BIBLIOGRAPHY

SAGAYO, BELEN B. May 2008. Growth and Yield Performance of Five Chickpea (*Cicer arietinum* L.) Varieties Under Bano-oy, Buguias, Benguet Condition. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The result of the study showed that all the six variety of chickpea grown in Bano-oy, Buguias, Benguet had varying yields due to differences in growth characteristics which affects their growth and yield performance.

On the emergence percentage ICCV 2, ICCV 93952, ICCV 94954 and ICCV 94954 had the highest percentage emergence while ICCV 95332 and ICCV 95334 had lowest percentage emergence. As to days from planting to flowering, ICCV 2 were earliest to produce flower and were also the earliest to reach harvesting stage. In terms of plant height at flowering kabuli type were significantly taller than desi type. On average number of lateral branches ICCV 94954 significantly produced more number of lateral branches over the other varieties evaluated.

As to percentage pod setting, ICCV 94954 and ICCV 95332 had the highest percentage pod setting followed by ICCV 2, ICCV 95334, ICCV 93954 and ICCV 93952 had lowest pod setting. In yield, ICCV 94954 produced higher number of seed per pod, weight of pod produced per plant, yield per plot and yield per hectare. Weight of 1000 seeds and average seed diameter follows a trend where ICCV 95334 had the highest

weight of 1000 seeds the same as through with seed diameter. As observed that the wider the seed diameter, the heavier the weight.

Result of germination test done, ragdoll method had a higher germination percentage than on petri disc.

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INTRODUCTION

Buguias is a leading vegetable producing municipality with 5,619 hectares devoted for planting potato, cabbage, sweet potato, Chinese cabbage, beans, garden pea, carrot, radish, celery, lettuce and root crop production.

Buguias is located in Northern Benguet bounded on the west of Mankayan and Bakun and on the south by Kabayan and Kibungan. It has an average temperature of 15^{o}C to 17^{o}C and elevation of 1,550 m. above sea level.

Chickpea (*Cicer arietinum L.*) belongs to the family Fabaceae. It is annual cool season legume or pulse crop or as a green vegetable with the former use being common. This crop is one of the most important legumes grown in India, ranking fourth among Indian food sources. Chickpea is often used as an alternative protein product and one of the plants with highest amount of protein.

Chickpea is mainly used by human consumption and only a small portion is used as feed. Kabuli type is generally used as whole grains, while desi type is used as whole seed, dehulled split or flour. Chickpea is also known for its herbal medicine and cosmetics.

The plant grows to between 20 cm to 50 cm. tall and has small feathery leaves on both sides of the stem. One seed pod contains two to three seeds. The flowers are white or reddish-blue. Chickpea need subtropical or tropical climate and more than 400 mm annual rain.

Chickpea is relatively drought – tolerant due to its long taproot, which allows it to extract water from greater depths in the soil profile. Chickpea have not been introduce or

cultivated in the Cordillera's specially in Benguet even the agroclimatic condition is suitable for its production due to lack of information and no available planting materials. The introduction of new highbred ICRISAT cultivar of chickpea coupled with the generation of location specific technologies for highland of CAR, chickpea could become a cash earner. More ever, the supply of chickpea in the Philippines depends on importation from chickpea producing countries.

It is then a worth while activity to conduct this study to select those chickpea varieties with good performance on our local condition to enable our farmer to increase their profit and as also an alternative crop and at the same time to provide food for the increasing population of the country.

This study was conducted to introduce and promote chickpea production in Benguet province especially in Bano-oy, Buguias, Benguet, to determine the growth and yield of chickpea under Bano-oy, Buguias, Benguet and to select chickpea varieties that could be profitably grown under Bano-oy, Buguias, Benguet.

The study was conducted at Bano-oy, Buguias, Benguet from November 2007 to January 2008.

REVIEW OF LITERATURE

Description of the Plant

Chickpea (*Cicer arietinum* L.) are multiple branched, spreading growth habit annual ranging from 20 cm to 50 cm. tall. Some chickpea varieties have compound leaves with 8 to 20 leaflets and some have simple leaves, which are pubescent or hairy in appearance. Chickpea leaves exude malic and oxalic acids.

Flower are usually self pollinated which are borne in group of two or three and come in purple, white, or blue in color depending upon the variety. Each flower produce short, pubescent pod which is 3/4 in. to 2 in. long. Each pod contains one or two seeds. The seed is spherical in shape, wrinkled and with pointed beak. The seed color is yellow to dark brown. The root system are well develop, has a strong tap root with numerous lateral branches that spread out in all direction in the upper layer of the soil.

Nutrition

Chickpea are good source of Zinc, folate and protein. They are also very high in dietary fiber and thus are a healthy food source of carbohydrates for person with insulin. They are low in fat, and most of the fat content is polysaturated.

According to International Crop Research Institute for the Semi- Arid Tropics (ICRISAT), on an average, chickpea seed contains 23% protein, 64% carbohydrates, 47% starch, 5% fat, 6% crude fiber, 6% soluble sugar and 3% ash. They also report that chickpea has high mineral content of Phosphorus (340 mg/100g), Calcium (190 mg/100g), Magnesium (140 mg/100g), Iron (7 mg/100g) and Zinc (3mg /100g).

Uses

Mature chickpeas can be cooked and eaten in salads, cooked in stews and ground into flour. Unripe chickpeas are often picked of the pod and eaten as a raw snack in many parts of India, and the plant are eaten there as a green vegetable in salad. In Chile, a cooked chickpea milk (4:1) mixture was food for feeding infants. Gram husk and green or dried stems and leaves are used for stock feed. Whole seeds may be milled directly for feed. Acids exudates from leaves can be applied medicinally or used as vinegar. Medicinal application includes use for aphrodisiac, dyspepsia, flatulence, snake bite, sun stroke and warts. Acids also used to lower blood cholesterol levels (Duke, 1981).

In addition, among the food legumes, chickpea is the most hypocholeteremic agent; germinated chickpea was reported to be effective in controlling cholesterol level in rats (Geervani, 1991).

Climate and Soil Requirement

Chickpea need a sub-tropical or tropical climate and are generally drought tolerant with moderate rainfall of 400 mm. per annum. Chickpea thrive under good condition with daytime temperature between 21^{o}C to 29^{o}C and night temperature near 20^{o}C.

