BIBLIOGRAPHY

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ABSTRACT

The growth and yield of five chickpea (*Cicer arietinum* L.) varieties under Naguey, Atok, Benguet condition was evaluated from November 2007 to March 2008. The study was conducted to introduce and promote chickpea production in Benguet Province specifically in Naguey, Atok, Benguet to determine the growth and yield of chickpea under Naguey, Atok, Benguet condition; and to select chickpea varieties that could be profitability grown under Naguey, Atok, Benguet.

After four months of growing the plants, the variety ICCV 95332 a kabuli type variety had the highest number of lateral branches (4.08), most number of harvest (4.0), heaviest weight of pods produced per plant (34.455g), heaviest weight of 1,000 seeds (383.33g), widest seed diameter (0.760cm), highest yield per plant (19.21g) and having also the heaviest total yield per plot (1.061 kg) and total yield per hectare (530.663 kg per hectare). The remaining varieties had lower yield ranging from 0.436 to 0.614 kg per plot or 219.250 to 306.888 kg per hectare.

As to number of days from planting to flowering, ICCV 2 was the earliest to produce flowers after 31.95 days from planting while ICCV 93952 were the latest with

50.99 days from planting. Similarly, ICCV 2 had the earliest to attain first harvesting stage.

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INTRODUCTION

Atok is located at the center of Benguet Province, bounded on the north by Kibungan and Buguias municipalities, and on the south of Tublay, on the east by Bokod and Kabayan and on the west by Kapangan. It has an average temperature of 14-29^{o}C and an elevation of 720 meter above sea level.

Atok, being an agricultural municipality has a total area of 10, 310, 334 hectares primarily devoted to all agricultural activities such as vegetable farming, rice farming and tree farming, pastured and used for grazing animal is included in this area.

The major crops grown are potatoes, cabbage and carrots as a cash crop. Likely, they also raised domesticated animals in the backyards. In the lower portion of the mountainous areas like Naguey, Pasdong and Poblacion, rice, sweet potatoes and other root crops and fruit trees are produced.

Chickpea is one of the legume crops whose seeds are not locally produced due to the lack of information and no available planting materials. The difficulty of producing chickpea seed in the country makes it necessary to import seeds from other countries.

Chickpea (*Cicer arietinum*) 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 any dry edible legume. It is the most important food legume grown globally because it is grown for its nutritious edible seeds, the whole seed or split seed are used in flour for preparing variety of snack, raw or roasted fresh green chickpeas and straw as a livestock feed. On an average chickpea seed contains 23% protein, 47% starch, 56% fat, 6% crude fiber, 6% soluble sugar and 3% ash. Chickpeas are rich in

minerals and vitamins. It is mainly used for human consumption and only a small proportion is used as feed. The Kabuli type (White or cream seed coat) is generally used as a whole grains, while Desi type (coloured seed coat) is used as whole seeds, dehulled splits or flour.

Chickpea have not been introduce or cultivated in the Cordilleras especially in Benguet even the agro climatic condition is suitable for its production due to lack of information and no available planting materials. The introduction of new highbred ICRISAT cultivars of chickpea coupled with the generation of location specific technologies for the highlands of CAR, chickpea could became a major cash earner. Moreover, the supply of chickpea in the Philippines depends mainly on importation from chickpea producing countries like India, Turkey, Pakistan, Iran, Mexico, Australia, and Canada.

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

The objective of the study were to introduce and promote chickpea production in Benguet province specifically in Naguey, Atok, Benguet, determine the growth and yield of chickpea under Naguey, Atok, Benguet condition, and select chickpea varieties that could be profitably grown under Naguey, Atok, Benguet.

The study was conducted at Naguey, Atok, Benguet from November 2007 to March 2008.

REVIEW OF LITERATURE

Description of the Crop

Chickpea(*Cicer arietinum*) a small bushy annual plant. It approximately grows about 1 to 2 feet (30 to 60cm) tall. The root system is well develop and usually include central strong tap root with numerous lateral branches that spread out in all directions in at the upper layer of the soil. The stem is generally grayish in appearance. Stem is branded with one terminal leaflet. However, the number as well as the size of the leaflet varies in different sizes. Leaflets have 9 to 15 pairs. The leaflets of the pinnate leaves are small and have serrated edges. A leaf of chickpea also varies in colors, some being light green while others are green to dark green. Certain types possess leaflets with red margins. The flowers are typical papilionaceous consisting of five sepals, five petals of the one standard, two wings and two keels, ten stamens, nine fored to form one staminal column and one free and a carpel with the style borne laterally on the ovary. The pod is about 2cm long and usually contains two seeds. A single plant produces about 50 to 150 pods. Seeds are spherical in shape, wrinkled and with a pointed beak. The seed vary in great deal in size as well as in color. Seed color may vary from white, light brown, yellowish-orange, brown, dark brownish and with a little bluish tinge. The seed coat may be smooth or puckered and wrinkled. The cotyledons are thick and yellowish in color (Singh, 1983).

There are two main seed types: the Desi types with small, angular seeds, which account for more than 85% of the world's production, and the Kabuli type which has large, rounded seeds. Desi types are grown principally in India, Ethiopia, Mexico and

Iran and the Kabuli types in Afghanistan, North Africa, Southern Europe and the Americas (Giller, 2001).

Importance of Chickpea

Legumes are highly valued as food because of the high protein content of their seeds. They are also valued for cultural purposes – they enrich the soil with Nitrogen; they are used as green manures; they are usually good cover crops, and as such they help in controlling soil erosion and weeds; and being deep rooted, they serve to bring up nutritive elements from the deeper strata of soils to the surface soil where they become available to shallower rooted crops. (Mendiola, 1958).

Generally, chickpea is grown for its economic importance and of its nutritive value. Chickpeas are a good source of zinc, foliate, calcium and protein. They are also very high in dietary fiber and this is a healthy food source, especially as a source of carbohydrates for persons with insulin sensitivity or diabetes. According to the International Crops Research Institute for the Semi-Arid Tropics, chickpea has one of the highest nutritional compositions of any dry edible legume and does not contain any specific major anti-nutritional factors. On an average, chickpea seed contains 23% protein, 64% total carbohydrates, 47% starch, 5% fat, 6% crude fiber, 6% soluble sugar and 3% ash (Oplinger, 1990).

Soil and Climatic Requirement

Chickpea can be grown in medium and high altitudes of more than 800m. It is typically adapted to cooler seasons after the monsoon at higher latitudes and the

subtropics, also at lower altitudes. Seedlings of chickpea are even known to revive from snow cover. Drought resistant species withstand the largest temperature amplitudes. Bright sunshine is essential for growth and fertilization of semi-arid pulses. Cloudy weather harms fruit setting in chickpeas. Long duration climbers such as yam beans and velvet beans may tolerate shade and moist conditions. The plant is a winter season crop but severe in the failure of the flowers to develop seeds, or in the killing of the seeds inside the pod. Similarly, according to Wein et al (undated), the most frequent cause of abscission of pepper flowers, fruit and flower bus are environmental factors such as heat, drought, or low light conditions, diseases or insect pests. Loss of flower buds, flowers and young fruits in pepper is one of the most important factors limiting the production of this crop in both temperate and tropical conditions.

