.25 ^c
ICCV 93954	53.00 ^c	47.25 ^b
ICCV 94954	24.50 ^c	39.25 ^{bc}
Kabuli Type		
ICCV2	85.25 ^a	64.00 ^a
ICCV 95332	62.00 ^b	15.25 ^d
ICCV 95334	64.00 ^b	30.00 ^c

Means with the same letter are not significantly different at 5% level by DMRT

Table 16. Varietal characteristics

VARIETY	LEAF SHAPE	LEAF COLOR
Desi Type		
ICCV 93952	Small rounded	Green
ICCV 93954	Small rounded	Green
ICCV 94954	small rounded	green
Kabuli type		
ICCV2	oblong leaflets	Light green
ICCV 95332	oblong leaflets	Light green
ICCV 95334	oblong leaflets	light green



Table 16a. Flower characteristics of the different varieties of chickpea

VARIETY	LEAF SHAPE	LEAF COLOR
Desi Type		
ICCV 93952	Purple/violet	Yellow
ICCV 93954	Purple/violet	Yellow
ICCV 94954	Purple/violet	Yellow
Kabuli type		
ICCV2	White	Yellow
ICCV 95332	White	Yellow
ICCV 95334	White	Yellow

Table 16b. Seed, color, shape and size

VARIETY	SEED COLOR	SEED SHAPE	SED SIZE
Desi Type			
ICCV 93952	Dark brown	Angular	Small
ICCV 93954	Dark brown	Angular	Small
ICCV 94954	Dark brown	Angular	Small
Kabuli type			
ICCV2	White/cream	Owls head	Medium
ICCV 95332	White/cream	Owls head	Medium
ICCV 95334	White/cream	Owls head	Big



Table 17a. Diseases of the chickpea varieties grown in Bila, Bokod, Benguet

DISEASE/COMMON NAME	CAUSAL ORGANISM	DEGREE OF INFESTATION	VARIETY ATTACKED
Root and stem rot			
Dry root rot	<i>Rhizootonia bbataticola</i>	Slight	Desi type
Wet root rot	<i>Rhizoctonia solani</i>	Slight	Kabuli type

Table 17b. Insect and pests of the chickpea varieties grown in Bila, Bokod, Benguet

COMMON NAME	CAUSAL ORGANISM	DEGREE OF INFESTATION	VARIETY ATTACKED
Rodents	<i>Mus boodoga</i>	Severe	Kabuli & Desi type
Rod Borer	<i>Helicoverpa armigera</i>	Severe	Kabuli 7 Desi type
Cutworm	<i>Agotis ipsilon</i>	Severe	Desi & Kabuli type



Meteorological Data

Shows the T^0 during the conduct of the study at Bila, Bokod, Benguet. The temperature ranged from 13 to 27°C during the months of December 2007 to March 2008

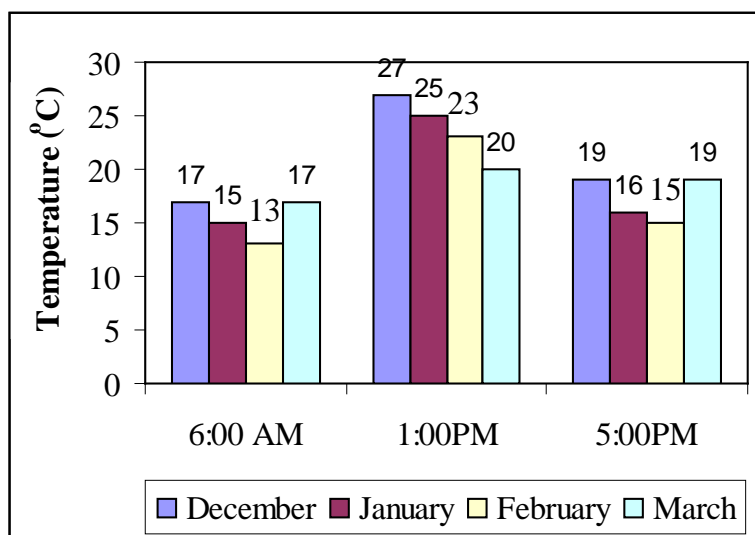


Figure 5. Temperature during the conduct of the study



SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The experiment was conducted at Bila, Bokod, Benguet from November 2007 to March 2008 to identify chickpea varieties that could be profitable under Bila, Bokod, Benguet.

The result showed that different chickpea varieties on emergence percentage numerically ICCV 93954, ICCV 94954, ICCV2 and ICCV 95332 produced highest percentage emergence while ICCV 93952 and ICCV 95334 obtained the lowest emergence percentage. In days from planting to flowering ICCV 95332 were earliest to produce flower while the Desi type varieties were the latest.