Chickpea does best on fertile sandy loam soils with good internal drainage. Good drainage is necessary because even short period of flooded or water logged fields reduce growth and increase susceptibility to root rot and stem rots. The pH requirement is 8.5 and below.

Harvesting

Chickpea can be harvested direct or swathed prior to combining depending upon uniformity of maturity and weed problems. About 1 week of good drying weather is required in the swath.

Chickpea can be swathed when the plants are yellowing and the pods are their mature color. This should be done when the plants are slightly damp to facilitate forming the swath without yield loss. When the vines, pods and seeds in the windrow are dry enough (seed moisture about 13%) the swath can be combined. Seed color is important (buyers prefer a yellowish-cream color) so greenish and brown seeds are generally unacceptable. Slight bleaching does occur in the swath. About 1% immature color seed is allowed before deductions is implemented.

Adjust the combine screen size, cylinder speed, concave clearance and air flow carefully to maintain a quality seed with little physical damage or excessive trash.

Drying and Storage

Moisture content should be around 10 to 12% to prevent insect and or disease outbreaks in storage. Because of their relatively large seed size, chickpea can be dried slightly with ambient temperature air flow through thin layers in a regular storage bin.

Storage system should be carefully fumigated before storing chickpea and all storage areas should be monitored regularly to identify potential problems early.

Importance of Selecting Varieties

Selection of the variety to be planted is one of the most important decisions the commercial vegetable grower must make each season. Considering the yield performance, the variety has the potential to produce crop at least equivalent to those already grown. It must also perform well under a range of environmental conditions usually encountered on individual farm, posses excellent resistant against pest, diseases and harvested product have the quality characteristics desired by the packers, shippers, wholesalers, retailer, and consumer which include size, shape, flavor and nutritional quality (Lorenz and Maynard, 1986). Currently large seeded, lighter colored seed types of chickpea are preferred for soup and salad bar uses (Doll *et al*., 1990).

Lorenz and Maynard (1986) mentioned the importance of good seed of the right variety of strain suitable for the locality should not be overlooked. Some variety produce extremely well under one set of condition but became worthless in another condition. Knott (1989) supported this when he stated that certain variety of crop do well in one district and be worthless in another condition. This is also noted by Edmund *et al* (1957) that varieties of the same kind are adoptable and thus, profitable and other variety are non-adoptable and this relatively unprofitable in some region.

In addition, Villareal (1969) explained that the planting good seeds is essential to the success on the growing vegetable. Planting vegetable variety except the best variety adapted to the environment in which it will grow unnecessary limit the potential for the high yield and profits even before the first seed is planted. Also Work and Carew (1955) stated that having varietal evaluation is important to observe the performance character

such as yield, earliness, vigor, maturity and keeping quality because different variety have wide range of differences in plant size and yielding performance.

Furthermore, Bautista *et al* (1983), pointed that plant species/ varieties has a set of genetic make-up and it is termed genotype. It determines the yield potentials, relative susceptibility to unfavorable environment, earliness and regularity of bearing, length of productive life and size and shape of the plant at maturity. Wolfe and Kipps (1953) also stated that before maximum yield can be attained a variety must be adapted to the selection in which it is grown.

MATERIALS AND METHODS

The materials used in the study wee the six chickpea varieties, farm tools, measuring material, weighing scale, identifying pegs, fertilizer, fungicide and insecticides.

The study was conducted at Bano-oy, Buguias, Benguet having an average temperature of 15^{o}C to 17^{o}C and an elevation of 1,550 meter above sea level.

Six varieties of chickpea from ICRISAT were introduced and evaluated at Bano-oy, Buguias, Benguet promising varieties adapted to Bano-oy, Buguias, Benguet condition were selected.

The experiment was laid out in randomized complete block design (RCBD) with our replication. The treatments were as follows.

Desi Type	Kabuli Type
T_1- ICCV 93952	T_4- ICCV 2
T_2- ICCV 93954	T_5- ICCV 95332
T_3- ICCV 94954	T_6- ICCV 95334

An area of 500 square meters that is previously planted with cabbage was prepared for the study. The area was divided into four blocks. Each treatment was planted in two plots measuring 1m x10m. Two furrows was made within the plot at 30 cm. apart where 1/ 2 kg. of inorganic fertilizer (14 - 14 -14) and 1 kerosene can of chicken dung were applied evenly and mixed with the soil before planting the seed singly at a distance of 30 cm between rows and 10 cm between hills. There were 20 sample plants per treatment / replicate selected randomly.

All other cultural practices like irrigation, weeding, insect and disease control was employed to ensure good growth and yield of the crop.

The data gathered were:

A. Vegetative Growth

1. Emergence Percentage (%). This was recorded 15 days after sowing the seeds using the formula;

$$\text{Emergence Percentage (\%)} = \frac{\text{Number of Seed Germinated}}{\text{Number of Seed Sown}} \times 100$$

2. Days from planting to flowering. This was taken at flowering stage. This was gathered by counting the number of days from planting to flowering.

3. Average height at flowering (cm). This was taken at flowering stage (first flower). The height of the plants in every sample was gathered from planting to flowering stage.

4. Days from planting to first harvest. This was noted on the first harvest of seeds. This was gathered by counting the number of days from planting to first harvest.

5. Average number of lateral branches at flowering. This was taken at flowering (first flowers). This was gathered by counting the lateral branches at flowering. This was computed as follows:

$$\text{Ave. No. of Lateral Branches at Flowering} = \frac{\text{No. of Lateral Branches of Samples Plants}}{\text{Sample Plant}}$$

6. Total number of harvests. This was the total number of harvesting done for one cropping season.

7. Percentage pod setting. This was taken using the formula:

$$\text{Percentage (\%) Pod Setting} = \frac{\text{Number of Pods per Plant}}{\text{Number of Flowers Produced per Plant}} \times 100$$

8. Average number of seeds per pod. This was computed using the formula:

$$\text{Average number of seeds per pod} = \frac{\text{Number of Seeds Produced per Plant}}{\text{Number of Pods per Plant}}$$

9. Average weight of pods produced per plant. This was computed as follows:

$$\text{Average Weight of Pods Produced per Plant} = \frac{\text{Total Weight of Pods Produced by Sample Plants}}{\text{Number of Sample Plants}}$$