Excessive rains soon after sowing or at flowering and fruiting or hail storm at ripening cause heavy loss. It is best suited to areas having moderate rainfall with 60-90cm per annum. It is generally grown under rain fed conditions but gives good returns in irrigated conditions as well (Singh, 1983).

Chickpea does best on fertile sandy loam soils with good internal drainage and a pH of 6.0 to 9.0. Good drainage is necessary because even short periods of flooded or water logged fields reduce growth an increase susceptibility to root and stem rots (Oplinger, 1990).

Soil Fertility and Lime Requirement

The best type of soil for chickpea is one that is well drained and not too heavy. One dry and light soil, the plants remain short while on heavy soils having high water

retention capacity, the vegetative growth is abundant, light becomes limiting and fruiting is retarded. The soil chosen for its cultivation should be free from excessive soluble salts and near neutral in reaction. However, it is not suited to soils having a pH higher than 8.5 (Singh, 1983).

Soil texture suitable for chickpea in Minnesota and Wisconsin are not well known but the crop will likely require the amounts of phosphorous, potassium and certain micronutrients which are recommended for other pulse or legume crops in this area. Any fertilizer application should be based on soil test level, previous crop and expected yield level. Soil should be limed to a pH of 6.0 unless a crop with a higher pH requirement is grown in rotation. Phosphate and potash recommendations based on soil test values. (Singh, 1983).

Harvesting and Threshing

Chickpea can be harvested direct or swathed prior to combining depending upon uniformity of maturity and weed problems. About one week of good drying weather is required in the swath. Chickpea can be swathed when the plants are yellowing and the pods are at 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 window are dry enough (seed moisture about 13%) the swath can be combined. Seed color is important (buyers prefer yellowish-cream color) so greenish and brown seeds are generally unacceptable. About 1% immature color seed is allowed before deductions are implemented (Oplinger, 1990).

Traditionally, farmers thresh their crop by trampling it with bullocks. The animals are allowed to walk on the plants in circles. Continuous stirring of materials is required for uniform threshing. For easy threshing and to avoid damage to the seeds, the seeds are removed from the threshing lot when about 60-70% seeds have separated from the straw. (Muehlbauer, 1997).

Drying and Storage

Moisture content should be around 10 to 12 % to prevent insect and disease outbreaks in storage. Because of their relatively large seed size, chick pea 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 (Oplinger, 1990).

Uses of Chickpea

Chickpea is mainly used for human consumption and only a small portion is used as feed. It is also known for its use in herbal medicine and cosmetics. Chickpea seeds are eaten fresh as green vegetables parched, fried, roasted and boiled; as snack food, sweet and condiments; seeds are ground and 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. Dhal is the split chickpea soup or ground into flour for snacks and sweetmeats. “Sprouted seeds are eaten as vegetable or added to salads. Young plants and green pods are eaten like spinach. Chickpea is also used as animal feed in many developing countries. Gram husks, and green or dried stems and leaves are used for stock feed; whole seeds may be milled

directly for feed. Leaves are said to yield our indigo like dye. Acid exudates from the leaves can be applied medicinally or used as vinegar. In Chile a cooked chickpea –milk (4) mixture was good for feeding infants, effectively controlling diarrhea. Chickpeas yield 21% starch suitable for textile sizing giving a light finish to silk, wool, and cotton cloth (Oplinger, 1990).

Chick pea could also be used for medicinal puposes. It could be use for aphrodisiac, bronchitis, catarrh, cutamenia, cholera, constipation, diarrhea, dyspepsis, flatulence, snake bite, sunstroke and warts. Acids are supposed to lower the blood cholesterol levels. Seeds are considered antibiotics (Muehlbauer, 1997).

Importance of Varietal Selection

Selection of varieties to be planted is one of the most important decision that commercial vegetable grower must know (Lorenz and Maynard, 1988). New varieties must perform well under wide range of environmental conditions usually encountered on the individual farms and posses excellent resistance against pest and diseases, and the products must also have characteristics desired by the factories, shipper, wholesaler and retailers as to size, shape, color, flavor and nutritional quality.

According to Work and Carew (1981), varietal evaluation is necessary to observe plant characteristics such as yield, earliness, vigor, maturity and keeping quality because different varieties have a wide range of different performance. It is also essential for a adaptability purpose in a given location. Similarly, Thompson and Kelly (1957) mentioned that main, agricultural experiments were conducted in variety and strain test of economic crop and have recommended varieties in order to determine if they fit or not in

this particular area or conditions. Earlier, Ware (1937) suggested that the importance of good seeds of the right variety or strain suitable for the locality can't be overemphasized. Since varieties produce exceptionally well under one set of conditions and become worthless under other conditions.

Rerly and Shry (1991) reported that variety must be adapted to the area in which it is grown. Different varieties which were grown under the same method have a great variation in the yielding ability. A variety that yields well in one region is not a guarantee that it can perform in another region. Likewise, Edmund and Andrews (1957) said that varieties differ in productivity as expression of hereditary genes influenced by the environment. The variety best adapted to the environment reflects the high yield potential according to Villareal and Wallace (1969).

According to Villareal (19690 to understand why and how genetic and environmental factors influence plant growth, it is helpful to recognize a concept accepted by biologists. This concept states that all variations of all characteristics, both observed and unobserved, biological organisms are a consequence of only two factors: genetic and environment. According to this concept, nothing except genetics and environment is responsible for any variations among within all plant species, you are one of these biological organisms and this concept means that your features are all jointly determined by genetics and environments.

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.

In addition, Villareal (1969) pointed out that the difference in the characteristics weight is the influence of the genetic and environmental factors.

Moreover, Liu et al (2003) cited that the number of seeds per pod is relatively correlated with seed size. It seems that a genetic factor is responsible for the number of seeds formed in a pod. Large seeded kabuli cultivars produce fewer seeds per pod. Large seeded kabuli cultivars produce more usually two seeds.

MATERIALS AND METHODS

Seeds of five chickpea varieties, fungicides, organic and inorganic fertilizers, insecticides, watering cans, weighing scale, grub hoes, identifying tags, meter stick, thermometer, verner caliper and altimeter were the materials provided for the study.

An area of 500 square meters that is previously planted with rice was used for the study. The area was divided into four blocks. Each treatment was planted in two (1m x 10m) plot or a total of 500 square meters. Two furrows were made within the plot at 30 cm apart where the inorganic (14-14-14) fertilizer of ½ kg and 1 kerosene can chicken dung was applied evenly and mixed with the soil before sowing the seeds singly at 30 cm between rows and 10 cm between hills. There were 20 samples per treatment replicate selected randomly.

The experiment was laid in a randomized complete block design (RCBD) with four replications. The treatments were as follows:

Treatment	Variety	Type
T1	ICCV 93952	Desi Type
T2	ICCV 93954	Desi Type
T3	ICCV 94954	Desi Type
T4	ICCV 2	Kabuli Type
T5	ICCV 95332	Kabuli Type

The data gathered were subjected to analysis of variance and mean separation test by Duncan's Multiple Range Test (DMRT) were the following:

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:

$$\text{Ave. weight of pods produced per plant} = \frac{\text{Total Weight of Pods Produced by Sample Plants}}{\text{Number of Sample Plants}}$$

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

1. Leaf. The shape, color and other leaf characteristics was recorded.
2. Flower/ pod. The color of flower and pod was recorded at flowering and at first harvesting stage.
3. Seed. The color shape and size was recorded at harvest.

