BIBLIOGRAPHY

DOMINGUEZ, FE A. OCTOBER 2009. Germplasm Collection and Evaluation of Chickpea Accessions Under La Trinidad, Benguet Condition. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted to evaluate and characterize thirty (30) chickpea accessions from International Crops Research for Semi Arid Tropics (ICRISAT) in Benguet specifically at La Trinidad and to identify accessions of chickpea adapted under La Trinidad, Benguet.

Results revealed that Desi Type accessions had significantly higher field emergence percentage than the Kabuli types. ICCV 06108 were significantly the earliest to produce flower compared to the other accessions evaluated. ICCV 06106 (Desi Type) was significantly taller at flowering stage and at final height. Kabuli type ICCV 95334 were the earliest to be harvested after 87 days while ICCV 07115 was the earliest among the Desi Type after 124 days. As to the number of lateral branches produced at flowering, ICCV 07114 produced the most lateral branches while ICCV 07304 produced the least number of lateral branches. There were no significant differences on the total number of harvest.

Desi type ICCV 10 significantly attained the highest number of filled pods with a mean of 237.64/plant while ICCV 92311 a kabuli type had the lowest filled pods with a

mean of 36.40/plant. Desi type ICCV 06102 significantly had the highest number of unfilled pods with a mean of 87.77/plant while Kabuli type ICCV 92311 had the lowest with a mean of 12.40/plant.

Kabuli type ICCV 95334 had the highest mean yield per plant with a mean of 54.30 while Desi type ICCV 07107 had the lowest yield per plant with a mean of 4.30 g.

As to the yield per plot and yield per hectare, ICCV 07307 significantly outyielded all the accessions evaluated. ICCV 06105 had significantly heavier 100 seed weight (36.80) while ICCV 10 had the lowest (13.23) Desi type (ICCV 06102) and Kabuli type (ICCV 2) had the highest percentage germination under laboratory condition.

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INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an ancient crop that has been grown in India, the Middle East and parts of Africa for many years. It has been grown in Turkey nearly 7,400 years ago. Much of the world's chickpea supply (8090%) comes from India where poor soil use of unimproved varieties and low rainfall results in yields averaging about 700 lb/acre (Anonymous, 2007).

Chickpea is a temperature crop. Crop improvement efforts have improved adaptation of chickpea to warmer conditions in the subtropics. The two most common types of chickpea are the white-seeded "Kabuli" and "Desi". The "Kabuli" types are mostly grown in WAHA, the Americas and Europe, while the "Desi" types predominate in Asia, parts of Africa and Australia (Smithson *et al*., 1985).

The plant grows to between 20 and 50 cm high and has small feathery leaves on either side of the stem. One seedpod contains two or three peas. The flowers are white or sometimes reddish-blue. Chickpeas need a subtropical or tropical climate with more than 400 mm of annual rain. They can be grown in a temperate climate but yield will be much lower (Vander Maesen *et al*., 1972).

Chickpea mature in 3-7 months and leaves turn brown or yellow during maturity. For dry seeds, the plants are harvested at maturity by cutting them close to the ground or uprooting. Chickpeas are usually stored in bags, but are more subject to insect damage than when stored in bulk (Anonymous, 2007).

Chickpea is consumed as a dry crop or as green vegetable with the former use being most common. Seeds average about 20% protein, 5% fat and 55% carbohydrate (Anonymous, 2007).

Common uses in United States are in soups, vegetable combinations, or as a component of fresh salads in restaurant salad bars. Some livestock feeding trials have been conducted and these show chickpea to be a good source of protein for feeds, except that the amino acids *methionine* and *cystine* are deficient (Anonymous, 2007).

Many popular Indian dishes are made with chickpea flour, such as *mirchi bajji* and *mirapakaya bajji telugu*. In India, unripe chickpeas are often picked out of the pod and eaten as raw snack and the leaves are eaten as a green vegetable in salads. Chickpea flour is also used to make "Burmese tofu" which was first known among the Shan people of Burma. The flour is also used as a batter to coat various vegetables and meats before frying, such as with panelle, a chickpea fritter from Sicily. In the Philippines, garbanzo beans preserved in syrup are eaten as sweets and in desserts such as for halo-halo(Singh, 1983).

The objectives of the study were:

1. To evaluate and select the chickpea accessions from ICRISAT adapted under La Trinidad, Benguet.

2. To evaluate the resistance of the different chickpea accessions to pests and diseases.

This study was conducted at Benguet State University experimental station, Benguet State University, La Trinidad, Benguet from October 2008 to February 2009.

REVIEW OF LITERATURE

Botany of Chickpea

Taxonomy, morphology and floral biology. Cicer, which was classified under *Vicieae alef*, was later reported to belong to monogeneric tribe, *Cicereae*. The Genus includes nine (9) annuals and thirty four (34) perennial herbs. Cross ability and fertility of hybrids in inter specific crosses have been used as a basis to classify the annuals into 4 cross ability groups. The first group includes the cultivated chickpea (*Cicer arietinum* L.) and *C. reticulatum*. Chickpea plants can be described as "stems are branched, erect, or spreading, sometimes shrubby much branched, 0.2-1 m tall, glandular pubescent with 3-8 pairs of leaflets and a top leaflets; leaflets ovate to elliptic, 0.6-2.0 cm long, 0.3-1.4 cm wide, margin serrate, apex acuminate to aristate, base cuneate, stipules 2-5 toothed, stipules absent.

Kabuli (large seeded 800 seeds/lb) varieties are generally taller than the desi (small-seeded = 1500 seed/lb) varieties.

Flowers (self pollinated) are borne in groups of two or three are ½ to 1 inch long and come in purple, white pink or blue color depending upon variety. Each flower produces a short, pubescent pod which in ¾ to increase long and which appear to be inflated. One or two seeds are present in each pod. The seeds come with either rough or smooth surfaces and can be crème, yellow, brown or green in color.

Climatic Requirements

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

tropics, also at lower altitudes. Chickpea seedlings are even known to survive from snow cover. The drought assistant species withstand the largest temperate amplitudes. Bright sunshine is essential for growth and fertilization of semi and pulses-cloudy weather harms first setting in chickpea. Long duration climbers such as yam beans and velvet beans may tolerate shade and moist conditions (Masen and Somaatjmadja, 1990).

The plant is a winter season crop but severs cold and frost is injurious to it. Forst at the time of flowering, results in the failure of the flowers to develop seeds, or the killing of the seeds inside pod. It is generally grown under rain conditions but gives good returns in irrigated conditions as well. Excessive rains soon after sowing or at flowering and fruiting or hailstorm at ripening cause heavy loss. It is best suited to areas having moderate rainfall of 60-90 centimeter per annum (Singh, 1983).

Chickpea is a cool season annual crop performing optimally in 210 to 270^{o}F day temperatures and 640 to 70^{o}F night temperatures.

They produce good yield in drier conditions because of their deep tap root. Heavier rainfall seasons (over 30 inches annually) show reduced yields due to disease outbreaks and stem lodging problems from the excessive vegetative growth. Areas with a welt distributed rainfall pattern produced the highest yield and quality chickpea seed (Anon., 2007).

Importance of Selecting Varieties

Selection of the variety to be planted is one of the most important decisions the commercial vegetable grower must take each season. Considering the yield performance, the variety has the potential crop at least equivalent to these already grown. It must also perform well under a range of environmental conditions usually encountered on

individual farms, possess excellent resistant against pests, 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.

In addition, 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 because worthless in another condition. Knott (1989) supported this when he started that certain variety of crops do well in one distinct and be worthless in another condition.

Furthermore, Villareal (1969) explained that planting of good seeds are essential to the success as the growing vegetable. Planting vegetable variety except the best variety adapted to the environmental in which it will grow unnecessary limit the potential for the high yield and profits even before the fruit seed is planted.

Harvesting

Chickpeas mature in 3-7 months and the leaves turn yellow/brown during maturity. For dry seeds, the plants are harvested at maturity or slightly earlier by cutting them close to the ground or uprooting. The plants are stacked in the field for a few days to dry and later the crop is threshed by trampling or beating with wooden flais. The chart is separated from the grain by winnowing. Tall cultivars are suitable for mechanized are more subject to insect damage than when stored in bulk. Proper cleaning, drying and aeration are necessary to control seed beetles. A thin coating with vegetable oil can

reduce storage damage. Sometimes baskets, made from twisted rice straw, are used as storage containers.

Field Cultivation

Chickpeas are propagated from seeds. "Seed is broadcast or (more often) drilled in rows 25-60 cm apart, spaced at 10 cm between seeds, at a depth of 2-12 cm with soil well pressed down. Soil is worked into a rough filth, clods broken and field-leveled. Seed is sown in spring when the ground has warmed or when the rains recede depending on the region (Smithson *et al*., 1985). Seedling rates vary from 25-40 kg/ha to 80-120 kg/ha, depending on the area and seed type. Chickpea may be cultivated as a sole crop, or mixed with barley, lathyms (grass pea), linseed, mustard, peas, corn, coffe, safflower, potato, sweet potato, sorghum, or wheat. In rotation is often follows wheat, barley, rice, or tet (Van der Maesen *et al*., 1972). In India, chickpeas are also grown as a catch crop in sugarcane fields and often as a second crop after rice. Although usually considered a dry land crop, develop well on rice lands.

In most areas, chickpeas are inter-cultivated once about 3-4 weeks after sowing; thereafter the crop develops enough shade to smother weeds. In other areas light weeding are recommended. On poor soils, manure or compost is beneficial. Seed inoculation improves yield only for crops grown for the first time or after rice, where *Rhizobium* populations are naturally low or absent. Irrigation at 45 and 75 days after planting is useful (Duke, 1981). Fertilizers or manure have often failed to increase yields substantially because of fixation of P by soils and the accumulation of nutrients in the upper layer of the soil which are often dry.