10. Average yield per plant (g). This was taken by using the formula:

$$\text{Average Yield per Plant (g)} = \frac{\text{Total Yield of Sample Plants}}{\text{Number of Samples}}$$

11. Total yield per plot (kg). This was the total yield of the experimental plot (20 sq. m.)

12. Total yield per hectare (t/ha). This was the total yield of experimental plot (20 sq.m) (500).

13. Weight of 1000 seeds (g). This was taken by weighing 1000 seeds.

14. Average seed diameter. This was taken by measuring the seed diameter using verner caliper.

15. Germination test. This was conducted one month from seed storage using petri dish and the ragdoll method. This was computed using the formula;

$$\text{Emergence Percentage (\%)} = \frac{\text{Number of Seed Germinated}}{\text{Number of Seed Sown}} \times 100$$

16. Varietal Characterization

a. Leaf. The shape, color and other leaf characteristics was recorded.

b. Flower/ pod. The color of flower and pod was recorded at flowering and at first harvesting stage.

c. Seed. The color shape and size was recorded at harvest.

17. Incidence of Pest and Diseases

a. Insect pest. Insects that infest the plant during the cropping season was noted and identified during the vegetative and reproductive stages of plant growth.

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

18. Meteorological Data

a. Temperature (^{O}C)

19. Documentation. This was taken through pictures.

Figure 1. Flowering stage

Figure 2. Flowering stage of kabuli type

Figure 3. Flowering stage of desi type

Figure 4. Overview of the experiment

Figure 5. Planting chickpea at Bano-oy, Buguias

RESULTS AND DISCUSSION

Emergence Percentage

Table 1 shows highly differences among the different varieties of chickpea in terms of emergence percentage. The highest emergence percentage was obtained from ICCV2, ICCV 93952, ICCV 94954 which had comparable means ranging from 86.25 to 98.25% ICCV 5332 and ICCV 95334 had the lowest percentage emergence.

These results confirmed the statement of Edmund *et. al.* (1957) that emergence is essentially a quickening of growth of embryo and the same explained that varieties and strains differ in adaptability for any given region.

Table 1. Percentage field emergence (%)

VARIETY	MEAN (%)
Desi Type	
ICCV 93952	93.75a
ICCV 93954	86.25a
ICCV 94954	90.25a
Kabuli Type	
ICCV 2	98.25a
ICCV 95332	66.00b
ICCV 95334	51.25b

Means with a common letter are not significantly different at 5% by DMRT

Days from Planting to Flowering

Table 2 shows that among the six cultivars ICCV 2 attained flowering the earliest but were comparable with ICCV 95332 while ICCV 93952 were the latest to flower. Differences on the days to flowering could be attributed to varietal characteristics of the plant were kabuli type are generally early maturing while desi type are late maturing varieties.

These results agrees that varietal evaluation is important to observe the performance character such as yield, earliness, vigor, maturity and keeping quality because different variety have wide range performance (Work and Carew, 1955). These results also confirm well to the statement of Bautista et. al., (1989) that each plant or variety has different genetic make-up that affects the earliness of bearing and regularity of flowering.

Table 2. Days from planting to flowering

VARIETY	MEAN
Desi Type	
ICCV 93952	64.25a
ICCV 93954	60.90b
ICCV 94954	61.04b
Kabuli Type	
ICCV 2	46.60d
ICCV 95332	49.64cd
ICCV 95334	51.31c

Means with a common letter are not significantly different at 5% by DMRT

Average Height at Flowering

Significant differences were obtained on the average height at flowering stage. As shown in Table 3, ICCV 95334 was the tallest among the varieties with a mean of 42.81 cm., while ICCV 94954 is the shortest with a mean of 34.41 cm. Generally, Kabuli type varieties were taller than Desi type at flowering stage.

The observed differences among the chickpea varieties further indicate their differential adaptability to local conditions as well as their inherent height potential. Furthermore, kabuli type are generally taller thank desi type.

Table 3. Average height at flowering (cm)

VARIETY	MEAN (cm)
Desi Type	
ICCV 93952	36.38b
ICCV 93954	35.61b
ICCV 94954	34.41b
Kabuli Type	
ICCV 2	38.71ab
ICCV 95332	38.77ab
ICCV 95334	42.81a

Means with a common letter are not significantly different at 5% by DMRT

Days from Planting to First Harvest

As presented in Table 4, ICCV 2 were the earliest to mature and reach harvesting stage, which differed significantly from the other cultivars. The differences in the days of planting to first harvest seem 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 of have pod harvest. Bautista et.al. (1983) mentioned that each variety contains a set of genetic make-up which determines earliness of bearing and maturity.

Table 4. Number of days from planting to first harvest

VARIETY	MEAN
Desi Type	
ICCV 93952	128.50a
ICCV 93954	123.75a
ICCV 94954	113.00b
Kabuli Type	
ICCV 2	94.75d
ICCV 95332	103.50c
ICCV 95334	104.50c

Means with a common letter are not significantly different at 5% by DMRT

Average Number of Lateral Branches at Flowering

There were significant differences on the average number of lateral branches at flowering as presented in Table 5. It was observed that ICCV 94954 variety produced higher number lateral branches. Followed by ICCV 94954, ICCV 95334, ICCV 2 and ICCV 93954 varieties had the lesser number of lateral branches produced.

Total Number of Harvest

Table 6 shows highly significant differences on the total number of harvest as affected by the different varieties evaluated. Result shows that ICCV 94954 had more number of harvest followed by ICCV 95332, ICCV 95334, ICCV 2 and ICCV 93954 while ICCV 93952 had the lowest number of harvest.

Table 5. Average number of lateral branches at flowering

VARIETY	MEAN
Desi Type	
ICCV 93952	3.13bc
ICCV 93954	3.00c
ICCV 94954	3.73a
Kabuli Type	
ICCV 2	3.28bc
ICCV 95332	3.43ab
ICCV 95334	3.38bc

Means with a common letter are not significantly different at 5% by DMRT

Table 6. Total number of harvest

VARIETY	MEAN
Desi Type	
ICCV 93952	2.50c
ICCV 93954	3.00bc
ICCV 94954	4.00a
Kabuli Type	
ICCV 2	3.50ab
ICCV 95332	4.00a
ICCV 95334	3.50ab

Means with a common letter are not significantly different at 5% by DMRT

As Bautista *et al.*, (1983) pointed that plant species or variety has a set of genetic make-up which determines the length of productive life. Thus, lower number of harvest greatly affects the yield.