17. Incidence of Pest and Diseases

1. Insect pest. Insects that infest the plant during the 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.

18. Meteorological Data

1. Temperature (^{O}C)

19. Documentation. This was taken through pictures.

Figure 1. Planting Chickpea at Naguey, Atok

Figure 2. Flowering stage

Figure 3. Pod stage

Figure 4. Overview of the experiment and the researcher during harvesting stage

Figure 5. Germination test

Figure 6. Chickpea stunt caused by *Sclerotium isolfsii* Sacc

Figure 7. Wet root rot caused by *Rhizoctonia solani*

RESULTS AND DISCUSSION

The results and discussion from the growth and yield performance of five chick pea varieties under Naguey, Atok, Benguet condition from November 2007 to March 2008 are presented and discussed in this section.

Emergence Percentage

Table 1 reveals significant differences among the different varieties of chick pea in terms of emergence percentage. The highest emergence percentage was observed in ICCV 2, ICCV 93954, ICCV 93952 and ICCV 95954 which showed similar emergence percentage which differed significantly from ICCV 95332 which had the lowest percentage emergence.

Table 1. Emergence percentage (%)

VARIETY	MEAN
Desi Type	
ICCV 93952	97.20[a]
ICCV 93954	97.64[a]
ICCV 94954	94.37[a]
Kabuli Type	
ICCV 2	99.66[a]
ICCV 95332	78.6[b]

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

This result indicates that all the varieties evaluated can grow under Naguey, Atok, Benguet conditions.

Days from Planting to Flowering

As presented in Table 2, ICCV 2 was the earliest to produce flowers. On the other hand ICCV 95332 had significantly shorter period of flowering compared to ICCV 93952, ICCV 94954 and ICCV 93954 which were the latest to produce flower. Differences on the days to flowering could be attributed to varietal characteristics of the plant were desi type cultivars are generally late maturing while kabuli type are early maturing varieties.

Table 2. Days from planting to flowering

VARIETY	MEAN
Desi Type	
ICCV 93952	50.99[a]
ICCV 93954	46.01[ab]
ICCV 94954	48.48[ab]
Kabuli Type	
ICCV 2	31.95[c]
ICCV 95332	42.71[b]

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

These results confirm that varietal evaluation is necessary to observe plant characteristics such as yield, earliness, vigor maturity and keeping quality because different varieties have a wide range of different performance (Work and Carew, 1981). These results also agrees well with the statement of Bautista et al (1989) that each plant species/variety has a set genetic make-up that determines the earliness and regularity of flowering.

Average Height at Flowering

The average height at flowering of the various chickpea varieties is shown in Table 3. Although no significant differences were noted, variety ICCV 93952 numerically, was the tallest followed by the variety ICCV 95332, ICCV 94954 and ICCV 93954 while ICCV 2 obtained the shortest at flowering stage.

Table 3. Average height at flowering

VARIETY	MEAN
Desi Type	
ICCV 93952	34.68[a]
ICCV 93954	29.86[a]
ICCV 94954	31.10[a]
Kabuli Type	
ICCV 2	29.00[a]
ICCV 95332	31.26[a]

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

This implies that all the chickpea varieties have similar average height at flowering under Naguey, Atok, Benguet condition.

Days from Planting to First Harvest

There were significant statistical differences on the days from planting to first harvest among the various chickpea entries observed as revealed in Table 4 which can be attributed to the varietal characteristics of the different chickpea cultivars. The days from planting to first harvest varies according to the cultivars, Bautista et al (1983). He also pointed out that each variety contains a set of genetic make up which determines the earliness of maturity.

Table 4. Days from planting to first harvest

VARIETY	MEAN
Desi Type	
ICCV 93952	95.75[a]
ICCV 93954	92.75[a]
ICCV 94954	92.75[a]
Kabuli Type	
ICCV 2	85.00[b]
ICCV 95332	94.00[a]

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

The earliest to mature and reach harvesting stage earlier among the different entries tested was ICCV2 which differed significantly from ICCV 93952, ICCV 95332, ICCV 93954 and ICCV 94954 which had longer days. The differences in the days of planting to first harvest seem to be directly related to the days from planting to flowering. It follows the same trend that the first to produce flowers was also the first to have a pod harvest. It also shows that ICCV2 is an early maturing variety compared to the other entries evaluated.

Average Number of Lateral Branches

As presented in Table 5, the average number of lateral branches of the various chickpea varieties did not differ significantly. Apparently, ICCV 95332 variety produced the highest number of lateral branches followed by ICCV 94954, ICCV 2 and ICCV 93952. The ICCV 93954 variety had lesser number of lateral branches produced.

This implies that all the chickpea varieties have similar average number of lateral branches under Naguey, Atok, Benguet condition.

Total Number of Harvest

There were no significant differences observed on the total number of harvest among the five varieties tested (Table 6). Apparently, ICCV 94954 and ICCV 95332 had higher number of harvest. This was followed by ICCV 93952 and ICCV 93954 which had almost similar total number of harvest while the lowest number of harvest was recorded from ICCV 2.

Table 5. Average number of lateral branches

VARIETY	MEAN
Desi Type	
ICCV 93952	3.29[a]
ICCV 93954	2.98[a]
ICCV 94954	4.01[a]
Kabuli Type	
ICCV 2	3.48[a]
ICCV 95332	4.08[a]

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	3.75 [a]
ICCV 93954	3.75 [a]
ICCV 94954	4.00 [a]
Kabuli Type	
ICCV 2	3.25 [a]
ICCV 95332	4.00[a]

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

Nevertheless, the result might suggest that all the varieties tested could be terminated at the same time with few variations as far as days from planting to first harvest is concerned. It also indicates that the period of harvest is similar on all the varieties studied. This imply that all the chickpea varieties have similar total number of harvest under Naguey, Atok, Benguet condition.

Percentage Pod Setting (%)

As presented in Table 7, similar percentage pod setting was observed from ICCV2 and ICCV 95332 statistically. This variety slightly differ from ICCV 94954 which in turn did not differ from ICCV 93952 and ICCV 93954 which has the lowest percentage pod setting. This result may be due to the differential responses of these cultivars to the existing environment of the locality. Similarly, these results corroborate with the statement of Wien et al (undated) who stated that the difference in fruit set among the different pepper cultivars may be an expression of resistance to environmental stresses such as temperature, moisture, shade, plant nitrogen status, fruit load and plant diseases, the most important of which is high temperature.

Average Number of Seeds Per Pod

Table 8 reveals significant differences in terms of average number of seeds per pod. ICCV 93954 variety had the highest number of seeds per pod. It was closely followed by variety ICCV 93952. ICCV 94954, ICCV 2 and ICCV 95332 had lesser number of seeds per pod with means of 1.092, 1.147 and 1.210, respectively.

Table 7. Percentage (%) pod setting

VARIETY	MEAN
Desi Type	
ICCV 93952	53.18[b]
ICCV 93954	57.82[b]
ICCV 94954	60.17[ab]
Kabuli Type	
ICCV 2	70.55 [a]
ICCV 95332	70.22 [a]

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

Table 8. Average number of seeds per pod

VARIETY	MEAN
Desi Type	
ICCV 93952	1.483[ab]
ICCV 93954	1.800[a]
ICCV 94954	1.210[b]
Kabuli Type	
ICCV 2	1.147[b]
ICCV 95332	1.092[b]

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

This was attributed to the fact that desi type (ICCV 93954) had greater number of seeds per pod containing two seeds while the other type and varieties had one seed per pod. These results corroborate with the statement of Liu et. at (2003) that the number of seeds per pod is negatively. It seems that a genetic factor is responsible for the number of fewer seed formed in a pod. Large seeded kabuli cultivars produce fewer seeds per pod, whereas small seeded cultivars produced more usually two seeds.