As to the number of days to days to first harvest ICCV 95332 matures earlier over the other varieties. Thus the earliest to initiate flowers was the first to have harvestable stage. The average height at flowering ICCV 95334 were the tallest in terms of height while ICCV 94954 were the shortest height. In the average number of lateral branches ICCV 94954 produced more lateral branches while ICCV 2 had the least number of lateral branches.

In terms of number of seeds per pod; ICCV 95334 had more number of seeds per pod while ICCV 93954 had least number of seeds per pod with a mean of 1.032. As to weight of pod produced per plant; ICCV 95334 had the highest weight of pod followed by ICCV 93954, ICCV 94954 and ICCV 95332 while ICCV 2 had the lowest weight of pods produced per plant.



As to the yield per plot and yield per hectare, ICCV 94954 significantly produced high yield in all the varieties evaluated.

The results of germination test done in Petri dish method and rag doll method ICCV 2 attained the highest percentage emergence of germination.

Conclusion

Based on the results presented and discussed ICCV 94954 a Desi type variety had higher yield potential among the six cultivars evaluated.

Recommendation

With the above results, it is recommended that the Desi type ICCV 94954 chickpea variety can be selected to be planted under Bila, Bokod, Benguet condition due to its high yield. It is also recommended that the results should further verify in the warm growing areas in the Cordillera for validation of results and for comparison.



LITERATURE CITED

- ANONYMOUS. 2007. Chickpea. Retrieved August 2007 from <http://hort.poduc.edu/newcrop/afcm/chickpea.html>.
- ANONYMOUS. 2007. Chickpea. Retrieved September 2007 from <http://hort.poduc.edu/newcrop/afcm/chickpea.html>.
- BAUTISTA, O.K., H.V. VALMAYOR, D.C. TABORA, JR. and P.R.C. ESPINO. 1983. Introduction to Tropical Horticulture College of Agriculture, UPLB. College, Laguna. Pp. 66-68.
- EDMUND, J.R. and ANDREW S. 1957. New York: Fundamental of Horticulture. McGraw-Hill Book Co., Inc. P. 68.
- GRILLER, K.E. 2001. Nitrogen Fixation in Tropical Cropping System. New York: CABI Publishing. P. 144.
- MAESSAN, I.S. and SOMAATMADJA. 1990. Plant Resources of South East Asia. ESGAP CGPRT Centre, Bogor, Indonesia. P. 26, 42-43.
- SINGH, C. 1983. Modern Techniques of Raising Field Crops, New Delhi Oxford and IBH. Pub. Co. Pp. 170-173.
- THE ENCYCLOPEDIA AMERICA INTERNATIONAL EDITION 1829. Vol. 6.
- WALLIS, S. and BYTH D.E. Food Legume Improvement for Asian Farming System.
- WOLFE and KIPPS. 1953. Principles of Field Crop Production. 4th edition. McMillan Publishing Co. Inc. New York. Pp. 30-32
- VILLAREAL, R.L. 1969. Seed Vegetable, Training Manual. College of Laguna; University of Philippine, College of Agriculture. Pp. 45-47.



APPENDICES

Appendix Table 1. Percentage field emergence (%)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	70.37	93.38	77.66	81.04	327.45	81.8625
ICCV 93954	94.25	95.14	78.74	78.81	338.94	84.7350
ICCV 94954	90.94	86.71	77.95	86.60	342.20	85.5500
Kabuli Type						
ICCV 2	84.83	84.46	82.30	89.13	340.82	85.2050
ICCV 95332	89.00	80.88	82.01	88.20	340.09	85.0225
ICCV 95334	75.17	89.58	84.18	54.74	303.67	75.9175

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	231.314	77.105			
Factor A	5	489.040	97.808	1.32NS	2.90	4.56
Error	15	115.264	74.351			
TOTAL	23	1835.264				

ns - not significant

Coefficient of variation = 10.39%



Appendix Table 2. Days from planting to flowering

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	53	53	53	53	212	53.00
ICCV 93954	53	56	59	59	227	56.15
ICCV 94954	55	56	53	52	216	54.00
Kabuli Type						
ICCV 2	38	38	35	41	152	38.00
ICCV 95332	38	37	36	38	149	37.25
ICCV 95334	38	38	38	38	152	38.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	5.000	1.667			
Factor A	5	173 1.833	346.367	102.88**	2.90	4.56
Error	15	5 0.500	3.367			
TOTAL	23					