Percentage Pod Setting

Table 7 shows highly significant differences on percentage pod setting. ICCV 94954 and ICCV 95332 had the highest percentage pod setting followed by ICCV 2, ICCV 95334 and ICCV 93954. ICCV 93952 had the lowest pod setting. This result may be due to the differential responses of this cultivar to the existing environment of the locality. Cloudy weather that prevails in the locality may have affected the pod settings of chickpea.

Table 7. Percentage pod setting (%)

VARIETY	MEAN (%)
Desi Type	
ICCV 93952	54.64b
ICCV 93954	62.99a
ICCV 94954	67.39a
Kabuli Type	
ICCV 2	66.10a
ICCV 95332	67.62a
ICCV 95334	64.27a

Means with a common letter are not significantly different at 5% by DMRT

This result may be attributed to their varietal characteristics whereas desi type which was small seeded usually produced two to three seeds per pod. While large seeded kabuli type consist only one seed per pod.

Average Number of Seeds per Pod

In terms of seed count per pod ICCV 94954 had the highest number of seeds per pod, it was closely followed by ICCV 93954, ICCV 93952, ICCV 2, ICCV 95332 and ICCV 95334 had the lesser number of seeds per pods.

This result may be attributed to their varietal characteristics which kabuli type are usually one seeded while desi type consists of 2 or 3 seeds per pod.

Table 8. Average number of seeds per pod

VARIETY	MEAN
Desi Type	
ICCV 93952	1.27b
ICCV 93954	1.24b
ICCV 94954	1.67a
Kabuli Type	
ICCV 2	1.22b
ICCV 95332	1.23b
ICCV 95334	1.13b

Means with a common letter are not significantly different at 5% by DMRT

Average Weight of Pod Produced per Plant

The highest number of pod produce per plant was recorded from ICCV 94954 and ICCV 95332 followed by ICCV 95334, ICCV 2 and ICCV 93954. ICCV 93952 had the lightest weight of pod produced. As it was observed that Kabuli type had bigger pod size which might have attributed to its heavy weight. On the other hand, Desi type had smaller pod size.

Table 9. Average weight of pod produced per plant (g)

VARIETY	MEAN (g)
Desi Type	
ICCV 93952	20.98c
ICCV 93954	21.94bc
ICCV 94954	28.69a
Kabuli Type	
ICCV 2	24.29b
ICCV 95332	28.26a
ICCV 95334	24.69b

Means with a common letter are not significantly different at 5% by DMRT

Average Yield per Plant

As shown in Table 10 entries which produced highest yield per plant is recorded from ICCV 94954 which did not markedly differ from ICCV 95332. Followed by ICCV 2, ICCV 93954, ICCV 9533. 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 the matured pods before harvesting.

Table 10. Average yield per plant (g)

VARIETY	MEAN (g)
Desi Type	
ICCV 93952	18.13c
ICCV 93954	19.78bc
ICCV 94954	25.95a
Kabuli Type	
ICCV 2	21.54b
ICCV 95332	24.75a
ICCV 95334	18.69bc

Means with a common letter are not significantly different at 5% by DMRT

Total Yield per Plot and Total Yield per Hectare

The trend in yield per plot is consistent with the total yield per hectare where ICCV 94954 had the highest computed yield. Followed by ICCV 95332, ICCV 95334, ICCV 2 and ICCV 93952 had the lowest yield (Table 11). The lowest yield of these varieties is due to excessive rainfall which leads to the development of sclerotinia stem rot which had greatly damage the crop, especially ICCV 939532 and ICCV 93954 and due to occurrence of pod borer and rodents.

Table 11. Total yield per plot and total yield per hectare (kg)

VARIETY	TOTAL YIELD PER PLOT (kg)	TOTAL YIELD PER HECTARE (kg/ha)
Desi Type		
ICCV 93952	0.94e	421.25e
ICCV 93954	1.14d	571.25d
ICCV 94954	1.87a	935.00a
Kabuli Type		
ICCV 2	1.33c	663.75c
ICCV 95332	1.66b	829.25b
ICCV 95334	1.36c	678.75c

Means with a common letter are not significantly different at 5% by DMRT

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 adapted 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 adapted to the section in which it is grown.

Weight of 1,000 Seeds (g)

The weight of 1000 seeds is shown in Table 12. Among the six varieties evaluated, it was observed that ICCV 95334 had the heaviest weight of 1000 seeds with a mean of 352.03 g. While ICCV 2 had the lightest weight having a mean of 219.25 g.

Table 12. Weight of 1,000 seeds (g)

VARIETY	MEAN (g)
Desi Type	
ICCV 93952	277.75d
ICCV 93954	230.85d
ICCV 94954	244.25c
Kabuli Type	
ICCV 2	219.25e
ICCV 95332	335.75b
ICCV 95334	352.03a

Means with a common letter are not significantly different at 5% by DMRT

Differences in weight of 1000 seeds are attributed to the differences in varietal characteristics such as their sizes. Thus, Kabuli type had bigger seed size which contributed to its weight while desi type has smaller seed size.

Average Seed Diameter

The widest seed diameter was significantly measured from ICCV 95334 and ICCV 95332 with a mean of 0.84 and 0.82 followed by ICCV 94954, ICCV 93954. The smallest seed was measured from ICCV 2 and ICCV 93952 having the same mean of 0.66 cm.

Table 13. Average seed diameter (cm)

VARIETY	MEAN (cm)
Desi Type	
ICCV 93952	0.66b
ICCV 93954	0.68b
ICCV 94954	0.69b
Kabuli Type	
ICCV 2	0.66b
ICCV 95332	0.82a
ICCV 95334	0.84a

Means with a common letter are not significantly different at 5% by DMRT

Result shows that seed diameter is directly related to the size and weight of a seed. The differences in seed diameter reflect the varietal characteristics and genetic make-up (Bautista *et. al*., 1983).

Germination Test

Seeds used in the germination test were harvested on their mature stage wherein their pod color was yellow but some pods with green color were harvested. Just after harvesting pods were put under the sun. After one week seeds were removed from the pods and seeds were put in net bag then air dried for two weeks on shaded area.