Average Weight of Pods Produced Per Plant

There were no significant differences on the average weight of pods produced per plant (Table 9). Numerically, the variety ICCV 93952 had the heaviest weight of pods produced per plant followed by the variety ICCV 93954, ICCV 94954, and ICCV 2 while ICCV 93952 had the lightest weight of pods produced.

It was observed that ICCV 95332 (Kabuli type) had bigger sizes of pods which might have contributed to its heaviest weight of pods while ICCV 93952 (Desi type) had smaller sizes of pods.

Average Yield Per Plant

There were no significant statistical differences among the five varieties of chickpea in relation to average yield per plant as shown in Table 10. Numerically, however the variety ICCV 95332 had the highest yield per plant followed by the variety ICCV 93954, ICCV 94954 and ICCV 2 while variety ICCV 93952 attained the lowest yield per plant.

Table 9. Average weight of pods produced per plant

VARIETY	MEAN
Desi Type	
ICCV 93952	25.86 [a]
ICCV 93954	30.013 [a]
ICCV 94954	29.443 [a]
Kabuli Type	
ICCV 2	28.161 [a]
ICCV 95332	34.455 [a]

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

Table 10. Average yield per plant

VARIETY	MEAN
Desi Type	
ICCV 93952	14.74[a]
ICCV 93954	17.15[a]
ICCV 94954	15.61[a]
Kabuli Type	
ICCV 2	14.83 [a]
ICCV 95332	19.21[a]

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

Total Yield per Plot and Total Yield per Hectare

The total yield per hectare follows the trend of total yield per plot where ICCV 95332 had the highest computed yield. This was followed by ICCV 94954, ICCV 93954, ICCV 2 and ICCV 93952 which produced the lowest yield (Table 11). The lowest yield of these varieties was due to rotting of seeds due to excessive rains and was infected with wet root rot, chickpea stunt and collar rot diseases.

Result show that ICCV 95332 is high yielding variety based on the computed yield per plot and per hectare of the different varieties grown under Naguey, Atok, Benguet condition. The high yield of ICCV 95332 is due to higher 1000-seed weight and bigger seed size, thus increase in seed weight and seed size.

The result also supports the statement of Edmund and Andrews (1957) that varieties differ in their productivity. This is an expression of their genetic memory to respond to various environments. The variety best adaptable to the environment reflects the high yield potential according to Villareal (1969). Moreover, Reily and Shry (1991), reported that variety must be adopted to the area in which it is grown. Different varieties which were grown under the same method have a great variation in the yielding potential. A variety that yields well in one region is not guarantee that it can perform well in another regions.

Table 11. Total yield per plot and total yield per hectare

VARIETY	TOTAL YIELD PER PLOT	TOTAL YIELD PER HECTARE
Desi Type		
ICCV 93952	0.436 b	219.250[b]
ICCV 93954	0.574 b	287.025[b]
ICCV 94954	0.614 b	306.888[b]
Kabuli Type		
ICCV 2	0.555 b	277.638[b]
ICCV 95332	1.061 a	530.663[b]

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

Weight of 1000 Seeds

Table 12 shows the weight of 1000 seeds. ICCV 95332 produced the heaviest weight of 1000 with a mean of 383.33g followed by ICCV 94954. On the other hand, ICCV 93952, ICCV 93954 and ICCV 2 produced the lightest weight of 1000 seeds.

The differences in weight of 1000 seeds are attributed to the differences in varietals characteristics such as sizes. ICCV 95332 had bigger sizes of seeds which might have contributed to its weight. The difference could also be influenced by the genetic and environmental factors according to Villareal (1969). Moreover, Lorenz and Maynard (1988) emphasized that the harvested products must have characteristics desired by the packer, shipper, retailer and consumer. Included among these qualities were size, shape, color, flavor and nutritional qualities.

Table 12. Weight of 1000 seeds

VARIETY	MEAN
Desi Type	
ICCV 93952	241.67[c]
ICCV 93954	235.06[c]
ICCV 94954	283.33[b]
Kabuli Type	
ICCV 2	221.67[c]
ICCV 95332	383.33 [a]

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

Average Seed Diameter

The widest seed diameter was significantly measured from ICCV 95332 followed by ICCV 94954 which did not differ from ICCV 93952 and ICCV 93954. The smallest seed diameter was measured from ICCV 2.

This result shows that the different chickpea varieties evaluated had varied varietal characteristics in terms of seed diameter. Result show that the seed diameter is related to the size and weight of 1000 seed weight. The differences in seed diameter reflect the varietal characteristics and genetic make-up (Bautista et., al, 1983).

Table 13. Average seed diameter

VARIETY	MEAN
Desi Type	
ICCV 93952	0.665[bc]
ICCV 93954	0.675[bc]
ICCV 94954	0.700[b]
Kabuli Type	
ICCV 2	0.645[c]
ICCV 95332	0.760 [a]

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

Germination Test

Petri dish. There were no significant differences among the five entries of chickpea tested in relation to germination test done in Petri dish as shown in Table 14. Numerically variety ICCV 94954 seems to have the best percentage of emergence followed by the varieties ICCV 93954, ICCV 2 and ICCV 95332 while variety ICCV 93954 appears to have the least performance. Nevertheless, the result show that all the varieties could survive under the conditions in Naguey, Atok, Benguet.

Ragdoll method. All the five varieties of chickpea entries planted in Naguey, Atok, Benguet had no significant differences in the germination test done in ragdoll method.

Table 14. Germination test

VARIETY	PETRI DISH	RAGDOLL METHOD
Desi Type		
ICCV 93952	50.67 [a]	90.33 [a]
ICCV 93954	38.67 [a]	81.33 [a]
ICCV 94954	61.33 [a]	87.33 [a]
Kabuli Type		
ICCV 2	49.33 [a]	93.33 [a]
ICCV 95332	43.33 [a]	86.67 [a]

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

However, the variety ICCV 2 had the highest percentage of emergence with a mean of 93.33 followed by the varieties ICCV 93952, ICCV 94954 and ICCV 95332 while ICCV 93954 had the lowest percentage of emergence. It is very evident, as shown by the result, that all the varieties evaluated could adopt under Naguey, Atok, Benguet condition.

The differences in the germination test done in Petri dish and ragdoll method is that in ragdoll method, the whole seeds were completely wrapped with a moist cheese cloth providing sufficient moisture to be absorbed by the seed during germination while in the Petri dish, only one side of the seed absorbs water resulting to lower germination.

Varietal Characteristics

This was obtained by recording the characteristics of each variety in terms of leaf shape, leaf color, color of flower and pod, seed color, shape and size.

Leaf characteristics. The desi type (Table 15) which are ICCV 93952, ICCV 93954, ICCV 94954 have small rounded leaflets and has green color which is like a fern leaf while the kabuli type which are ICCV 2 and ICCV 95332 have oblong leaflets which is light green and dark green.