** - highly significant

Coefficient of variation = 3.97%



Appendix Table 3. Average height at flowering (cm)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	31.15	30.95	32.65	32.15	126.90	31.725
ICCV 93954	32.25	30.05	30.80	32.3-	125.40	31.350
ICCV 94954	31.25	32.30	32.30	32.80	128.65	32.1625
Kabuli Type						
ICCV 2	35.95	32.90	40.25	37.30	146.40	36.60
ICCV 95332	34.35	35.75	39.10	38.80	148.00	37
ICCV 95334	42.25	42.70	42.50	39.35	166.80	41.70

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	16.726	5.575			
Factor A	5	334.006	66.801	23.94**	2.90	4.56
Error	15	41.848	2.790			
TOTAL	23	392.580				

ns - not significant

Coefficient of variation = 10.39%



Appendix Table 4. Average number of lateral branches of flowering

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	3.15	3.00	2.60	2.90	11.65	2.91
ICCV 93954	2.95	2.80	3.30	3.15	12.20	3.05
ICCV 94954	3.30	3.40	3.00	2.90	12.40	3.10
Kabuli Type						
ICCV 2	2.60	2.70	2.55	2.55	10.50	2.62
ICCV 95332	2.60	2.95	2.90	2.90	10.80	2.70
ICCV 95334	2.55	2.65	2.85	2.85	10.80	2.70

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	0.064	0.071			
Factor A	5	0.917	0.183	3.87*	2.90	4.56
Error	15	0.711	0.047			
TOTAL	23	1.692				

* - significant

Coefficient of variation = 7.62%



Appendix Table 5. Days from planting to first harvest

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	104	104	106	106	420	105.00
ICCV 93954	104	104	100	104	412	103.00
ICCV 94954	104	104	106	106	420	105.00
Kabuli Type						
ICCV 2	111	104	107	100	422	105.50
ICCV 95332	100	100	100	100	400	100.00
ICCV 95334	100	107	100	107	414	103.50

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	2.000	0.667			
Factor A	5	83.333	16.667	1.89ns	2.90	4.56
Error	15	132.000	8.800			
TOTAL	23	217.333				

ns – not significant

Coefficient of variation = 2.86%



Appendix Table 6. Total number of pod picking

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	3	3	3	3	12	3.0
ICCV 93954	3	4	4	3	14	3.5
ICCV 94954	3	4	3	4	14	3.5
Kabuli Type						
ICCV 2	2	3	3	2	10	2.5
ICCV 95332	2	2	3	3	10	2.5
ICCV 95334	2	2	3	2	8	2.0

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	1.000	0.333			
Factor A	5	7.333	1.467	7.33*	2.90	4.56
Error	15	3.000	0.200			
TOTAL	23	11.333				

** - highly significant

Coefficient of variation = 15.78%



Appendix Table 7. Average weight of pods produced per plant (g)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	38.11	35.29	38.52	46.71	158.66	39.665
ICCV 93954	41.05	46.34	47.34	48/63	183.36	45.840
ICCV 94954	43.29	46.26	50.31	51.41	191.27	47.8175
Kabuli Type						
ICCV 2	52.65	54.31	58.79	54.93	220.68	55.17
ICCV 95332	57.01	49.49	41.43	41.36	189.29	47.3225
ICCV 95334	34.74	44.02	48.07	42.73	169.56	42.39

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	333.650	111.217			
Factor A	5	229.552	45.910	0.78ns	2.90	4.56
Error	15	881.233	58.749			
TOTAL	23	1444.434				
Ns – not significant				Coefficient of variation = 17.01%		



Appendix Table 8. Average number of seeds per pod

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	1.08	1.12	1.03	1.04	4.27	1.0675
ICCV 93954	1.05	1.05	1.03	1.00	4.13	1.0325
ICCV 94954	1.03	1.04	1.05	1.03	4.15	1.0375
Kabuli Type						
ICCV 2	1.05	1.09	1.13	1.03	4.30	1.075
ICCV 95332	1.03	1.04	1.10	1.05	4.28	1.07
ICCV 95334	1.07	1.07	1.09	1.08	4.31	1.0775

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	0.007	0.001			
Factor A	5	0.012	0.001	1.87ns	2.90	4.56
Error	15	0.012	0.001			
TOTAL	23	0.023				

ns - not significant

Coefficient of variation = 2.65%



Appendix Table 9. Percentage pod setting (%)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	16.90	17.35	11.40	12.75	58.40	14.60
ICCV 93954	26.90	16.30	19.60	22.00	74.80	18.70
ICCV 94954	16.10	11.20	26.00	22.65	75.95	18.9875
Kabuli Type						
ICCV 2	10.60	18.15	16.50	11.25	56.50	14.125
ICCV 95332	14.90	18.20	17.70	11.75	62.55	15.6375
ICCV 95334	15.60	13.65	16.80	14.15	60.10	15.025