Ragdoll method. As shown in Table 14, there is highly significant differences in germination test done in ragdoll method. ICCV 2 had the highest percentage emergence

followed by ICCV 94954, ICCV 95334, ICCV 95332 and ICCV 93954 while ICCV 93952 lowest percentage emergence. However, result shows that all varieties of chickpea could survive under Buguias condition.

Petri disc. Result shows that ICCV 2 had the highest germination percentage petri disc while ICCV 93952 had least percentage emergence.

Low percentage germination maybe due to some factor such as high moisture content as seeds. However, difference in the germination test done in ragdoll method and Petri disc is that in ragdoll method, the whole seeds were completely wrapped with moist cheese cloth providing sufficient moisture to be used by the seed during germination while in petri disc, only one side of the seed absorbs water resulting to lower germination.

Table 14. Germination test

VARIETY	MEAN	
	Ragdoll Method	Petri disc Method
Desi Type		
ICCV 93952	49.50d	18.00b
ICCV 93954	51.25d	26.00b
ICCV 94954	72.75b	42.25a
Kabuli Type		
ICCV 2	86.75a	45.00a
ICCV 95332	62.75c	27.25b
ICCV 95334	63.00c	19.25b

Means with a common letter are not significantly different at 5% by DMRT

Varietal Characteristics

Leaf characteristics. In Table 15, desi type have small rounded leaflet and has green leaf color while kabuli type have oblong leaflets and had a light green leaf.

Flower characteristics. Table 16 shows that flower of desi type are violet while kabuli type is white. All pods of chickpea cultivars are yellow at harvesting stage.

Seed characteristics. Table 17 shows that desi type has brown seed color, angular in shape and are small to medium in size, while kabuli type had cream seed color, owl's head shape and are big to medium in size.

Table 15. Leaf 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		
ICCV 2	Oblong leaflets	light green
ICCV 95332	Oblong leaflets	light green
ICCV 95334	Oblong leaflets	light green

Table 16. Flower characteristics of the different varieties of chickpea

VARIETY	FLOWER COLOR	COLOR OF POD AT 1st HARVESTING STAGE
Desi Type		
ICCV 93952	violet	yellow
ICCV 93954	violet	yellow
ICCV 94954	violet	yellow
Kabuli Type		
ICCV 2	white	yellow
ICCV 95332	white	yellow
ICCV 95334	white	yellow

Table 17. Seed characteristics of the different varieties of chickpea

VARIETY	SEED COLOR	SEED SHAPE	SEED SIZE
Desi Type			
ICCV 93952	brown	angular	small
ICCV 93954	brown	angular	small
ICCV 94954	brown	angular	medium
Kabuli Type			
ICCV 2	Cream/ivory white	Owl's head	Medium
ICCV 95332	Cream/ivory white	Owl' head	Big
ICCV 95334	Cream/ivory white	Owl's head	Big

Pest and Diseases

Table 16 shows that all the varieties evaluated were infested by cutworm during the vegetative stage. Pod borer were observed during the reproductive stage of the crop.

Collar rot, chickpea stunt and sclerotinia stem rot were the diseases observed during the cropping season (Table 17). Greater damage on the crop, this is due to excessive rainfall. The occurrence of sclerotinia stem rot greatly affects the crop specially the desi type ICCV 93952 and ICCV 94954 which had excessive vegetative growth, collar root rot was observe to kabuli type and chickpea stunt are usually observed from desi type.

Table 18. Insect pest observed during the conduct of the study

INSECT PEST	STAGE THEY ATTACKED
Cutworm (*Agrotis ipsilon*)	Vegetative stage
Pod Borer (*Helicoverpa armigera*)	Reproductive stage

Table 19. Diseases observed during the conduct of the study

DISEASE	CAUSAL ORGANISM	DEGREE OF INFESTATION	VARIETIES INFECTED
Collar rot	*Sclerotium isolfsii sacc*	*Slight*	ICCV2, ICCV 95332, and ICCV 95334
Sclerotinia stem rot	*Sclerotium sclerotiorum*	*Severe*	ICCV 93952 and ICCV 94954
Chickpea stunt	Bean (pea) leaf roll virus	*Slight*	ICCV 93952, ICCV 93954, and ICCV 94954