Soil Requirement

Legume crops can be grown in any type of soil provided water is available. They perform best in soil that is granular, fertile, well drained and relatively free from nematodes and fusarium diseases. Clay loam soil is probably the best type for commercial production. They thrive in moderately acidic soil with a range of 50-60 (PCARRD, 1975).

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 and stem roots.

Seed Preparation and Germination

Seed quality certified chickpea seed should always be used. This seed should be high in germination percentage (over 85%) free from damage and free of weed seeds. Good quality seeds do not need to be treated with an insecticide or fungicide, but if you have had past problems with *Pythium* or *R/zizoctonia* rots in your fields, you may need to treat your seeds prior to planting (Anonymous, 2007).

MATERIALS AND METHODS

Materials

The materials used in the study were seeds of chickpea, garden tools, record book and identifying pegs.

Methods

This study was conducted at La Trinidad, Benguet. Thirty chickpea accessions from ICRISAT was introduced and evaluated. The study was laid out in randomized complete block design (RCBD) with three replications. There were three plots per treatment measuring 1 x 3 m plot. Two furrows were made within the plot at 30 cm apart where the inorganic fertilizer were applied evenly and mixed with the soil before sowing. The seeds were planted singly at a distance of 40 cm between rows and 20 cm between hills. Three sample plants per accession was characterized.

The treatments were as follows:

Chickpea accessions from International Crops Research Institute for semi arid tropics (ICRISAT).

Desi Type	Kabuli Type
T_1 – ICCC 37	T_{16} – ICCV2
T_2 – ICCV 10	T_{17} – ICCV 92311
T_3 – ICCV 93952	T_{18} – ICCV 92337
T_4 – ICCV 93954	T_{19} – ICCV 95311
T_5 – ICCV 94954	T_{20} – ICCV 95332
T_6 – ICCV 06101	T_{21} – ICCV 95333
T_7 – ICCV 06102	T_{22} – ICCV 95334
T_8 – ICCV 06104	T_{23} – ICCV 06301
T_9 – ICCV 06105	T_{24} – ICCV 06306
T_{10} – ICCV 06106	T_{25} – ICCV 07304
T_{11} – ICCV 06107	T_{26} – ICCV 07306
T_{12} – ICCV 06108	T_{27} – ICCV 07307

Desi Type	Kabuli Type
T_{13} – ICCV 07107	T_{28} – ICCV 07309
T_{14} – ICCV 07114	T_{29} – ICCV 07312
T_{15} – ICCV 07115	T_{30} – ICCV 07313

Care and Maintenance

Care and maintenance were done to all samples throughout the duration of the study.

Data Gathered

The data gathered were as follows:

A. Vegetable Growth

1. Field emergence (%). This was recorded 15 days from sowing seeds.

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

2. Days from planting to 50% flowering. This was taken when 50% of the plant population reaches flowering stage.

3. Average height at flowering (cm). This was taken at flowering stage (first flowers).

4. Final height. This was taken at full grown stage (75% pod development).

5. Days from planting to first harvest. This was noted on the first harvest of pods.

6. Mean number of lateral branches at flowering. This was taken at flowering (first flowers).

7. Total number of harvest. This was the total number of harvesting done for one cropping season.

B. Yield

1. Mean number of filled and unfilled pods produced per plant. This was the total number of pods produced by sample plants divided by number of sample plants.

2. Mean yield per plant (g). This was taken using the formula:

$$\text{Mean Yield Per Plant} = \frac{\text{Total Yield of Samples}}{\text{Number of Sample}}$$

3. Total yield per plot (kg). Total yield of the experimental plot.

4. Total yield per hectare (t/ha). Yield of experimental plot (10 m^2) (1000).

C. Seed Quality

1. Weight of 100 seeds (g). This was taken at 10% moisture content.

2. Germination test. This was conducted one month prior to seed storage using the Petri dish method.

D. Incidence of Pests and Diseases

1. Insect pest. Insect that infested 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 will be identified including the degree of infestation.

3. Natural condition biotic stress susceptibility.

E. Meteorological data. Figures 1 to 4 are graphical illustrations of the following data gathered throughout the duration of the study:

1. Temperature (°C)
2. Relative humidity (%)
3. Sunlight duration
4. Rainfall

F. Documentation. Figures 6 to 10 show a documentation of the experimental area from seed set-up to harvesting.

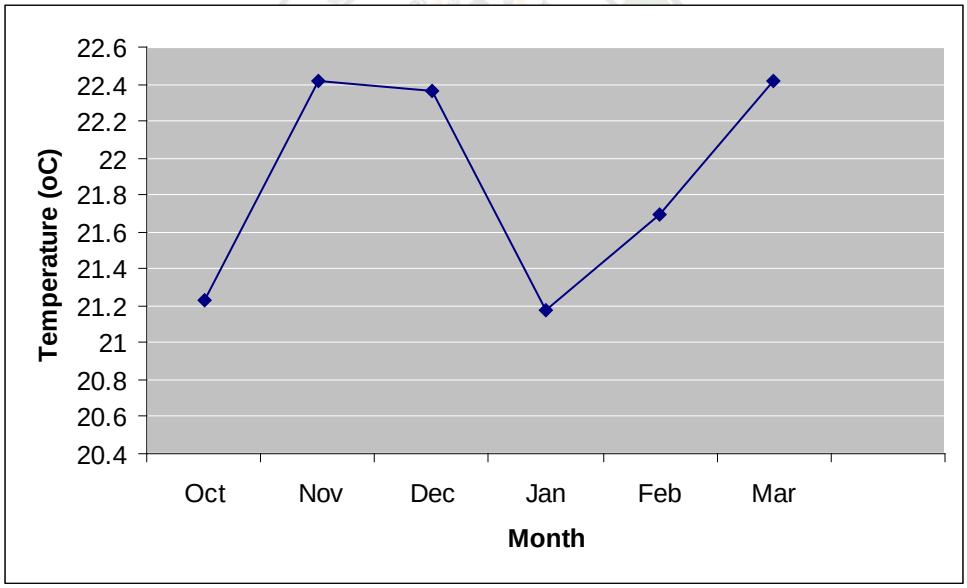

Figure 1. Average temperature (minimum + maximum) (°C)

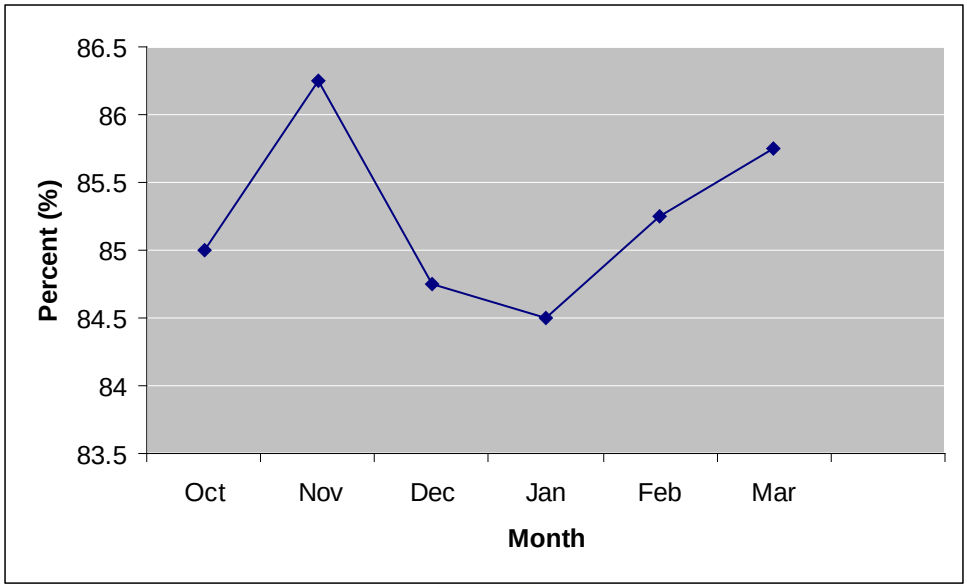

Figure 2. Relative humidity (%)

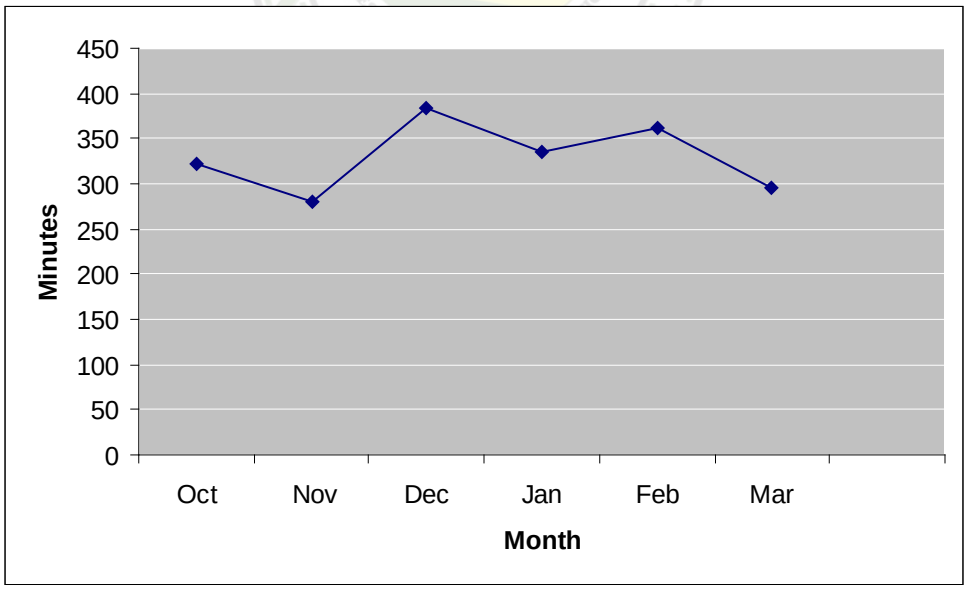

Figure 3. Light duration (min.)