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	18.551	6.184			
Factor A	5	18.891	3.778	0.21ns	2.90	4.56
Error	15	269.566	17.971			
TOTAL	23	307.007				

Ns – not significant

Coefficient of variation = 26.25%



Appendix Table 10. Average yield per plant (g)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	15.65	15.85	18.45	19.95	69.90	17.475
ICCV 93954	23.55	27.40	18.65	16.75	81.35	20.3375
ICCV 94954	22.75	22.50	25.90	26.75	97.40	24.35
Kabuli Type						
ICCV 2	26.00	25.50	23.90	31.35	106.75	26.6875
ICCV 95332	29.65	22.25	25.60	28.65	106.75	26.5375
ICCV 95334	27.65	25.05	22.00	18.80	93.50	23.375

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	8.688	2.896			
Factor A	5	202.853	40.571	3.47*	2.90	4.56
Error	15	175.173	11.678			
TOTAL	23	386.715				

* - significant

Coefficient of variation = 15.08%



Appendix Table 11. Total yield per plot (kg)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	1.31	1.33	1.45	1.55	5.64	1.410
ICCV 93954	1.77	1.70	1.57	1.90	6.94	1.735
ICCV 94954	1.71	1.71	1.85	1.80	7.07	1.7675
Kabuli Type						
ICCV 2	1.64	1.51	1.78	1.58	6.51	1.6275
ICCV 95332	1.53	1.78	1.39	1.53	6.23	1.5575
ICCV 95334	1.60	1.57	1.29	1.48	5.94	1.485

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	0.022	0.007			
Factor A	5	0.378	0.076	4.39*	2.90	4.56
Error	15	0.259	0.017			
TOTAL	23	0.659				

* - significant

Coefficient of variation = 0.659%



Appendix Table 12. Computed yield per hectare (kg/ha)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	655	665	725	775	2820	705.00
ICCV 93954	885	850	785	950	3470	867.50
ICCV 94954	855	855	925	900	3535	883.75
Kabuli Type						
ICCV 2	820	755	890	790	3255	813.75
ICCV 95332	765	890	695	765	3115	778.75
ICCV 95334	800	785	645	740	2970	742.50

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	5453.125	1817.708			
Factor A	5	98117.708	19623.542	4.46*	2.90	4.56
Error	15	66053.125	4403.542			
TOTAL	23	169623.958				

* - significant

Coefficient of variation = 8.31%



Appendix Table 13. Weight of 1000 seeds (g)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	230	233	230	231	924	231.00
ICCV 93954	243	243	240	243	969	242.25
ICCV 94954	260	262	261	260	1043	260.75
Kabuli Type						
ICCV 2	272	270	270	271	1083	270.75
ICCV 95332	317	318	317	317	1269	317.25
ICCV 95334	416	415	416	416	1663	415.75

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	4.125	1.375			
Factor A	5	94167.875	18833.575	18080.23**	2.90	4.56
Error	15	15.625	1.042			
TOTAL	23	94187.625				

** - highly significant

Coefficient of variation = 0.35%



Appendix Table 14. Average seed diameter (cm)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	6.9	7.2	7.3	7.8	29.2	7.30
ICCV 93954	7.7	6.7	6.5	7.3	28.2	7.05
ICCV 94954	7.7	7.6	8.2	6.7	30.2	7.55
Kabuli Type						
ICCV 2	8.5	8.7	7.7	7.3	32.2	8.05
ICCV 95332	8.8	8.7	8.6	8.2	34.3	8.575
ICCV 95334	9.2	8.6	8.8	8.6	35.2	8.80

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	0.007	0.002			
Factor A	5	0.100	0.020	8.44**	2.90	4.56
Error	15	0.350	0.002			
TOTAL	23	0.142				

** - highly significant

Coefficient of variation = 6.16%



Appendix Table 15. Germination test (ragdoll method)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	70	68	56	64	258	64.50
ICCV 93954	58	52	50	53	213	53.25
ICCV 94954	28	26	20	24	98	24.50
Kabuli Type						
ICCV 2	82	86	88	85	341	85.25
ICCV 95332	64	68	54	62	248	62.00
ICCV 95334	68	70	54	64	256	65.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	251.125	83.708			
Factor A	5	7917.875	1583.575	112.24**	2.90	4.56
Error	15	211.625	14.108			
TOTAL	23	8380.625				