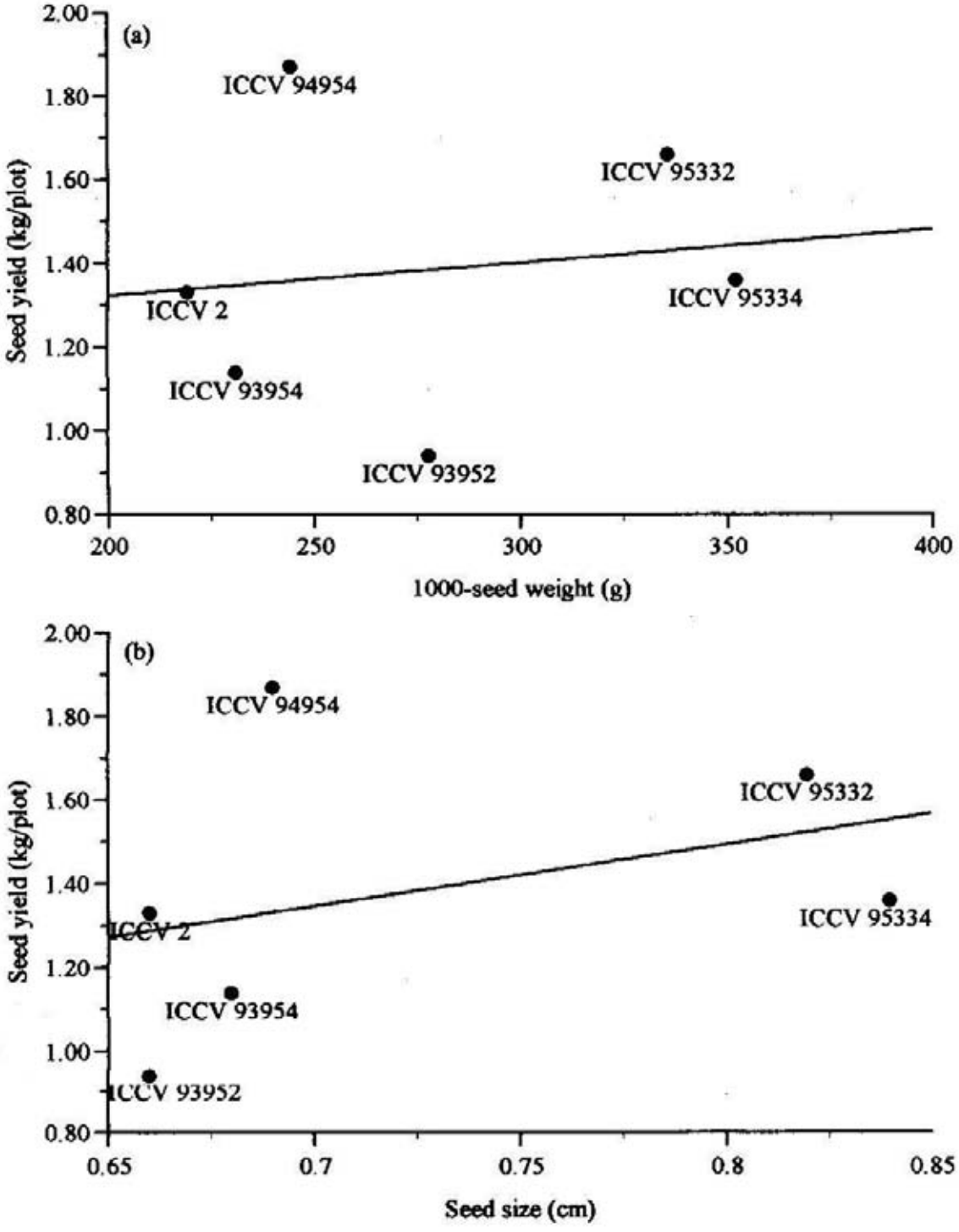

Figure 6. Correlation and regression analysis between seed yield and 1000-seed weight (a) and seed sized (b)

Meteorological Data

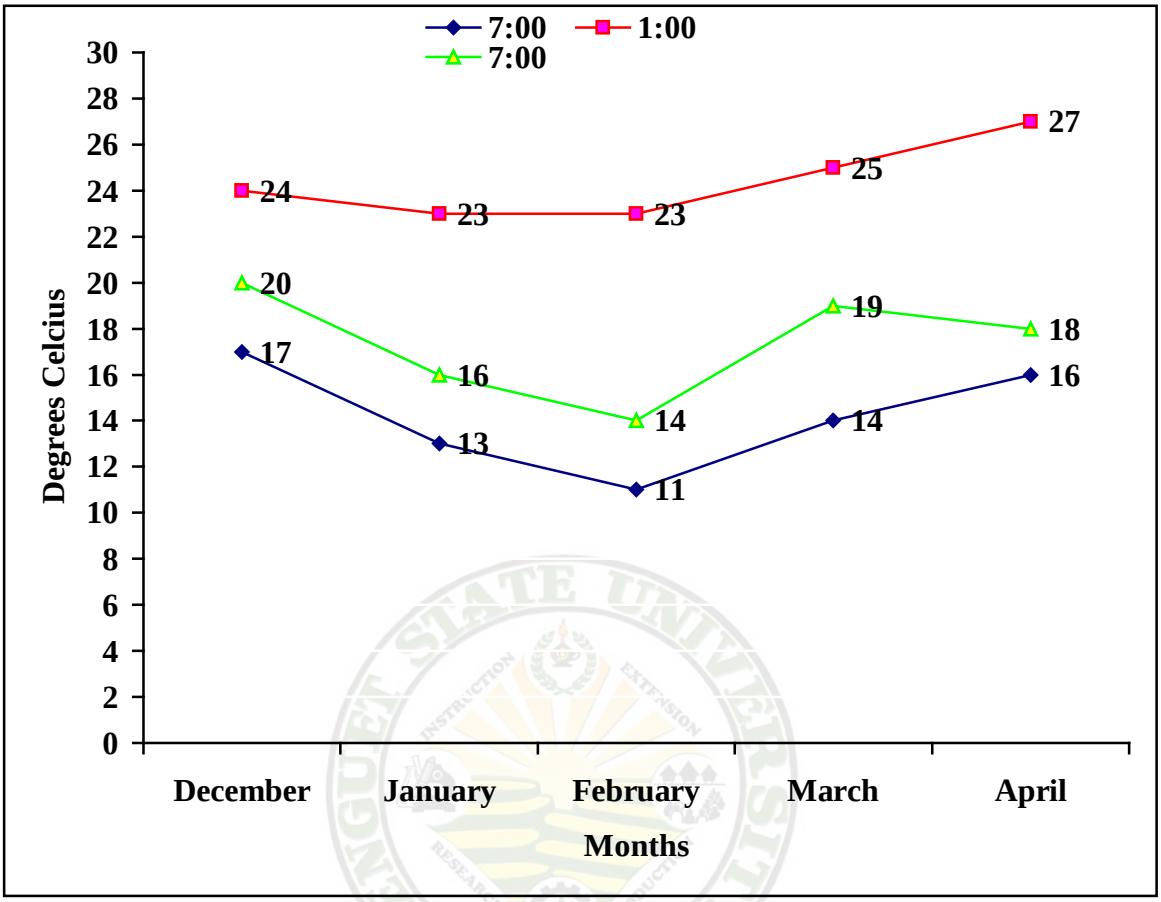

Figure 7. Temperature during the conduct of the study

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted to introduce and promote chickpea production in Benguet specifically at Bano-oy, Buguias, Benguet and to determine the growth and yield of chickpea under Buguias condition and to identify chickpea varieties that could be profitably grown under Buguias condition. The study was conducted at Bano-oy, Buguias, Benguet from November to April 2008.

Result showed that different chickpea varieties significantly vary on emergence percentage were ICCV 2, ICCV 93952, ICCV 94954 and ICCV 93954 had higher percentage emergence while the lowest emergence was observed from ICCV 95332 and ICCV 95334. In days from planting to flowering, ICCV 2 were earliest to produce flower while Desi type varieties were the latest. As to the number of days to first harvest ICCV 2 matures earlier over the other varieties evaluated. Thus, varieties that produced flower earlier were the first to attain harvestable stage.