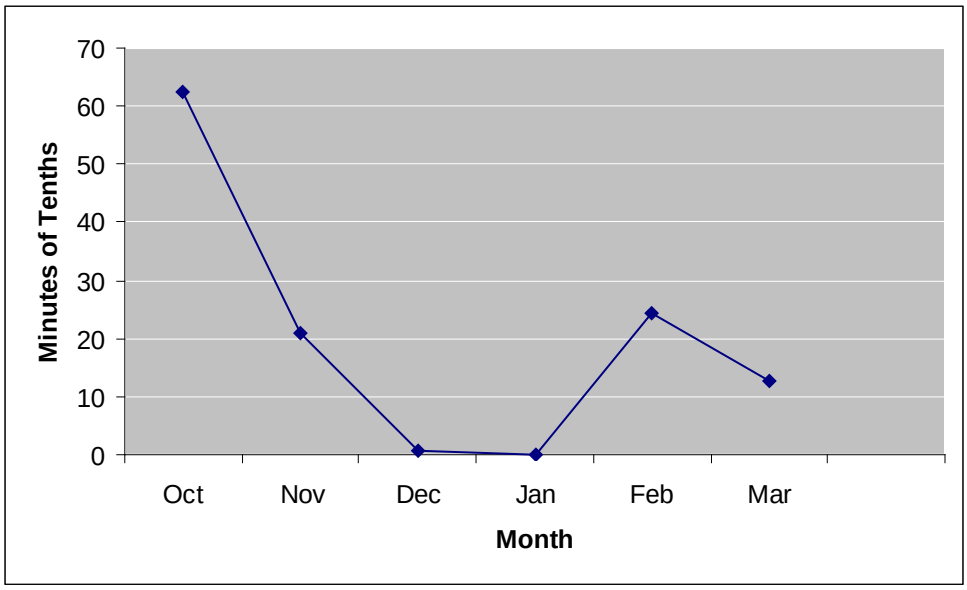

Figure 4. Rainfall (mins. of tenths)

Figure 5. Set-up of the seeds sown

Figure 6. Experimental area

Figure 7. Flowering stage

Figure 8. Pod setting stage

Figure 9. Harvesting stage

RESULTS AND DISCUSSION

Field Emergence

The field emergence as presented in Table 1 showed that there were highly significant differences among the accessions used. Accessions ICCV 06104 and ICCV 94954 (Desi type) had significantly the highest percentage field emergence of 98.26% Kabuli accessions had significantly lower percentage emergence.

Result shows that Desi type accessions had higher percentage field emergence which Kabuli types had generally lower field emergence under La Trinidad, Benguet.

Table 1. Field emergence

TREATMENT	FIELD EMERGENCE (%)	TREATMENT	FIELD EMERGENCE (%)
Desi Type		Kabuli Type	
ICCC 37	89.23[b]	ICCV 2	3.47[f]
ICCV 10	86.15[c]	ICCV 92311	20.13[f]
ICCV 93952	89.23[b]	ICCV 92337	20.88[f]
ICCV 93954	85.28[c]	ICCV 95311	35.56[e]
ICCV 94954	97.57[a]	ICCV 95332	10.67[f]
ICCV 06101	85.54[c]	ICCV 95333	4.51[f]
ICCV 06102	90.62[b]	ICCV 95334	1.38[f]
ICCV 06104	98.26[a]	ICCV 06301	28.13[f]
ICCV 06105	76.90[d`]	ICCV 06306	17.11[f]
ICCV 06106	88.88[c]	ICCV 07304	39.10[e]
ICCV 06107	83.68[c]	ICCV 07306	31.27[e]
ICCV 06108	72.57[d]	ICCV 07307	31.02[e]
ICCV 07107	70.48[d]	ICCV 07309	7.29[f]
ICCV 07114	77.77[d]	ICCV 07312	39.11[e]
ICCV 07115	90.27[b]	ICCV 07313	24.51[f]

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

Days from Planting to 50% Flowering

The number of days from planting to flowering is shown in Table 2. Statistical analysis revealed that there were highly significant differences among the accessions used. Result showed that ICCV 06108 , a Desi type were the earliest to flower after 42.6 days but were comparable with ICCV 92311 while ICCV 95334 a Kabuli type were the latest to flower after 101.3 days.

These results agrees that varietal evaluation is important to observe the performance character such as yield, earliness to flower, vigor, maturity and keeping quality because different variety have wide ranges performance (Work and Carew, 1955).

Table 2. Days from planting to 50% flowering

TREATMENT	DAYS FROM PLANTING TO 50% FLOWERING (cm)	TREATMENT	DAYS FROM PLANTING TO 50% FLOWERING (cm)
Desi Type		Kabuli Type	
ICCC 37	65.0[d]	ICCV 2	58.3[d]
ICCV 10	70.3[c]	ICCV 92311	43.0[f]
ICCV 93952	70.0[e]	ICCV 92337	60.0[d]
ICCV 93954	66.0[d]	ICCV 95311	96.0[b]
ICCV 94954	72.0[c]	ICCV 95332	46.3[f]
ICCV 06101	68.3[c]	ICCV 95333	99.6[b]
ICCV 06102	50.3[e]	ICCV 95334	101.3[a]
ICCV 06104	52.0[e]	ICCV 06301	45.3[f]
ICCV 06105	52.6[e]	ICCV 06306	55.0[d]
ICCV 06106	74.3[c]	ICCV 07304	48.0[e]
ICCV 06107	75.0[c]	ICCV 07306	53.3[e]
ICCV 06108	42.6[f]	ICCV 07307	45.6[f]
ICCV 07107	54.0[e]	ICCV 07309	46.3[f]
ICCV 07114	69.6[c]	ICCV 07312	51.0[e]
ICCV 07115	60.3[d]	ICCV 07313	47.3[f]

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

Average Height at Flowering (cm)

Highly significant differences were obtained on the average height at flowering stage. As shown in Table 3, ICCV 06106, a Desi type was the tallest among the accessions at flowering with a mean of 58.43 cm, while ICCV 06301 was the shortest with a mean of 28.1 cm. Generally, Desi type accession were taller than Kabuli type at flowering stage.

The observed differences among the chickpea accessions indicate their differential adaptability to local conditions as well as their inherent height potential (Anonymous, 2007).

Table 3. Average height at flowering (cm)

TREATMENT	AVE. HEIGHT AT FLOWERING (cm)	TREATMENT	AVE. HEIGHT AT FLOWERING (cm)
Desi Type		Kabuli Type	
ICCC 37	49.72[c]	ICCV 2	44.40[c]
ICCV 10	39.52[d]	ICCV 92311	32.30[d]
ICCV 93952	45.64[c]	ICCV 92337	37.90[d]
ICCV 93954	40.96[c]	ICCV 95311	39.30[d]
ICCV 94954	51.96[b]	ICCV 95332	34.40[d]
ICCV 06101	52.50[d]	ICCV 95333	45.86[c]
ICCV 06102	45.30[c]	ICCV 95334	37.66[d]
ICCV 06104	37.43[d]	ICCV 06301	28.10[d]
ICCV 06105	45.30[c]	ICCV 06306	36.43[d]
ICCV 06106	58.43[a]	ICCV 07304	31.73[d]
ICCV 06107	54.86[b]	ICCV 07306	34.06[d]
ICCV 06108	57.20[a]	ICCV 07307	33.53[d]
ICCV 07107	34.53[d]	ICCV 07309	35.20[d]
ICCV 07114	51.96[b]	ICCV 07312	54.73[b]
ICCV 07115	56.06[a]	ICCV 07313	36.50[d]

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

Final Height

The final height is presented in Table 4. Among the accessions used, ICCV 07312 (Kabuli type) was significantly the tallest while ICCV 37 (Desi type) which was the shortest. It was further observed that Kabuli type were taller than Desi type as regards final height.

Dahiya and Lather (1990) suggested that a compact plant type with erect growth habit and short internodes could help resist excessive growth in high input conditions.

Table 4. Final height

TREATMENT	FINAL HEIGHT (cm)	TREATMENT	FINAL HEIGHT (cm)
Desi Type		Kabuli Type	
ICCC 37	64.66[d]	ICCV 2	80.67[c]
ICCV 10	72.77[d]	ICCV 92311	93.22[b]
ICCV 93952	72.33[d]	ICCV 92337	90.22[b]
ICCV 93954	77.32[d]	ICCV 95311	76.33[d]
ICCV 94954	75.33[d]	ICCV 95332	85.77[c]
ICCV 06101	76.77[d]	ICCV 95333	75.55[d]
ICCV 06102	77.00[d]	ICCV 95334	77.78[d]
ICCV 06104	76.66[d]	ICCV 06301	80.22[d]
ICCV 06105	82.33[d]	ICCV 06306	94.55[b]
ICCV 06106	90.00[b]	ICCV 07304	85.11[c]
ICCV 06107	84.33[c]	ICCV 07306	79.55[c]
ICCV 06108	81.00[d]	ICCV 07307	81.89[c]
ICCV 07107	78.00[d]	ICCV 07309	70.11[d]
ICCV 07114	79.44[c]	ICCV 07312	102.44[d]
ICCV 07115	82.55[c]	ICCV 07313	93.78[b]

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

Days from Planting to First Harvest

As presented in Table 5, ICCV 95334 a Kabuli type was the earliest to mature and reach harvesting stage after 87 days which differed significantly from the other accessions used. Results showed that generally, Desi type accessions are late maturing which can be harvested ranging from 124 to 129 days compared to Kabuli type accessions which had shorter days from planting to first harvest which ranges from 122 to 124 days.