** - significant

Coefficient of variation = 6.38%



Appendix Table 16. Germination test (Petri dish method)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	28	30	36	31	125	31.25
ICCV 93954	38	66	38	47	189	47.25
ICCV 94954	36	42	40	39	157	39.25
Kabuli Type						
ICCV 2	56	64	72	64	256	64.00
ICCV 95332	20	16	10	15	61	15.25
ICCV 95334	20	40	30	30	120	30.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY	
					0.05	0.01
Replication	3	300.667	100.222			
Factor A	5	5560.333	1112.067	25.49**	2.90	4.56
Error	15	654.333	43.622			
TOTAL	23	6515.333				

** - significant

Coefficient of variation = 17.46



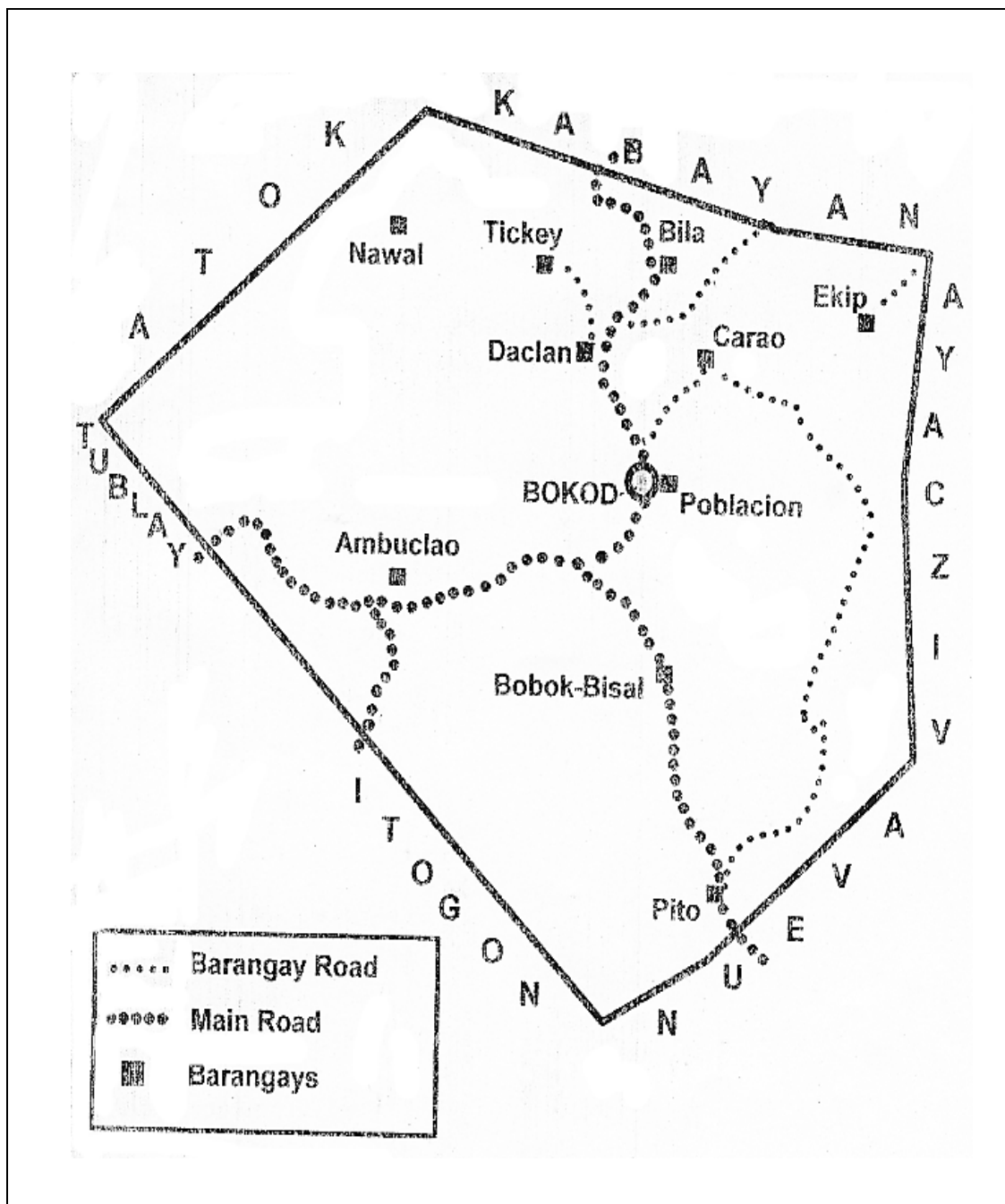


Figure 1. Map showing the locale of the study