As to the number of lateral branches at flowering ICCV 94954 produced more number of lateral branches while ICCV 93954 produced the least number of branches.

ICCV 94954 had produced more number of seeds per pod with a mean of 1.67 compared to other varieties which had lesser seeds per pod. As to weight of pod produced per plant, ICCV 94954 and ICCV 2 had the highest weight of pod while ICCV 93952 had the lowest pod weight per plant. As to yield per plant, yield per plot and yield per hectare ICCV 94954 significantly out yielded all the varieties evaluated.

The result of germination test done in ragdoll method and petri disc wherein ICCV2 had the highest percentage germination while ICCV 93952 had the lowest germination percentage.

Conclusion

Based on the results presented and discussed, all the six varieties of chickpea were adapted under Bano-oy, Buguias, Benguet however ICCV 94954, a desi type variety and ICCV 95334 a kabuli type had higher yield potential among the six cultivars evaluated.

Recommendation

With this observation, it is recommended that ICCV 94954 for the desi type and ICCV 95332 for the kabuli type are to be chosen to be planted by farmers in Bano-oy, Buguias, Benguet. It is also recommended that further evaluation be done on other part of Buguias to verify this finding.

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APPENDICES

APPENDIX TABLE 1. Percentage field emergence (%)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	99	90	95	91	375	93.75a
ICCV 93954	96	79	88	82	345	86.25a
ICCV 94954	90	83	98	90	361	90.25a
Kabuli Type						
ICCV 2	99	99	96	99	393	98.25a
ICCV 95332	41	78	72	73	264	66.00b
ICCV 95334	28	59	71	53	205	51.25b

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	377.458	125.819			
Factor A	5	6733.208	1346.642	11.53*	2.90	4.56
Error	15	1752.292	116.819			
Total	23	8862.958				

*- Significant Coefficient of Variation: 13.35%

APPENDIX TABLE 2. Days from planting to flowering

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	63.9	65.8	60.8	66.5	257	64.250
ICCV 93954	60.1	60.6	58.8	64.1	243.60	60.900
ICCV 94954	58.4	58.4	61.55	65.8	224.15	61.038
Kabuli Type						
ICCV 2	47.15	45.8	47.4	46.05	186.40	46.400
ICCV 95332	49.25	50.7	50.65	47.95	198.55	49.638
ICCV 95334	50.55	52.25	51.60	50.85	205.25	51.312

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	14.059	4.686			
Factor A	5	1069.639	213.928	48.28**	2.90	4.56
Error	15	66.462	4.431			
Total	23	1150.160				

**- Highly significant Coefficient of Variation: 3.78%

APPENDIX TABLE 3. Average height at flowering (cm)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	33.66	38.45	35.05	38.36	145.52	36.380
ICCV 93954	32.54	33.98	34.35	41.58	142.45	35.613
ICCV 94954	32.95	32.18	33.78	38.78	137.62	34.405
Kabuli Type						
ICCV 2	36.93	36.95	41.35	39.59	154.82	38.705
ICCV 95332	34.38	34.98	40.74	44.96	155.06	38.765
ICCV 95334	42.75	44.10	44.25	40.13	171.23	42.807

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	101.177	33.726			
Factor A	5	180.601	36.120	4.44*	2.90	4.56
Error	15	122.075	8.138			
Total	23	403.854				

*- Significant Coefficient of Variation: 7.55%

APPENDIX TABLE 4. Number of days from planting to first harvest

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	130	132	126	126	514	128.50
ICCV 93954	121	126	125	123	495	123.75
ICCV 94954	112	110	114	116	452	113.00
Kabuli Type						
ICCV 2	95	92	94	98	379	94.75
ICCV 95332	100	102	104	108	414	103.50
ICCV 95334	105	103	110	100	418	104.50

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	11.333	3.778			
Factor A	5	3338.833	667.767	63.73**	2.90	4.56
Error	15	157.167	10.478			
Total	23	3507.333				

**- Highly significant Coefficient of Variation: 2.91%

APPENDIX TABLE 5. Average number of lateral branches at flowering

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	3.25	3.00	3.25	3	12.50	3.125
ICCV 93954	3.05	2.95	3.05	2.95	12.00	3.00
ICCV 94954	3.90	3.55	3.90	3.55	14.90	3.725
Kabuli Type						
ICCV 2	3.3	3.25	3.3	3.25	13.10	3.275
ICCV 95332	3.0	3.85	3.0	3.85	13.70	3.425
ICCV 95334	3.5	3.25	3.5	3.25	13.50	3.75

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	0.004	0.001			
Factor A	5	1.282	0.256	3.93*	2.90	4.56
Error	15	0.979	0.065			
Total	23	2.265				

*- Significant Coefficient of Variation: 7.69%

APPENDIX TABLE 6. Total number of harvest

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	3	3	2	2	10	2.50
ICCV 93954	3	4	2	3	12	3.00
ICCV 94954	4	4	4	4	16	4.00
Kabuli Type						
ICCV 2	3	4	3	4	14	3.50
ICCV 95332	4	4	4	4	16	4.00
ICCV 95334	3	4	4	3	14	3.50

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	1.500	0.500			
Factor A	5	6.833	1.367	5.86**	2.90	4.56
Error	15	3.500	0.233			
Total	23	11.833				

**- Highly significant Coefficient of Variation: 14.14%

APPENDIX TABLE 7. Percentage pod setting (%)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	54.86	50.7	51.62	61.37	218.55	54.637
ICCV 93954	62.59	60.49	60.32	68.56	251.96	62.990
ICCV 94954	67.8	65.3	67.42	69.07	269.59	67.398
Kabuli Type						
ICCV 2	62.4	70.72	65.61	65.67	264.40	66.100
ICCV 95332	66.89	62.29	69.01	72.28	270.47	67.618
ICCV 95334	63.72	64.66	63.92	64.76	257.06	64.265

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	79.448	26.483			
Factor A	5	470.488	94.098	10.75**	2.90	4.56
Error	15	131.326	8.755			
Total	23	681.262				