Bautista *et al* (1985) pointed out that each variety contains a set of genetic make up which determines the earliness of maturity and attributed to the varietal characteristics of the different cultivars.

Table 5. Days from planting to first harvest

TREATMENT	DAYS FROM PLANTING TO FIRST HARVEST	TREATMENT	DAYS FROM PLANTING TO FIRST HARVEST
Desi Type		Kabuli Type	
ICCC 37	129.00[a]	ICCV 2	124[e]
ICCV 10	129.00[a]	ICCV 92311	124[e]
ICCV 93952	129.00[a]	ICCV 92337	124[e]
ICCV 93954	128.00[b]	ICCV 95311	124[e]
ICCV 94954	128.00[b]	ICCV 95332	124[e]
ICCV 06101	127.00[c]	ICCV 95333	123[f]
ICCV 06102	127.00[c]	ICCV 95334	87[h]
ICCV 06104	127.00[c]	ICCV 06301	123[f]
ICCV 06105	127.00[c]	ICCV 06306	123[f]
ICCV 06106	126.66[d]	ICCV 07304	123[f]
ICCV 06107	126.00[d]	ICCV 07306	123[f]
ICCV 06108	126.00[d]	ICCV 07307	123[f]
ICCV 07107	126.00[d]	ICCV 07309	122[g]
ICCV 07114	126.00[d]	ICCV 07312	122[g]
ICCV 07115	124.00[e]	ICCV 07313	122[g]

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

Mean Number of Lateral Branches at Flowering

There were significant differences on the average number of lateral branches at flowering as presented in Table 6. Results showed that ICCV 07114 accession produced higher number of branches with a mean of 2.44 but were comparable to ICCV 10, ICCV 07309, ICCV 06105, ICCV 06106, ICCV 2, ICCV 06306 and ICCV 93952 with a mean of 2.33, 2.22, 2.11 and 2.00, respectively. Kabuli type ICCV 07304 obtained the lowest number of lateral branches with a mean of 1.11 followed by ICCV 95333, ICCV 07307, ICCV 07312, ICCV 94954, ICCV 95334 and ICCV 07115 with a mean of 1.22, 1.33 and 1.44.

It was shown in the table that almost all the accessions has the same number of lateral branches produced which ranges from 1.11 to 2.44.

Table 6. Mean number of lateral branches at flowering

TREATMENT	NO. OF LATERAL BRANCHES AT FLOWERING	TREATMENT	NO. OF LATERAL BRANCHES AT FLOWERING
Desi Type		Kabuli Type	
ICCC 37	1.77[c]	ICCV 2	2.11[b]
ICCV 10	2.33[a]	ICCV 92311	1.89[c]
ICCV 93952	2.00[b]	ICCV 92337	1.66[d]
ICCV 93954	1.55[d]	ICCV 95311	1.77[c]
ICCV 94954	1.33[d]	ICCV 95332	1.66[d]
ICCV 06101	1.78[c]	ICCV 95333	1.22[d]
ICCV 06102	1.78[c]	ICCV 95334	1.33[d]
ICCV 06104	1.89[c]	ICCV 06301	1.78[c]
ICCV 06105	2.11[b]	ICCV 06306	2.11[b]
ICCV 06106	2.11[b]	ICCV 07304	1.11[d]
ICCV 06107	1.89[c]	ICCV 07306	1.66[d]
ICCV 06108	1.55[d]	ICCV 07307	1.22[d]
ICCV 07107	1.55[d]	ICCV 07309	2.22[a]
ICCV 07114	2.44[a]	ICCV 07312	1.33[d]
ICCV 07115	1.44[d]	ICCV 07313	1.99[b]

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

Total Number of Harvest or Picking

Table 7 showed that there were no significant differences on the total number of harvest indicating that all the accessions evaluated had similar number of harvest/picking. Results showed that the number of pickings ranges from 1.33 to 2.33.

The number of picking/harvest was generally affected by rainfall, pests and diseases that attacked or affect the crops.

Table 7. Total number of harvest or picking

TREATMENT	NO. OF HARVEST OR PICKING	TREATMENT	NO. OF HARVEST OR PICKING
Desi Type		Kabuli Type	
ICCC 37	2.00[a]	ICCV 2	2.00[a]
ICCV 10	2.00[a]	ICCV 92311	2.00[a]
ICCV 93952	2.00[a]	ICCV 92337	1.67[a]
ICCV 93954	2.00[a]	ICCV 95311	2.00[a]
ICCV 94954	2.00[a]	ICCV 95332	2.00[a]
ICCV 06101	2.00[a]	ICCV 95333	2.00[a]
ICCV 06102	2.00[a]	ICCV 95334	2.33[a]
ICCV 06104	2.00[a]	ICCV 06301	2.33[a]
ICCV 06105	2.00[a]	ICCV 06306	2.33[a]
ICCV 06106	1.33[a]	ICCV 07304	2.33[a]
ICCV 06107	2.00[a]	ICCV 07306	2.00[a]
ICCV 06108	2.00[a]	ICCV 07307	2.00[a]
ICCV 07107	2.00[a]	ICCV 07309	2.00[a]
ICCV 07114	2.00[a]	ICCV 07312	2.00[a]
ICCV 07115	2.00[a]	ICCV 07313	2.00[a]

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

Number of Filled and Unfilled Pods Produced Per Plant

The mean number of filled and unfilled pods produced per plant was shown in Table 8. There were significant differences among the accessions evaluated. Desi type ICCV 10 attained the highest number of filled pods with a mean of 260.73 followed by ICCC 37, ICCV 06104, ICCV 06102 and ICCV 93952 with a mean of 237.64, 236.73, 231.83 and 228.53, respectively. The lowest filled pods was obtained from Kabuli type ICCV 07107 with a mean of 29.40 but were comparable to Desi type ICCV 07313 and ICCV 95334 with a mean of 36.40 and 37.80.

Table 8. Mean number of filled and unfilled pod produced per plant

TREATMENT	NUMBER OF		TREATMENT	NUMBER OF	
	Filled	Unfilled		Filled	Unfilled
Desi Type			Kabuli Type		
ICCC 37	237.64^{ab}	37.64^{c}	ICCV 2	121.33^{e}	45.77^{c}
ICCV 10	260.73^{a}	47.10^{c}	ICCV 92311	99.30^{e}	12.40^{f}
ICCV 93952	228.53^{b}	63.32^{b}	ICCV 92337	89.07^{e}	12.63^{f}
ICCV 93954	203.83^{b}	18.20^{c}	ICCV 95311	66.07^{e}	17.30^{e}
ICCV 94954	90.17^{e}	45.87^{c}	ICCV 95332	122.73^{e}	27.45^{d}
ICCV 06101	105.93^{e}	56.87^{c}	ICCV 95333	125.20^{e}	14.43^{e}
ICCV 06102	231.83^{b}	87.77^{a}	ICCV 95334	37.80^{e}	14.00^{f}
ICCV 06104	236.73^{ab}	29.10^{d}	ICCV 06301	142.43^{d}	40.40^{c}
ICCV 06105	65.30^{e}	24.58^{d}	ICCV 06306	145.63^{d}	28.30^{d}
ICCV 06106	49.87^{e}	32.77^{d}	ICCV 07304	150.07^{d}	22.30^{e}
ICCV 06107	105.65^{e}	27.10^{d}	ICCV 07306	76.20^{e}	47.50^{c}
ICCV 06108	164.20^{d}	32.20^{d}	ICCV 07307	132.77^{d}	20.30^{e}
ICCV 07107	29.40^{e}	27.97^{d}	ICCV 07309	105.77^{e}	20.50^{e}
ICCV 07114	187.50^{c}	68.60^{b}	ICCV 07312	77.07^{e}	42.83^{c}
ICCV 07115	148.77^{d}	68.20^{b}	ICCV 07313	36.40^{e}	24.53^{d}

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

In terms of unfilled pods, Desi type ICCV 06102 significantly had the highest number of unfilled pods with a mean of 87.77 followed by ICCV 07114, ICCV 07115 and ICCV 93952 with a mean of 68.60, 68.20 and 63.32. ICCV 92311, a Kabuli type attained the lowest unfilled pods with a mean of 12.40 followed by ICCV 92337 (12.63), ICCV 95334 (14.00) and ICCV 95333 (14.43).

Seed Yield Per Plant

Table 9 presents the mean seed yield per plant. Statistical analysis showed that there were significant differences among the accessions evaluated. Kabuli type (ICCV 95334) attained the highest mean yield per plant with a mean of 54.30, but was comparable to ICCV 07304 (Kabuli type), ICCV 06102 (Desi type), ICCV 07307 (Kabuli

Table 9. Mean yield per plant

TREATMENT	SEED YIELD (g)	TREATMENT	SEED YIELD (g)
Desi Type		Kabuli Type	
ICCC 37	43.90[ab]	ICCV 2	18.49[ab]
ICCV 10	48.95[a]	ICCV 92311	32.31[ab]
ICCV 93952	40.60[ab]	ICCV 92337	27.33[ab]
ICCV 93954	27.57[ab]	ICCV 95311	21.00[ab]
ICCV 94954	11.48[ab]	ICCV 95332	39.27[ab]
ICCV 06101	32.27[ab]	ICCV 95333	39.83[ab]
ICCV 06102	51.39[a]	ICCV 95334	54.30[a]
ICCV 06104	42.73[ab]	ICCV 06301	34.97[ab]
ICCV 06105	23.93[ab]	ICCV 06306	37.57[ab]
ICCV 06106	8.14[ab]	ICCV 07304	51.93[a]
ICCV 06107	20.07[ab]	ICCV 07306	16.73[ab]
ICCV 06108	30.67[ab]	ICCV 07307	49.80[a]
ICCV 07107	4.30[b]	ICCV 07309	26.00[ab]
ICCV 07114	27.47[ab]	ICCV 07312	17.90[ab]
ICCV 07115	28.09[ab]	ICCV 07313	11.83[ab]

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

type) and ICCV 10 (Desi type) with a mean of 51.93g, 51.39g, 49.80g and 48.95g, respectively. Desi type ICCV 07107 attained the lowest mean yield per plant with a mean of 4.30 g followed by ICCV 06106, ICCV 94954 and ICCV 07313 with a mean of 8.14g, 11.48g and 11.83g, respectively.