Flower characteristics. In Table 16, the flowers of desi type are violet while the kabuli type is white. All the pods of the chickpea varieties are yellow at harvesting stage.

Seed characteristics. Desi type has brown seeds which are angular in shape and are small to medium (Table 17). The kabuli type had cream seeds, owl's head shape and are big to medium in size.

Table 15. Leaf characteristics of the different varieties of chickpea

TREATMENT	LEAF SHAPE	LEAF COLOR
Desi Type		
ICCV 93952	Small rounded	Green, "fern leaf"
ICCV 93954	Small rounded	Green, "fern leaf"
ICCV 94954	Small rounded	Green, "fern leaf"
Kabuli Type		
ICCV 2	Oblong leaflets	Light green
ICCV 95332	Oblong leaflets	Dark green

Table 16. Flower characteristics of the different varieties of chickpea

TREATMENT	FLOWER COLOR	COLOR OF POD AT 1ST HARVESTING STAGE
Desi Type		
ICCV 93952	Purple or violet	Yellow
ICCV 93954	Purple or violet	Yellow
ICCV 94954	Purple or violet	Yellow
Kabuli Type		
ICCV 2	White	Yellow
ICCV 95332	White	Yellow

Table 17. Seed characteristics of the different varieties of chickpea

TREATMENT	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

Pests and Diseases

All of the varieties of chickpea tested were attacked by cutworm during the vegetative stage and during the reproductive stage, it was infested by pod borer.

On the other hand, collar rot, chickpea stunt, and wet root rot were the diseases which infected the chickpea during the cropping season.

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
Collar rot	*Sclerotium isolfsii sacc*
Chickpea stunt	Bean (pea) leaf roll virus
Wet root rot	*Rhizotonia solani*

Correlation Regression analysis

Figure 8 shows that total seed yield is positively correlated with 1000-seed weight and seed size.

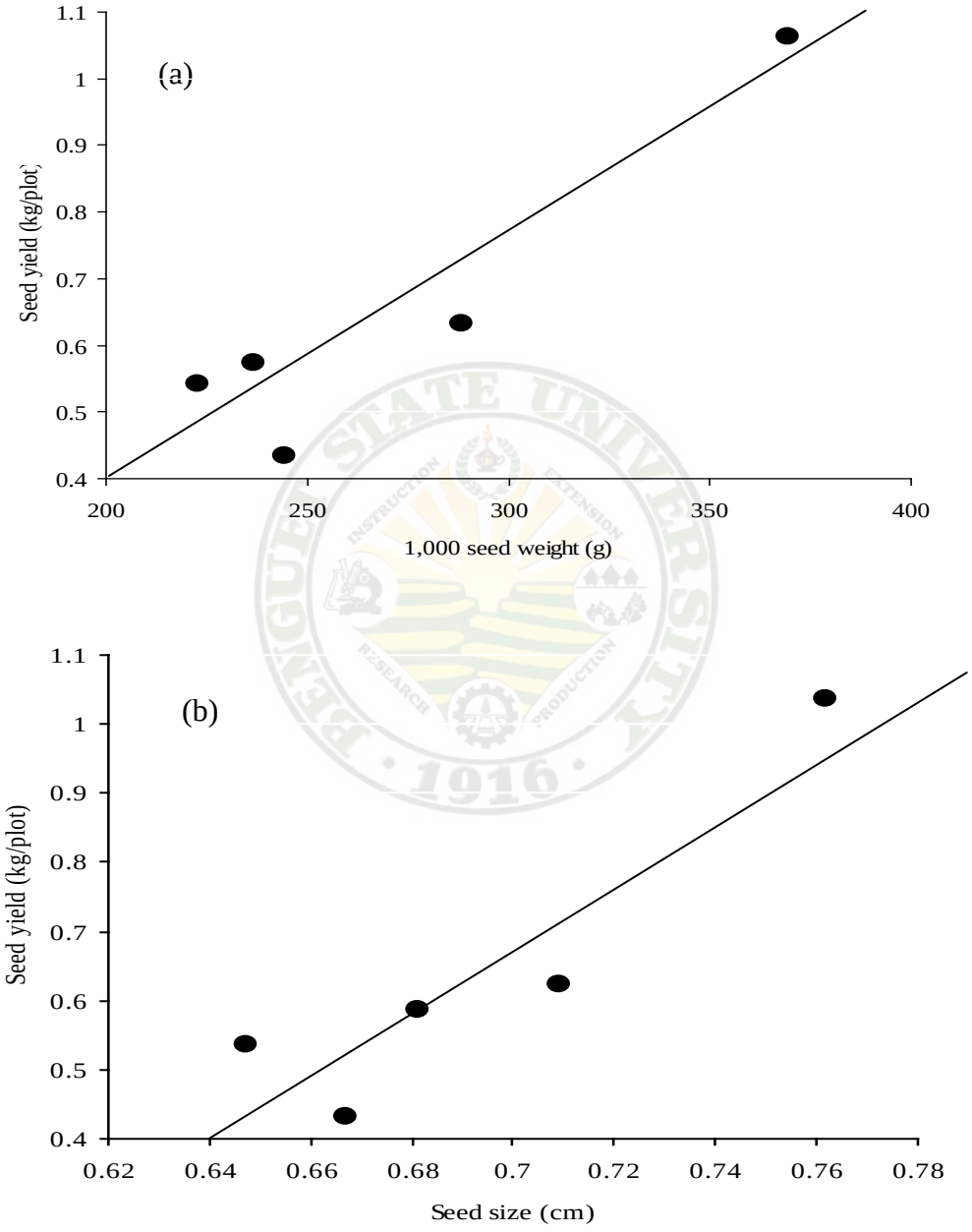

Figure 8. Correlation and regression analysis between seed yield and 1000-seed weight (a) and seed sized (b)

Meteorological Data

Figure 9 shows the temperature during the conduct of the study. The temperature ranges from 14 to 29 ^{O}C during the months of December 2007 to March 2008.