**- Highly significant Coefficient of Variation: 4.64%

APPENDIX TABLE 8. Average number of seeds per pod

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	1.11	1.0	1.31	1.27	4.69	1.27
ICCV 93954	1.08	1.02	1.75	1.11	4.96	1.24
ICCV 94954	1.01	1.3	1.07	1.28	6.67	1.667
Kabuli Type						
ICCV 2	1.48	1.03	1.26	1.27	5.04	1.22
ICCV 95332	1.22	1.48	1.35	1.37	5.42	1.23
ICCV 95334	1.29	1.2	1.01	1.05	4.55	1.13

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	0.265	0.088			
Factor A	5	0.899	0.180	1.15**	2.90	4.56
Error	15	2.351	0.157			
Total	23	3.514				

**- Highly significant Coefficient of Variation: 24.90%

APPENDIX TABLE 9. Average weight of pods produce per plant

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	22.5	20.6	20.7	20.1	83.90	20.975
ICCV 93954	21.7	24.75	20.15	21.15	87.75	21.938
ICCV 94954	31.45	28.4	28.15	26.75	114.75	28.688
Kabuli Type						
ICCV 2	24.95	26.4	20.1	25.7	97.15	24.288
ICCV 95332	31.05	28.0	26.0	28.0	113.03	28.262
ICCV 95334	22.06	25.05	23.75	28.2	98.76	24.690

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	24.956	8.319			
Factor A	5	200.802	40.160	9.99**	2.90	4.56
Error	15	60.254	4.017			
Total	23	286.012				

**- Highly significant Coefficient of Variation: 8.08%

APPENDIX TABLE 10. Average yield per plant (g)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	20.4	18.5	16.3	17.3	72.50	18.125
ICCV 93954	19.0	21.6	17.5	21.35	79.10	19.775
ICCV 94954	28.65	26.1	25.45	23.6	103.80	25.950
Kabuli Type						
ICCV 2	2.05	21.3	22.65	20.15	86.15	21.537
ICCV 95332	27.8	24.75	21.85	24.6	99.00	24.750
ICCV 95334	18.95	17.25	16.7	22.35	74.75	18.688

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	25.039	8.346			
Factor A	5	210.551	42.110	11.78**	2.90	4.56
Error	15	53.630	3.575			
Total	23	289.220				

**- Highly significant Coefficient of Variation: 8.81%

APPENDIX TABLE 11. Total yield per plot (kg)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	0.94	1.06	0.86	0.91	3.77	0.942
ICCV 93954	1.03	1.23	1.18	1.13	4.57	1.142
ICCV 94954	1.95	1.79	1.86	1.88	7.48	1.870
Kabuli Type						
ICCV 2	1.21	1.57	1.21	1.32	5.31	1.328
ICCV 95332	1.68	1.79	1.54	1.62	6.63	1.657
ICCV 95334	1.18	1.41	1.23	1.61	5.43	1.357

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	0.101	0.034			
Factor A	5	2.273	0.455	35.90**	2.90	4.56
Error	15	0.190	0.013			
Total	23	2.563				

**- Highly significant

Coefficient of Variation: 8.14%

APPENDIX TABLE 12. Total yield per hectare

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	470	530	430	455	1885	471.25
ICCV 93954	515	615	590	565	2285	571.25
ICCV 94954	975	895	930	940	3740	935.00
Kabuli Type						
ICCV 2	605	785	605	660	2655	663.25
ICCV 95332	840	895	775	810	3317	829.25
ICCV 95334	590	705	615	805	2715	678.75

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	25346.125	8448.708			
Factor A	5	568680.208	113736.042	35.87**	2.90	4.56
Error	15	47565.625	3171.042			
Total	23	641591.958				

**- Highly significant Coefficient of Variation: 8.14%

APPENDIX TABLE 13. Seed quality

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	234	226	223	228	911.00	227.750
ICCV 93954	225	234	233	231	923.40	230.850
ICCV 94954	236	238	259	244	977.00	244.250
Kabuli Type						
ICCV 2	218	220	220	219	877.00	219.50
ICCV 95332	336	337	334	336	1343.00	335.750
ICCV 95334	348	352	356	352	1408.10	252.025

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	66.941	22.314			
Factor A	5	70361.949	14072.390	511.75**	2.90	4.56
Error	15	412.476	27.498			
Total	23	70841.367				

**- Highly significant Coefficient of Variation: 1.95%

APPENDIX TABLE 14. Average seed diameter (cm)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	0.66	0.66	0.66	0.66	2.64	0.660
ICCV 93954	0.65	0.69	0.68	0.68	2.70	0.675
ICCV 94954	0.63	0.74	0.74	0.68	2.79	0.698
Kabuli Type						
ICCV 2	0.65	0.65	0.68	0.66	2.64	0.660
ICCV 95332	0.82	0.82	0.82	0.80	3.26	0.815
ICCV 95334	0.84	0.86	0.86	0.86	3.36	0.840

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	0.003	0.001			
Factor A	5	0.132	0.026	39.52**	2.90	4.56
Error	15	0.010	0.001			
Total	23	0.145				

**- Highly significant Coefficient of Variation: 3.57%

APPENDIX TABLE 15. Germination test (ragdoll method)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	48	51	50	50	198	49.50
ICCV 93954	53	51	50	51	205	51.25
ICCV 94954	76	66	76	73	291	72.75
Kabuli Type						
ICCV 2	92	80	88	87	347	86.75
ICCV 95332	68	56	64	63	251	62.75
ICCV 95334	72	61	54	62	252	63.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	157.667	52.556			
Factor A	5	3875.333	775.067	50.04**	2.90	4.56
Error	15	232.333	15.489			
Total	23	4265.333				

**- Highly significant Coefficient of Variation: 6.12%

APPENDIX TABLE 16. Germination test (petri dish method)

VARIETY	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Desi Type						
ICCV 93952	21	18	15	18	72	18.00
ICCV 93954	27	31	27	28	104	26.00
ICCV 94954	68	30	29	42	169	42.25
Kabuli Type						
ICCV 2	41	35	59	45	180	45.00
ICCV 95332	24	31	27	27	109	27.25
ICCV 95334	21	18	15	18	77	19.25

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	TABULATED F	
					0.05	0.01
Replication	3	129.458	43.153			
Factor A	5	2629.375	525.875	6.42**	2.90	4.56
Error	15	1228.792	81.919			
Total	23	3987.625				

**- Highly significant Coefficient of Variation: 30.55%

Figure 8. Location of the study