Total Yield Per Plot

Table 10 presents the total yield per plot. ICCV 07307 had significantly the highest total yield per plot with a mean of 1.31g but were comparable to Desi type ICCV 93952, ICCV 10, ICCC 37 , ICCV 06104 and ICCV 06108 with a mean of 1.30 kg, 1.20 kg, 1.13 kg, 1.06 and 1.05 kg, respectively. Kabuli type ICCV 06106 obtained the lowest yield per plot with a mean of 0.33 but were comparable to Desi type ICCV 92337, ICCV 07107, ICCV 95333 and ICCV 07313 with a mean of 0.39, 0.40, 0.43 and 0.44 kg, respectively.

This result strongly agreed with the statement of Edmund *et al*. (1957) that varieties differ in productivity due to their adaptability in the environment. According to Wien (1983), choice of the most adapted cultivar is a key decision that a vegetable grower faces every growing season in which the profitability of the crops depends. Evaluation of cultivars for adaptation to local growing conditions, therefore is of crucial importance a grower make when determining crops from planting. Crop productivity is usually attributed to disease and insect pests, resistance, environmental adaptability and yield potential.

Table 10. Total yield per plot

TREATMENT	TOTAL YIELD (kg)	TREATMENT	TOTAL YIELD (kg)
Desi Type		Kabuli Type	
ICCC 37	1.13[c]	ICCV 2	0.63[f]
ICCV 10	1.20[b]	ICCV 92311	0.97[d]
ICCV 93952	1.30[a]	ICCV 92337	0.39[g]
ICCV 93954	0.82[e]	ICCV 95311	0.57[f]
ICCV 94954	0.54[f]	ICCV 95332	0.84[e]
ICCV 06101	0.61[f]	ICCV 95333	0.43[g]
ICCV 06102	0.91[d]	ICCV 95334	0.67[f]
ICCV 06104	1.06[c]	ICCV 06301	0.99[c]
ICCV 06105	0.76[f]	ICCV 06306	0.83[e]
ICCV 06106	0.33[g]	ICCV 07304	0.91[d]
ICCV 06107	0.85[e]	ICCV 07306	0.67[f]
ICCV 06108	1.05[c]	ICCV 07307	1.31[d]
ICCV 07107	0.40[g]	ICCV 07309	0.62[f]
ICCV 07114	0.94[d]	ICCV 07312	0.52[f]
ICCV 07115	0.67[f]	ICCV 07313	0.44[g]

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

Total Yield Per Hectare

Table 11 shows the total yield per hectare. The total yield per hectare is consistent with the total yield per plot. ICCV 07307 a Kabuli type significantly attained the highest yield with a mean of 1307 kg. It was comparable to Desi type accessions ICCV 93952 (1302.30 kg), ICCV 10 (1198 kg) and ICCC 37 (129.80). The lowest yield was attained by Kabuli type ICCV 06106 with a mean of 325.90 kg followed by ICCV 92337, ICCV 07107, ICCV 07313 and ICCV 0713 with a mean of 394 kg, 400.60 kg, 433.20 kg and 441.90 kg, respectively.

Table 11. Total yield per hectare

TREATMENT	TOTAL YIELD (kg)	TREATMENT	TOTAL YIELD (kg)
Desi Type		Kabuli Type	
ICCC 37	1129.80[b]	ICCV 2	625.40[f]
ICCV 10	1198.00[b]	ICCV 92311	965.10[d]
ICCV 93952	1302.30[a]	ICCV 92337	394.00[f]
ICCV 93954	816.80[e]	ICCV 95311	571.50[f]
ICCV 94954	536.20[f]	ICCV 95332	837.40[d]
ICCV 06101	608.10[f]	ICCV 95333	433.20[f]
ICCV 06102	912.30[d]	ICCV 95334	672.67[d]
ICCV 06104	1056.60[e]	ICCV 06301	990.00[d]
ICCV 06105	755.00[f]	ICCV 06306	834.20[d]
ICCV 06106	325.90[f]	ICCV 07304	913.80[d]
ICCV 06107	848.20[d]	ICCV 07306	666.60[f]
ICCV 06108	1049.00[c]	ICCV 07307	1307.00[c]
ICCV 07107	400.60[f]	ICCV 07309	620.90[f]
ICCV 07114	941.20[d]	ICCV 07312	524.20[f]
ICCV 07115	666.73[f]	ICCV 07313	441.90[f]

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

The lowest yield of these varieties was due to excessive rainfall which leads to the development of stem rot which had greatly damage the crop and due to occurrence of pod borer and rodents.

Weight of 100 Seeds (g)

As shown in Table 12, Desi type ICCV 06105 had significantly heavier seed weight with a mean of 36.80 g/100 seed but was comparable to the Kabuli type ICCV 07307 and ICCV 92311 with a mean of 34.83 g and 34.80 g, respectively. Desi type ICCV 10 had the lightest weight of 13.23 g followed by ICCC 37 with 14.67 g.

The differences in weight of 100 seeds are attributed to the differences in varietal characteristics such as sizes. ICCV 06105 had bigger sizes of seeds which might have

Table 12. Weight of 100 seeds

TREATMENT	WEIGHT (g)	TREATMENT	WEIGHT (g)
Desi Type		Kabuli Type	
ICCC 37	14.67[f]	ICCV 2	20.77[e]
ICCV 10	13.23[f]	ICCV 92311	34.80[b]
ICCV 93952	21.00[c]	ICCV 92337	24.93[d]
ICCV 93954	17.73[f]	ICCV 95311	26.07[c]
ICCV 94954	21.10[e]	ICCV 95332	29.07[c]
ICCV 06101	21.37[e]	ICCV 95333	26.33[c]
ICCV 06102	20.67[e]	ICCV 95334	24.47[d]
ICCV 06104	17.50[f]	ICCV 06301	25.30[d]
ICCV 06105	36.80[a]	ICCV 06306	23.87[d]
ICCV 06106	18.40[f]	ICCV 07304	27.87[c]
ICCV 06107	22.47[e]	ICCV 07306	25.83[d]
ICCV 06108	22.87[e]	ICCV 07307	34.83[b]
ICCV 07107	15.50[f]	ICCV 07309	27.87[c]
ICCV 07114	24.13[d]	ICCV 07312	24.53[d]
ICCV 07115	16.15[f]	ICCV 07313	26.67[d]

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

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.

Moreover, Muehlbaner and Singh (1987), Poniedzialek *et al* (1996) is about 495 g especially to the large seeded Kabuli chickpea, whereas Desi type, a small seeded has a minimum weight of 245 g per 1000 seeds, cited by Poniedzialek (2005).

Germination Test

Table 13 shows the germination test done in Petri dish method. Desi type ICCV 06102 and Kabuli type ICCV 2 had significantly higher germination percentage with a identical mean of 87.33%. It was followed by ICCV 95311 (86.67%), ICCV 93954 (81.33%), ICCV 07107 (79.33%), ICCV 0713 (76.67%), ICCV 07114 (76%) and ICCV 93952 (74%). The lowest percentage germination was obtained by ICCV 93952 (Desi type) with a mean of 25.33 but were comparable to ICCV 06107 with a mean of 30.67, ICCV 07307 with a mean of 36.67 and ICCV 06106 with a mean of 37.33.

Table 13. Germination test of harvested seeds

TREATMENT	GERMINATION TEST (%)	TREATMENT	GERMINATION TEST (%)
Desi Type		Kabuli Type	
ICCC 37	61.33[d]	ICCV 2	87.33[a]
ICCV 10	44.67[f]	ICCV 92311	62.00[d]
ICCV 93952	25.33[f]	ICCV 92337	61.33[d]
ICCV 93954	81.33[b]	ICCV 95311	86.67[b]
ICCV 94954	72.00[c]	ICCV 95332	74.00[c]
ICCV 06101	57.33[e]	ICCV 95333	63.33[d]
ICCV 06102	87.33[a]	ICCV 95334	50.00[e]
ICCV 06104	60.00[f]	ICCV 06301	61.33[d]
ICCV 06105	68.00[d]	ICCV 06306	69.33[d]
ICCV 06106	37.33[f]	ICCV 07304	53.33[e]
ICCV 06107	30.67[f]	ICCV 07306	51.33[e]
ICCV 06108	50.00[e]	ICCV 07307	36.67[f]
ICCV 07107	79.33[c]	ICCV 07309	69.33[d]
ICCV 07114	76.00[c]	ICCV 07312	62.00[d]
ICCV 07115	60.67[d]	ICCV 07313	76.67[c]

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

Pest and Diseases

Table 14 shows that all the accessions evaluated were infested by cutworm during the vegetative stage. Almost 10% of plant population was infested by cutworm, pod borer (*Helicoverpa armigera*) also was observed during the reproductive stage of the crop, it infested almost 10% of the plant population as well as the rodents (5%).

On the other hand, the diseases noted during the study were collar rot (*Sclerotium rolfsii* Sacc.) which infested 15-20% of the plant population. Another disease that was observed was chickpea stunt (bean leaf roll virus) which infested 5% of the plant population. Ascochyta blight (*Ascochyta rabiei* Labr.), fusarium wilt (*Fusarium oxysporum* Schlecht.), alternaria blight (*Alternaria alternate*) and mosaic (Alfalfa mosaic virus) 3% infection.