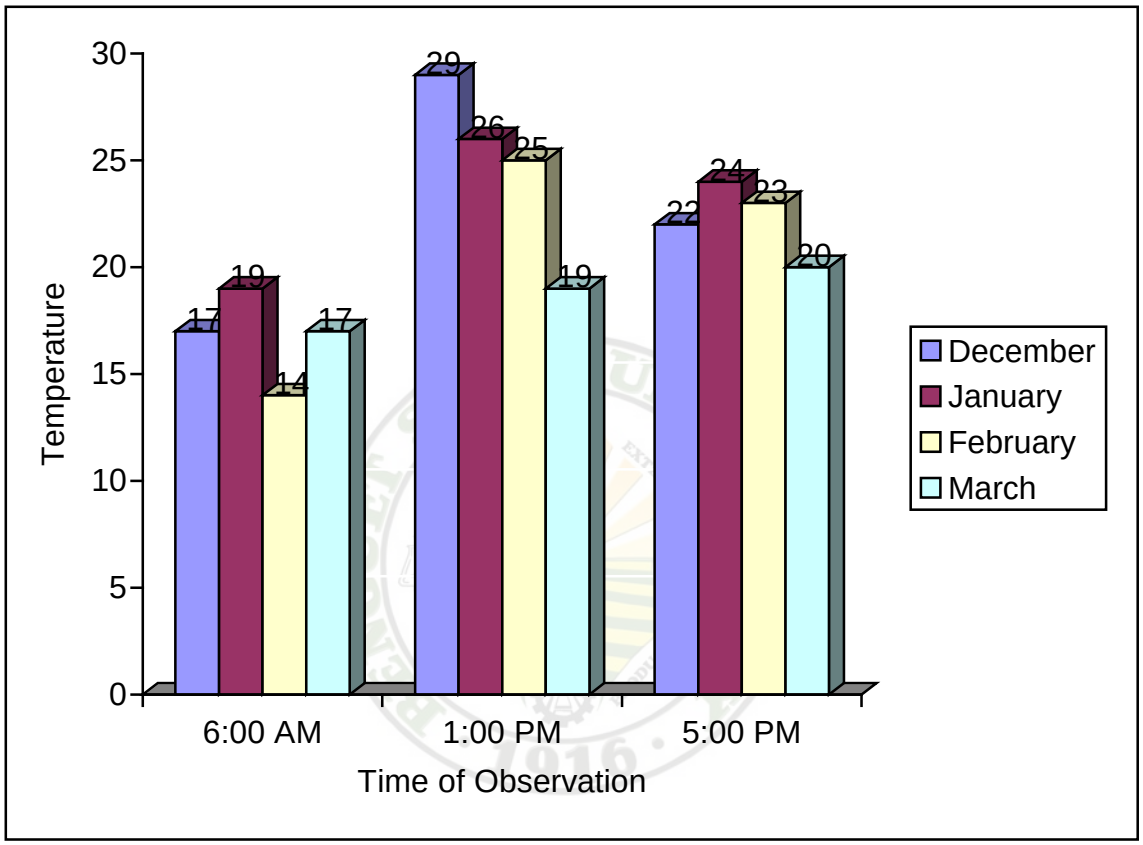

Figure 9. Temperature during the conduct of the study

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The experiment was conducted at Naguey, Atok, Benguet from November 2007 to March 2008 to introduce and promote chickpea production in Benguet province specifically in Naguey, Atok, Benguet to determine the growth and yield of chickpea under Naguey, Atok, Benguet condition; and to select chickpea varieties that could be profitability grown under Naguey, Atok, Benguet.

Result of the study revealed that the different chickpea cultivars significantly vary in terms of emergence percentage where in ICCV 2, ICCV 93954, ICCV 93952 and ICCV 94954 produced the highest emergence percentage while ICCV 95332 obtained the lowest emergence percentage.

In the days from planting to flowering, ICCV 2 was the earliest to produced flowers after 31.95 days while ICCV93952 were the latest to flower among the cultivars after 50.99 days. The rest of the varieties required 42.71 to 48.48 days from planting to flowering. As to number of days to first harvest, ICCV2 significantly reach maturity earlier over the other varieties. Results showed that the earliest to initiate flowers were the first to have pod harvest.

All the cultivars evaluated had comparable average height at flowering although ICCV93952 numerically were the tallest in terms of height while ICCV2 were the shortest. In the average number of lateral branches, ICCV 95332 attained the highest number of lateral branches with a mean of 4.08 which was followed by ICCV 94954 (4.01), ICCV 2, ICCV 93952 and ICCV 93954 (3.48 – 2.98) respectively.

ICCV 94954 and ICCV 95332 had the most number of harvest while ICCV 2 had the least. In the percentage pod setting ICCV 2 and ICCV 95332 had the highest percentage with a mean of 70.55 and 70.22 while the lowest was ICCV 93952.

As to average number of seeds per pod, ICCV 93954 produced the most number of seeds per pod while ICCV 94954 and ICCV 95332 had lesser number of seeds per pod.

In terms of yield ICCV 95332 produced the heaviest average weight of pods produced per plant (34.455g) while ICCV 93952 had the highest weight of pods produced. In the average yield per plant, ICCV 95332 attained the highest while ICCV 93952 obtained the lowest yield per plant. The total yield per plot and total yield per hectare showed that ICCV 95332 significantly out yielded the rest of the cultivars tested with a mean of 1.061 kg per plot and 530.663 kg per hectare. The remaining varieties had lower yield ranging from 0.436 to 0.614 kg per plot or 219.250 to 306.888 kg per hectare.

As to weight of 1000 seeds, heavier weight of seeds was produced by ICCV 95332. The lightest weight of seeds was produced by ICCV 2. In terms of seed diameter, bigger seed size was measured from ICCV 95332 while the smallest seed was measured from ICCV 2.

In terms of germination test done in petri dish and ragdoll method ICCV 94954 attained the highest percentage of germination in petri dish while ICCV 2 in ragdoll method. ICCV 93954 obtained the lowest percentage of germination.

Conclusion

Based on the result presented and discussed, the variety ICCV 95332 out yielded the rest of the varieties evaluated. It had the highest total yield per plot and total yield per hectare.

Recommendation

From the preceding result and discussion, it is recommended that the variety ICCV 95332 will be the first priority chickpea variety under Naguey, Atok, Benguet condition due to their higher yield per plot and per hectare that out yielded the variety ICCV 93952, ICCV 93954, ICCV 94954 and ICCV 2. It is also recommended that the results of this study should be verified in other warm vegetable growing areas in the Cordillera.

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APPENDICES

APPENDIX TABLE 1. Emergence percentage (%)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
Desi Type						
ICCV 93952	99.40	97.00	98.76	93.62	388.78	97.20
ICCV 93954	99.66	97.82	98.10	94.97	390.55	97.64
ICCV 94954	99.71	94.74	98.57	84.47	377.49	94.37
Kabuli Type						
ICCV 2	100.00	99.69	98.95	100.00	398.64	99.66
ICCV 95332	70.88	94.53	78.21	70.81	314.43	78.61
TOTAL	469.65	483.78	472.59	443.87	1869.89	93.49

ANOVA TABLE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY 0.05	0.01
Treatment	4	1165.0608	291.2652	9.20**	3.26	5.41
Replication	3	170.7886	56.9295			
Error	12	380.0325	31.6694			
Total	19	1715.8819				

**- highly significant coefficient of variation – 6.02%

APPENDIX TABLE 2. Days from planting to flowering

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
Desi Type						
ICCV 93952	45.40	57.60	49.70	51.25	203.95	50.99
ICCV 93954	42.95	49.50	47.25	44.35	184.05	46.01
ICCV 94954	44.90	47.40	46.15	55.45	193.90	48.48
Kabuli Type						
ICCV 2	32.15	34.15	31.15	30.35	127.80	31.95
ICCV 95332	43.35	47.75	42.90	36.85	170.85	42.71
TOTAL	208.75	236.40	217.15	218.25	880.55	44.03

ANOVA TABLE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY 0.05	0.01
Treatment	4	879.0293	219.7573	16.75**	3.26	5.41
Replication	3	81.3264	27.1088			
Error	12	157.4417	13.1201			
Total	19	1117.7974				

**- highly significant coefficient of variation – 8.23%

APPENDIX TABLE 3. Average height at flowering (cm)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
Desi Type						
ICCV 93952	31.45	41.05	33.95	32.25	138.70	34.68
ICCV 93954	28.85	34.10	31.20	25.30	119.45	29.86
ICCV 94954	26.75	35.50	28.25	33.90	124.40	31.10
Kabuli Type						
ICCV 2	29.55	30.50	25.70	30.25	116.00	29.00
ICCV 95332	31.45	34.20	29.40	30.00	125.05	31.26
TOTAL	148.05	175.35	148.50	151.70	623.60	31.18