Table 14. Insect pest observed during the conduct of the study

INSECT PEST	ATTACKING STAGE
Cutworm	Vegetative growth
Pod borer	Reproductive stage

Table 15. Diseases observed during the conduct of the study

DISEASE	CAUSAL ORGANISM	DEGREE OF INFESTATION
Chickpea stunt	Bean leaf roll virus	Slight
Collar rot	*Sclerotium rolfsii* Sacc.	Slight
Ascochyta blight	*Ascochyta rabiei* Labr.	Slight
Fusarium wilt	*Fusarium oxysporum* Schlecht.	Slight
Alternaria blight	*Alternaria alternate*	Slight
Mosaid	Alfalfa mosaic virus	Slight

Table 16. Natural condition biotic stress susceptibility

ACCESSIONS	ASCOCHYTA BLIGHT (*Ascochyta rabiei* Labr.)	FUSARIUM WILT (*Fusarium oxysporum* Schlecht.)	ALTERNARIA BLIGHT (*Alternaria alternate*)	ROOT/STEM ROT (Collar Rot) (*Schlerotium rolfsii* Sacc.)	CHICKPEA STUNT (Bean Leaf Roll Virus)	MOSAIC (Alfalfa Mosaic Virus	CUTWORM (*Agrotis ipsilon* Hutnagel)	POD BORER (*Helicoverpa armigera*)
1	2	2	1	1	3	1	2	2
2	2	2	1	1	3	1	1	2
3	2	3	1	1	1	1	1	2
4	3	3	1	1	1	1	2	3
5	2	1	1	1	2	2	1	2
6	3	2	1	.2	2	1	1	3
7	2	2	1	1	3	1	1	1
8	3	2	1	1	1	1	2	2
9	3	2	2	1	1	1	1	2
10	3	2	1	1	2	1	2	3
11	3	1	1	1	1	1	1	3
12	3	2	1	1	1	1	2	3
13	2	2	1	1	1	2	2	3
14	2	2	1	1	1	1	1	2
15	2	1	1	1	2	1	1	2
16	2	1	1	1	1	1	2	3
17	3	1	1	2	2	1	1	1
18	3	1	1	2	2	1	2	3
19	2	1	1	2	1	3	1	3
20	2	3	1	1	1	2	1	2
21	2	1	1	1	2	1	2	3
22	3	2	1	1	1	1	1	2
23	3	1	1	2	3	1	2	2
24	3	1	1	1	2	2	2	3
25	3	2	1	1	2	3	2	3
26	2	3	1	1	2	1	2	2
27	2	2	2	1	2	1	1	1
28	2	1	1	1	3	3	2	3
29	3	1	1	1	1	2	2	2
30	3	2	2	2	1	2	2	2

Legend:

1 – Very low or no visible sign of susceptibility (<20%)
3 – Low (21-40%)
5 – Intermediate (41-60%)
7 – High (61-80%)
9 – Very high (1-100%)

Table 17. Meteorological data

MONTH	AVERAGE TEMPERATURE (°C)		RELATIVE HUMIDITY (%)	SUNLIGHT DURATION (Min.)	RAINFALL (Mins. of Tenths)
	Maximum	Minimum			
October 2008					
1st week	24.7	18.8	86.0	290.5	73.9
2nd week	24.1	18.1	85.0	176.5	10.5
3rd week	24.3	19.6	84.0	382.8	78.4
4th week	24.2	16.0	85.0	435.4	86.7
November 2008					
1st week	25.7	19.1	85.0	229.7	54.2
2nd week	25.3	20.0	87.0	332.5	29.0
3rd week	25.1	19.2	90.0	198.8	T
4th week	24.7	20.2	83.0	361.7	00
December 2008					
1st week	24.9	18.5	80.0	434.5	00
2nd week	24.3	17.6	81.0	364.2	3.4
3rd week	23.8	19.1	82.0	432.0	00
4th week	27.7	22.9	96.2	305.1	00
January 2009					
1st week	24.5	18.5	85.0	225.4	00
2nd week	24.4	17.3	85.0	225.4	00
3rd week	24.2	16.4	85.0	474.8	00
4th week	25.1	19.0	83.0	414.0	T
February 2009					
1st week	24.0	16.8	89.0	365.1	17.6
2nd week	23.8	18.5	84.0	256.2	45.3
3rd week	23.9	19.1	84.0	454.2	35.1
4th week	25.3	22.1	84.0	375.7	00
March 2009					
1st week	25.0	19.4	84.0	417.4	T
2nd week	25.4	19.6	87.0	143.1	11.1
3rd week	25.0	20.3	84.0	372.8	00
4th week	24.6	20.0	88.0	248.5	39.1

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted to introduce and promote chickpea production in Benguet specifically at La Trinidad, Benguet and to determine the germplasm collection and evaluation of chickpea accessions under La Trinidad, Benguet and to identify chickpea accessions that could be profitably grown under La Trinidad condition. The study was conducted at La Trinidad, Benguet from October 2008 to March 2009.

Results revealed that the different chickpea accessions significantly vary on emergence percentage where ICCV 06104 and ICCV 94954 had the highest field percentage emergence while the lowest was observed from ICCV 95334 and ICCV 2. ICCV 06108 were the earliest to produce flowers while ICCV 95334 were the latest to obtain 50% flowering. ICCV 0-6106 (Desi type) was significantly taller than the other varieties including Kabuli type. As to the final height, ICCV 07312 was significantly the tallest while ICCV 37 was the shortest.

Kabuli type variety (ICCV 95334) were significantly the earliest to be harvested compared to the rest of the accessions. As to the number of lateral branches produced at flowering, ICCV 07114 produced the most number of lateral branches while ICCV 07304 produced the least number of branches. There were no significant differences in the total number of harvest.

In terms of filled and unfilled pods, Desi type ICCV 10 had significantly the highest number of filled pods with a mean of 36.40/plant. Desi type ICCV 06102 significantly had the highest number of unfilled pods with a mean of 87.77 while Kabuli type ICCV 92311 had the lowest with a mean of 12.40/plant.

For the yield per plot and yield per hectare, ICCV 93952 significantly outyielded all the accessions evaluated. ICCV 06105 had significantly heavier in seed weight compared to other accessions which has lesser seed weight.

The result of germination test done in Petri dish method showed that ICCV 06102 and ICCV 2 had the highest percentage germination while ICCV 93952 had the lowest germination percentage.

Conclusion

Based on the results presented and discussed, the best accession tested in La Trinidad, Benguet was Kabuli type ICCV 07307, ICCV 06301 and Desi type ICCV 93952 and ICCV 10 since they produced the highest yield potential among the cultivars evaluated.

Recommendation

Based on the findings of this study, it is therefore recommended that Kabuli type ICCV 07307, 06301 and Desi types ICCV 93952 and ICCV 10 accessions can be productively grown in La Trinidad, Benguet since it outyielded all the accessions evaluated. The yields of the selected accessions are within the global yield potential of 800-1,200 kg/ha.

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APPENDICES

Appendix Table 1. Field emergence (%)

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	95.13	83.33	89.23	267.69	89.23
ICCV 10	80.90	91.40	86.15	258.45	86.15
ICCV 93952	88.19	90.27	89.23	267.69	89.23
ICCV 93954	79.16	91.40	85.28	255.84	85.28
ICCV 94954	96.52	98.62	97.57	292.71	95.57
ICCV 06101	92.63	89.06	85.84	257.53	85.84
ICCV 06102	93.75	87.50	90.62	271.87	90.62
ICCV 06104	96.52	100.00	98.26	294.78	98.26
ICCV 06105	69.44	84.37	76.90	230.71	76.90
ICCV 06106	90.27	87.50	88.88	266.65	88.88
ICCV 06107	86.80	80.56	83.68	251.04	83.68
ICCV 06108	77.08	68.06	72.57	217.71	72.57
ICCV 07107	70.13	70.84	70.48	211.45	70.48
ICCV 07114	80.55	75.00	77.77	233.32	77.77
ICCV 07115	88.88	91.67	90.27	270.82	90.27
Kabuli Type					
ICCV 2	2.77	4.17	3.47	10.41	3.47
ICCV 92311	18.75	21.52	20.13	60.40	20.13
ICCV 92337	22.22	19.55	20.88	62.65	20.88
ICCV 95311	27.08	44.05	35.56	106.69	35.56
ICCV 95332	11.11	10.25	10.67	32.03	10.67
ICCV 95333	5.55	3.47	4.51	13.53	4.51
ICCV 95334	2.77	0	1.38	4.15	1.38
ICCV 06301	23.60	32.66	28.13	84.39	28.13
ICCV 06306	12.49	21.73	17.11	51.33	17.11
ICCV 07304	30.55	47.66	39.10	117.31	39.10
ICCV 07306	27.08	35.45	31.29	93.82	31.27
ICCV 07307	23.60	38.45	31.02	93.07	31.02
ICCV 07309	6.25	8.34	7.29	21.88	7.29
ICCV 07312	34.71	43.52	39.11	117.34	39.11
ICCV 07313	21.52	27.50	24.51	73.53	24.51

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	109137.745	3763.371		1.65	2.03
Treatment	2	398.516	199.258	87.999**		
Error	58	2480.425	42.766			
TOTAL	89	112016.686				

** - Highly significant

Coefficient of variation = 0.41%

Appendix Table 2. Days from planting to 50% flowering

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	67	64	64	195	65.0
ICCV 10	70	73	68	211	70.3
ICCV 93952	68	68	74	210	70.0
ICCV 93954	64	67	67	198	66.0
ICCV 94954	71	75	70	216	72.0
ICCV 06101	69	69	67	205	68.3
ICCV 06102	51	50	50	151	50.3
ICCV 06104	53	53	50	156	52.0
ICCV 06105	62	47	49	158	52.6
ICCV 06106	68	84	71	223	74.3
ICCV 06107	78	78	69	225	75.0
ICCV 06108	67	76	70	213	42.6
ICCV 07107	44	73	45	162	54.0
ICCV 07114	68	71	70	209	69.6
ICCV 07115	68	71	42	181	60.3
Kabuli Type					
ICCV 2	52	71	52	175	58.3
ICCV 92311	47	40	42	129	43.0
ICCV 92337	41	45	94	180	60.0
ICCV 95311	99	92	97	288	96.0
ICCV 95332	41	52	46	189	46.3
ICCV 95333	97	104	98	299	99.6
ICCV 95334	100	103	101	304	101.3
ICCV 06301	44	46	46	136	45.3
ICCV 06306	69	44	52	165	55.0
ICCV 07304	47	52	45	144	48.0
ICCV 07306	52	40	68	160	53.3
ICCV 07307	42	46	49	137	45.6
ICCV 07309	39	51	49	139	46.3
ICCV 07312	51	53	56	173	51.0
ICCV 07313	45	47	50	142	47.3

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	21876.667	754.368		1.65	2.03
Treatment	2	84.067	42.033	9.883**		
Error	58	4427.267	76.332			
TOTAL	89	26388.000				

** - Highly significant

Coefficient of variation = 0.47%

Appendix Table 3. Average height at flowering (cm)

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	41.53	51.63	56.00	149.16	49.72
ICCV 10	40.60	35.66	42.30	118.56	39.52
ICCV 93952	41.33	50.00	45.60	136.93	45.64
ICCV 93954	41.00	43.30	38.3	122.90	40.96
ICCV 94954	50.33	58.30	47.30	155.90	51.96
ICCV 06101	54.30	51.60	51.60	157.50	52.50
ICCV 06102	39.30	42.30	54.30	135.90	45.30
ICCV 06104	43.00	36.00	33.30	112.30	37.43
ICCV 06105	44.30	58.00	33.60	135.90	45.30
ICCV 06106	64.00	53.30	58.00	175.30	58.43
ICCV 06107	59.00	53.00	52.60	164.60	54.86
ICCV 06108	46.60	61.00	64.00	171.60	57.20
ICCV 07107	36.00	36.30	31.30	103.60	34.53
ICCV 07114	45.00	64.30	46.60	155.90	51.96
ICCV 07115	61.00	55.60	51.60	168.20	56.06
Kabuli Type					
ICCV 2	29.60	56.30	47.30	133.20	44.40
ICCV 92311	30.30	33.30	33.30	96.90	32.30
ICCV 92337	35.30	46.00	32.60	113.90	37.90
ICCV 95311	29.60	47.00	41.30	117.90	39.30
ICCV 95332	33.00	29.60	40.60	103.20	34.40
ICCV 95333	47.30	52.30	38.00	137.60	45.86
ICCV 95334	39.00	39.00	35.00	113.00	37.66
ICCV 06301	31.00	25.30	28.00	84.300	28.10
ICCV 06306	36.00	41.30	32.00	109.30	36.43
ICCV 07304	32.60	32.00	30.60	95.20	31.73
ICCV 07306	36.60	33.60	32.00	102.20	34.06
ICCV 07307	34.00	30.00	36.60	100.60	33.53
ICCV 07309	37.30	33.30	35.00	105.60	35.20
ICCV 07312	57.00	56.60	50.60	164.20	54.73
ICCV 07313	35.60	34.30	39.60	109.50	36.50

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	6753.207	232.869		1.65	2.03
Treatment	2	160.877	80.438	6.524**		
Error	58	2070.374	35.696			
TOTAL	89	8984.458				

** - Highly significant

Coefficient of variation = 0.47%

Appendix Table 4. Final height (cm)

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	58.66	71.66	63.66	194.98	64.66
ICCV 10	66.66	73.00	78.66	218.32	72.77
ICCV 93952	71.00	69.00	77.00	217.00	72.33
ICCV 93954	71.66	81.66	78.66	231.98	77.32
ICCV 94954	75.33	78.00	72.66	225.98	75.33
ICCV 06101	81.66	72.33	76.66	225.99	77.00
ICCV 06102	72.00	84.66	74.33	230.32	77.00
ICCV 06104	83.00	75.33	71.66	229.99	76.66
ICCV 06105	85.66	98.00	63.33	246.99	82.33
ICCV 06106	94.33	83.33	92.33	269.99	90.00
ICCV 06107	92.00	81.33	79.66	252.99	84.33
ICCV 06108	80.00	82.00	81.00	243.00	81.00
ICCV 07107	70.33	79.33	84.33	233.99	78.00
ICCV 07114	78.00	82.33	78.00	238.33	79.44
ICCV 07115	83.66	79.66	84.33	247.65	82.55
Kabuli Type					
ICCV 2	80.00	82.00	80.00	242.00	86.67
ICCV 92311	86.33	106.66	86.66	279.65	93.22
ICCV 92337	85.00	95.33	90.33	270.66	90.22
ICCV 95311	91.33	58.66	79.00	228.99	76.33
ICCV 95332	81.66	81.33	94.33	257.32	85.77
ICCV 95333	89.66	75.00	62.00	226.66	75.55
ICCV 95334	77.00	81.00	75.33	233.33	77.78
ICCV 06301	97.66	83.33	59.66	240.65	80.22
ICCV 06306	98.66	104.66	80.33	283.65	94.55
ICCV 07304	78.00	87.33	90.00	255.33	85.11
ICCV 07306	67.66	89.33	81.66	238.65	79.55
ICCV 07307	81.00	75.00	89.66	245.66	81.89
ICCV 07309	87.00	66.66	56.66	210.32	70.11
ICCV 07312	91.33	107.66	108.33	307.32	104.44
ICCV 07313	93.00	99.00	89.33	281.33	93.78

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	5635.196	194.317		1.65	2.03
Treatment	2	191.663	95.831	2.371**		
Error	58	4753.310	81.954			
TOTAL	89	10580.169				

** - Highly significant Coefficient of variation = 0.37%

Appendix Table 5. Days from planting to first harvest

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	129	129	129	387	129.00
ICCV 10	129	129	129	387	129.00
ICCV 93952	129	129	129	387	129.00
ICCV 93954	128	128	128	384	128.00
ICCV 94954	128	128	128	384	128.00
ICCV 06101	127	127	127	381	127.00
ICCV 06102	127	127	127	381	127.00
ICCV 06104	127	127	127	381	127.00
ICCV 06105	127	127	127	381	127.00
ICCV 06106	135	127	127	389	129.66
ICCV 06107	126	126	126	378	126.00
ICCV 06108	126	126	126	378	126.00
ICCV 07107	126	126	126	378	126.00
ICCV 07114	126	126	126	378	126.00
ICCV 07115	124	124	124	372	124.00
Kabuli Type					
ICCV 2	124	124	124	372	124.00
ICCV 92311	124	124	124	372	124.00
ICCV 92337	124	124	124	372	124.00
ICCV 95311	124	124	124	372	124.00
ICCV 95332	124	124	124	372	124.00
ICCV 95333	123	123	123	369	123.00
ICCV 95334	87	82	92	261	87.00
ICCV 06301	123	123	123	369	123.00
ICCV 06306	123	123	123	369	123.00
ICCV 07304	123	123	123	369	123.00
ICCV 07306	123	123	123	369	123.00
ICCV 07307	123	123	123	369	123.00
ICCV 07309	122	122	122	366	122.00
ICCV 07312	122	122	122	366	122.00
ICCV 07313	122	122	122	366	122.00

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	4734.322	163.252	105.703**	1.65	2.03
Treatment	2	3.089	1.544			
Error	58	89.578	1.544			
TOTAL	89	4826.989				

** - Highly significant

Coefficient of variation = 0.03%

Appendix Table 6. Mean number of lateral branches at flowering

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	2.33	1.33	1.66	5.32	1.77
ICCV 10	3.00	2.00	2.00	7.00	2.33
ICCV 93952	1.66	2.00	2.33	5.99	2.00
ICCV 93954	1.00	1.66	2.00	4.66	1.55
ICCV 94954	1.33	1.33	1.33	3.99	1.33
ICCV 06101	2.00	2.00	1.33	5.33	1.78
ICCV 06102	2.33	1.00	2.00	5.33	1.78
ICCV 06104	2.00	2.00	1.66	5.33	1.89
ICCV 06105	2.00	2.33	2.00	6.33	2.11
ICCV 06106	2.33	2.33	1.66	6.32	2.11
ICCV 06107	1.66	2.00	2.00	5.66	1.89
ICCV 06108	1.00	1.66	2.00	4.66	1.55
ICCV 07107	1.33	1.33	2.00	4.66	1.55
ICCV 07114	2.66	2.00	2.66	7.32	2.44
ICCV 07115	1.00	1.33	2.00	4.33	1.44
Kabuli Type					
ICCV 2	2.33	1.66	2.33	6.32	2.11
ICCV 92311	1.33	2.33	2.00	5.66	1.89
ICCV 92337	1.66	1.33	2.00	4.99	1.66
ICCV 95311	2.33	1.33	1.66	5.32	1.77
ICCV 95332	1.33	2.00	1.66	4.99	1.66
ICCV 95333	1.33	1.33	1.00	3.66	1.22
ICCV 95334	1.66	1.33	1.00	3.99	1.33
ICCV 06301	2.00	2.00	1.33	5.33	1.78
ICCV 06306	2.33	2.33	1.66	6.32	2.11
ICCV 07304	1.00	1.00	1.33	3.33	1.11
ICCV 07306	1.66	1.33	2.00	4.99	1.66
ICCV 07307	1.33	1.66	3.00	5.99	2.00
ICCV 07309	1.66	3.00	2.00	6.66	2.22
ICCV 07312	1.33	1.33	1.33	3.99	1.33
ICCV 07313	1.66	1.00	2.66	5.98	1.99