ANOVA TABLE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY 0.05	0.01
Treatment	4	74.8658	18.7164	2.82^{ns}	3.26	5.41
Replication	3	102.4650	34.1550			
Error	12	79.5462	6.6289			
Total	19	256.8770				

ns - not significant coefficient of variation – 8.26%

APPENDIX TABLE 4. Days from planting to first harvest

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
Desi Type						
ICCV 93952	91	100	100	92	383	95.75
ICCV 93954	91	94	94	92	371	92.75
ICCV 94954	91	94	94	92	371	92.75
Kabuli Type						
ICCV 2	85	85	85	85	350	85.00
ICCV 95332	94	94	94	94	376	94.00
TOTAL	452	467	467	455	1841	92.55

ANOVA TABLE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY 0.05	0.01
Treatment	4	272.7	68.175	16.7301**	3.26	5.41
Replication	3	37.35	12.45			
Error	12	48.9	4.075			
Total	19	358.95				

**- highly significant coefficient of variation – 2.24%

APPENDIX TABLE 5. Average number of lateral branches

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
Desi Type						
ICCV 93952	3.75	3.25	2.90	3.25	13.15	3.29
ICCV 93954	3.10	3.55	2.65	2.60	11.90	2.98
ICCV 94954	3.20	5.05	3.15	4.65	16.05	4.01
Kabuli Type						
ICCV 2	3.20	3.85	3.00	3.85	13.90	3.48
ICCV 95332	3.60	6.75	2.95	3.00	16.30	4.08
TOTAL	16.85	22.45	14.65	17.35	71.30	3.57

ANOVA TABLE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY 0.05	0.01
Treatment	4	3.5743	0.8936	1.39^{ns}	3.26	5.41
Replication	3	6.5295	2.1765			
Error	12	7.7017	0.6418			
Total	19	17.8055				

ns- not significant coefficient of variation – 22.47%

APPENDIX TABLE 6. Total number of harvest

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
Desi Type						
ICCV 93952	4	3	4	4	15	3.75
ICCV 93954	4	3	4	4	15	3.75
ICCV 94954	4	4	4	4	16	4.00
Kabuli Type						
ICCV 2	1	4	4	4	13	3.25
ICCV 95332	4	4	4	4	16	4.00
TOTAL	17	18	20	20	75	3.75

ANOVA TABLE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY 0.05	0.01
Treatment	4	1.5000	0.3750	0.65^{ns}	3.26	5.41
Replication	3	1.3500	0.4500			
Error	12	6.9000	0.5750			
Total	19	9.7500				

ns- not significant coefficient of variation – 20.22%

APPENDIX TABLE 7. Percentage pod setting (%)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
Desi Type						
ICCV 93952	53.07	48.64	48.93	62.07	212.71	53.18
ICCV 93954	53.90	56.08	57.55	63.75	231.28	57.82
ICCV 94954	61.51	55.39	60.03	63.74	240.67	60.17
Kabuli Type						
ICCV 2	62.36	66.51	73.57	79.77	282.21	70.55
ICCV 95332	86.80	59.06	65.46	69.57	280.89	70.22
TOTAL	317.64	285.68	305.54	338.90	1247.76	62.39

ANOVA TABLE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY 0.05	0.01
Treatment	4	954.6760	238.6690	5.61**	3.26	5.41
Replication	3	297.9758	99.3253			
Error	12	510.8313	42.5693			
Total	19	1763.4831				

**- highly significant coefficient of variation – 10.46%

APPENDIX TABLE 8. Average number of seeds per pod

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
Desi Type						
ICCV 93952	1.10	1.36	1.60	1.87	5.93	1.48
ICCV 93954	2.43	1.21	1.77	1.79	7.20	1.80
ICCV 94954	1.03	1.15	1.54	1.12	4.84	1.21
Kabuli Type						
ICCV 2	1.04	1.09	1.43	1.03	4.59	1.15
ICCV 95332	1.02	1.06	1.03	1.26	4.37	1.09
TOTAL	6.62	5.87	7.37	7.07	26.93	6.73

ANOVA TABLE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY 0.05	0.01
Replication	3	0.255	0.085	3.73*	3.26	5.41
Factor A	4	1.388	0.347			
Error	12	1.116	0.093			
Total	19	2.759				

*- significant coefficient of variation – 22.64%

APPENDIX TABLE 9. Average weight of pods produced (g)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
Desi Type						
ICCV 93952	24.325	23.250	28.455	27.425	103.455	25.864
ICCV 93954	26.075	30.845	37.585	25.545	120.050	30.013
ICCV 94954	28.595	30.485	34.080	24.610	117.770	29.443
Kabuli Type						
ICCV 2	24.425	34.025	25.685	28.510	112.645	28.161
ICCV 95332	45.240	25.985	34.425	32.170	137.820	34.455
TOTAL	148.660	144.590	160.230	138.260	591.740	29.59

ANOVA TABLE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY 0.05	0.01
Treatment	4	159.1788	39.7947	1.34^{ns}	3.26	5.41
Replication	3	51.2975	17.0992			
Error	12	355.0927	29.5911			
Total	19	565.5690				

ns- not significant coefficient of variation – 18.39%

APPENDIX TABLE 10. Average yield per plant (g)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
Desi Type						
ICCV 93952	13.03	13.09	14.78	18.07	58.97	14.74
ICCV 93954	16.98	17.96	21.18	12.46	68.58	17.51
ICCV 94954	13.81	16.01	18.28	14.32	62.42	15.61
Kabuli Type						
ICCV 2	12.93	16.69	14.22	15.48	59.32	14.83
ICCV 95332	22.24	18.27	17.47	18.85	76.83	19.21
TOTAL	78.99	82.02	85.93	79.18	326.12	16.31

ANOVA TABLE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY 0.05	0.01
Treatment	4	56.9485	14.2371	2.07^{ns}	3.26	5.41
Replication	3	6.3148	2.1049			
Error	12	82.6229	6.8852			
Total	19	145.8863				

ns- not significant coefficient of variation – 16.09%

APPENDIX TABLE 11. Total yield per plot (kg)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
Desi Type						
ICCV 93952	0.4232	0.4919	0.3044	0.5265	1.746	0.436
ICCV 93954	0.3245	0.9451	0.7489	0.2777	2.296	0.574
ICCV 94954	0.5496	0.7359	0.7972	0.3724	2.455	0.614
Kabuli Type						
ICCV 2	0.4324	0.7005	0.4377	0.6505	2.221	0.555
ICCV 95332	1.1673	0.9934	1.0705	1.0141	4.245	1.061
TOTAL	2.8970	3.8668	3.3587	2.8412	12.963	3.241

ANOVA TABLE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY 0.05	0.01
Replication	3	0.137	0.046	6.95**	3.26	5.41
Factor A	4	0.923	0.231			
Error	12	0.399	0.033			
Total	19	1.459				

**- highly significant coefficient of variation – 28.12%

APPENDIX TABLE 12. Total yield per hectare (kg/ha)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
Desi Type						
ICCV 93952	211.60	245.95	152.20	263.25	877.00	219.250
ICCV 93954	162.25	472.55	374.45	138.85	1148.10	287.025
ICCV 94954	274.80	367.95	398.60	186.20	1227.55	306.888
Kabuli Type						
ICCV 2	216.20	350.25	218.85	325.25	1110.55	277.638
ICCV 95332	583.65	496.70	535.25	507.05	2122.65	530.663
TOTAL	1448.50	1933.40	1679.35	1420.6	6481.85	1621.46

ANOVA TABLE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY 0.05	0.01
Replication	3	33865.369	11288.456	6.88**	3.26	5.41
Factor A	4	229963.982	57490.996			
Error	12	100337.712	8361.476			
Total	19	364167.063				

** - highly significant coefficient of variation – 28.20%

APPENDIX TABLE 13. Weighed of 1000 seeds (g)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Desi Type					
ICCV 93952	250	215	260	725	241.67
ICCV 93954	240	255	210	705	235.00
ICCV 94954	280	315	255	850	283.33
Kabuli Type					
ICCV 2	225	230	210	665	221.67
ICCV 95332	390	400	360	1150	383.33
TOTAL	1385	1415	1295	4095	273.00

ANOVA TABLE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROBABILITY 0.05	0.01
Treatment	4	52023.333	13005.8333	29.67**	3.84	7.01
Replication	2	1560.0000	780.0000			
Error	8	3506.6667	438.333			
Total	14	57090.000				

**- highly significant coefficient of variation – 7.67%

APPENDIX TABLE 14. Average seed diameter (cm)

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
1	0.66	0.66	0.66	0.68	2.66	0.665
2	0.68	0.65	0.69	0.68	2.70	0.675
3	0.64	0.68	0.74	0.74	2.80	0.700
4	0.65	0.65	0.62	0.66	2.58	0.645
5	0.84	0.73	0.76	0.71	3.04	0.760
TOTAL	3.47	3.37	3.47	3.47	13.78	3.445

ANOVA TABLE

SV	DF	SS	MS	Fc	F0.05	F0.01
Replication	3	0.002	0.001	5.37*	3.26	5.41
Factor A	4	0.031	0.008			
Error	12	0.018	0.001			
Total	19	0.051				

*- significant coefficient of variation – 5.56%

APPENDIX TABLE 15. Germination test

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Desi Type					
ICCV 93952	54	40	58	152	50.67
ICCV 93954	58	34	24	116	38.67
ICCV 94954	60	66	58	184	61.33
Kabuli Type					
ICCV 2	52	48	48	148	49.33
ICCV 95332	28	56	46	130	43.33
TOTAL	252	244	234	730	48.67

ANOVA TABLE

SV	DF	DD	MS	F c	F0.05	F0.01
Treatment	4	880.000	220.0000	1.46^{ns}	3.26	5.41
Replication	3	32.53333	16.2667			
Error	12	1204.8000	150.6000			
Total	19	2117.333				

ns- not significant coefficient of variation – 25.22%

APPENDIX TABLE 16. Ragdoll method

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Desi Type					
ICCV 93952	92	85	94	271	90.33
ICCV 93954	92	80	72	244	81.33
ICCV 94954	90	86	86	262	87.33
Kabuli Type					
ICCV 2	96	88	96	280	93.33
ICCV 95332	90	90	80	260	86.67
TOTAL	460	429	428	1317	87.80

ANOVA TABLE

SV	DF	SS	MS	Fc	0.05	0.01
Treatment	4	241.0667	60.2667	2.05^{ns}	3.84	7.01
Replication	3	132.4000	66.2000			
Error	12	234.9333	29.3667			
Total	19	608.4000				

ns- not significant coefficient of variation – 6.02%

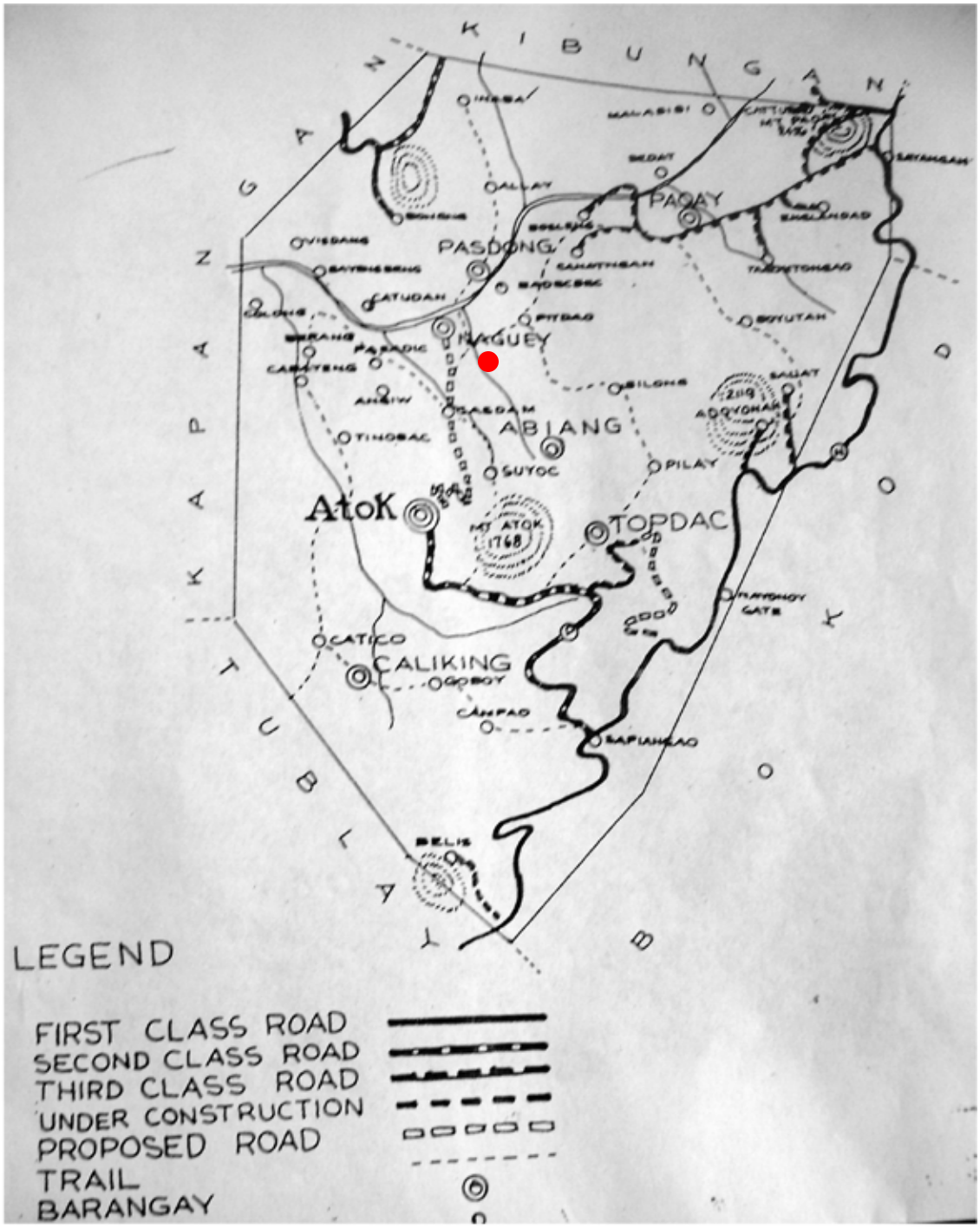

Figure 10. Map of Atok