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	9.649	0.333		1.65	2.03
Treatment	2	0.256	0.128	1.714*		
Error	58	11.257	0.194			
TOTAL	89	21.61				

* - Significant

Coefficient of variation = 0.83%

Appendix Table 7. Total number of harvest

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	2	2	2	6	2.00
ICCV 10	2	2	2	6	2.00
ICCV 93952	2	2	2	6	2.00
ICCV 93954	2	2	2	6	2.00
ICCV 94954	2	2	2	6	2.00
ICCV 06101	2	2	2	6	2.00
ICCV 06102	2	2	2	6	2.00
ICCV 06104	2	2	2	6	2.00
ICCV 06105	2	2	2	6	2.00
ICCV 06106	1	1	2	4	1.33
ICCV 06107	2	2	2	6	2.00
ICCV 06108	2	2	2	6	2.00
ICCV 07107	2	2	2	6	2.00
ICCV 07114	2	2	2	6	2.00
ICCV 07115	2	2	2	6	2.00
Kabuli Type					
ICCV 2	2	2	2	6	2.00
ICCV 92311	2	2	2	6	2.00
ICCV 92337	2	2	1	5	1.67
ICCV 95311	2	2	2	6	2.00
ICCV 95332	2	2	2	6	2.00
ICCV 95333	3	2	1	6	2.00
ICCV 95334	2	3	2	7	2.33
ICCV 06301	2	3	2	7	2.33
ICCV 06306	3	2	2	7	2.33
ICCV 07304	2	3	2	7	2.33
ICCV 07306	2	2	2	6	2.00
ICCV 07307	2	2	2	6	2.00
ICCV 07309	2	2	2	6	2.00
ICCV 07312	2	2	2	6	2.00
ICCV 07313	2	2	2	6	2.00

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	2.989	0.103		1.65	2.03
Treatment	2	0.289	0.144	1.047^{ns}		
Error	58	5.711	0.098			
TOTAL	89	8.989				

^{ns} - Not significant

Coefficient of variation = 0.52%

Appendix Table 8. Number of filled pods produced per plant

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	198.33	223.30	291.30	712.93	237.64
ICCV 10	529.60	52.30	200.30	782.20	260.73
ICCV 93952	212.30	169.00	304.30	685.63	228.53
ICCV 93954	184.60	60.60	366.30	611.50	203.83
ICCV 94954	20.60	115.60	134.30	270.50	90.17
ICCV 06101	21.60	179.60	116.60	317.80	105.93
ICCV 06102	299.60	211.60	234.30	695.50	231.83
ICCV 06104	119.60	369.30	221.30	710.20	236.73
ICCV 06105	30.30	89.00	76.60	195.90	65.30
ICCV 06106	39.30	14.30	96.00	149.60	49.87
ICCV 06107	70.00	94.66	152.30	316.96	105.65
ICCV 06108	236.30	86.00	170.30	492.60	164.20
ICCV 07107	49.00	10.60	28.60	88.20	29.40
ICCV 07114	293.60	89.60	179.30	562.50	187.50
ICCV 07115	78.00	221.30	147.00	446.30	148.77
Kabuli Type					
ICCV 2	186.00	90.00	88.30	364.00	121.33
ICCV 92311	74.00	93.30	9.30	297.90	99.30
ICCV 92337	223.30	42.60	0.60	267.20	89.07
ICCV 95311	87.60	56.00	18.30	198.20	66.07
ICCV 95332	85.30	86.30	13.00	368.20	122.73
ICCV 95333	284.60	89.00	0.30	375.60	125.20
ICCV 95334	37.80	40.80	34.80	113.40	37.80
ICCV 06301	180.00	90.30	27.60	427.30	142.43
ICCV 06306	228.30	82.00	16.30	436.90	145.63
ICCV 07304	219.00	131.60	33.60	450.20	150.07
ICCV 07306	82.00	93.30	57.30	228.30	76.20
ICCV 07307	109.30	128.00	34.60	398.30	132.77
ICCV 07309	187.00	123.00	3.60	317.30	105.77
ICCV 07312	89.60	101.30	35.60	213.20	77.07
ICCV 07313	266.00	24.00	58.60	109.20	36.40

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	375310.761	12941.750		1.65	2.03
Treatment	2	23164.768	11582.384	1.906*		
Error	58	393773.691	6789.202			
TOTAL	89	792249.290				

* - Significant Coefficient of variation = 2.13%

Appendix Table 9. Number of unfilled pods produced per plant

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	48.33	54.30	10.30	112.90	37.64
ICCV 10	88.66	17.33	35.30	141.29	47.10
ICCV 93952	62.30	66.33	61.30	189.90	63.32
ICCV 93954	32.30	11.30	11.00	54.60	18.20
ICCV 94954	11.30	35.30	91.00	137.60	45.87
ICCV 06101	37.30	104.00	29.30	170.60	56.87
ICCV 06102	31.00	52.30	180.00	263.30	87.77
ICCV 06104	42.30	17.00	28.00	87.30	29.10
ICCV 06105	34.60	27.00	12.13	73.90	24.58
ICCV 06106	34.30	16.00	48.00	98.30	32.77
ICCV 06107	18.30	25.00	38.00	81.30	27.10
ICCV 06108	46.00	38.60	12.00	96.60	32.20
ICCV 07107	32.30	8.00	43.60	83.90	27.97
ICCV 07114	95.60	46.60	63.60	205.80	68.60
ICCV 07115	37.30	97.30	70.00	204.60	68.20
Kabuli Type					
ICCV 2	34.00	15.00	88.30	137.30	45.77
ICCV 92311	15.30	12.60	9.30	37.20	12.40
ICCV 92337	18.00	19.30	0.60	37.90	12.63
ICCV 95311	29.60	4.00	18.30	51.90	17.30
ICCV 95332	24.00	45.30	13.00	82.30	27.45
ICCV 95333	23.00	20.00	0.30	43.30	14.43
ICCV 95334	14.00	10.00	18.00	42.00	14.00
ICCV 06301	47.00	46.60	27.60	121.20	40.40
ICCV 06306	43.00	25.60	16.30	84.90	28.30
ICCV 07304	7.00	26.30	33.60	66.90	22.30
ICCV 07306	47.60	37.60	57.30	142.50	47.50
ICCV 07307	4.30	22.00	34.60	609.00	20.30
ICCV 07309	32.30	25.60	3.60	61.50	20.50
ICCV 07312	51.30	41.60	35.60	128.50	42.83
ICCV 07313	28.60	23.00	22.00	73.60	24.53

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	31393.849	1082.547		1.65	2.03
Treatment	2	252.879	126.439	1.750*		
Error	58	35875.047	618.535			
TOTAL	89	67521.776				

* - Significant

Coefficient of variation = 2.35%

Appendix Table 10. Mean yield per plant

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	40.20	44.80	46.80	131.80	43.90
ICCV 10	75.06	39.60	32.20	146.80	48.95
ICCV 93952	45.10	3.20	73.50	121.80	40.60
ICCV 93954	26.20	7.30	49.20	82.70	27.57
ICCV 94954	3.03	17.00	14.40	34.40	11.48
ICCV 06101	16.20	55.20	25.40	96.80	32.27
ICCV 06102	72.30	42.80	39.06	154.16	51.39
ICCV 06104	21.70	73.70	32.08	128.20	42.73
ICCV 06105	32.20	19.10	20.50	71.80	23.93
ICCV 06106	5.93	2.50	16.00	24.43	8.14
ICCV 06107	12.70	17.70	29.80	60.20	20.07
ICCV 06108	45.90	16.30	29.80	92.00	30.67
ICCV 07107	9.20	1.30	2.40	12.90	4.30
ICCV 07114	39.60	12.60	30.20	84.40	27.47
ICCV 07115	13.90	39.20	31.16	84.26	28.08
Kabuli Type					
ICCV 2	25.16	13.70	16.60	55.40	18.49
ICCV 92311	21.30	28.40	47.23	96.93	32.31
ICCV 92337	70.80	11.00	0.20	82.00	27.33
ICCV 95311	10.60	37.00	15.40	63.00	21.00
ICCV 95332	23.20	20.40	76.30	119.90	39.97
ICCV 95333	88.00	31.10	0.40	119.50	39.83
ICCV 95334	54.30	49.30	59.30	162.90	54.30
ICCV 06301	55.60	23.80	25.50	104.90	34.97
ICCV 06306	53.70	20.80	38.20	112.70	37.57
ICCV 07304	117.50	11.50	26.80	155.80	51.93
ICCV 07306	16.10	23.30	10.80	50.20	16.73
ICCV 07307	47.40	45.50	56.50	149.40	49.80
ICCV 07309	41.50	34.40	2.10	78.00	26.00
ICCV 07312	21.30	23.80	8.60	53.70	17.90
ICCV 07313	13.40	8.60	13.50	35.50	11.82

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	15779.731512	544.12867	2.12**	1.65	2.03
Treatment	2	1895.12277556	947.56138778			
Error	58	25919.24129111				
TOTAL	89	43594.095578				

** – Highly significant Coefficient of variation = 68.26%

Appendix Table 11. Total yield per plot (kg)

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	1.1298	1.43966	0.81994	3.3894	1.13
ICCV 10	1.198	1.59570	0.8003	3.5940	1.20
ICCV 93952	1.3023	1.73630	0.8683	3.9069	1.32
ICCV 93954	0.8168	1.07230	0.5613	2.4504	0.82
ICCV 94954	0.5362	0.71480	0.3576	1.6086	0.54
ICCV 06101	0.6081	0.81060	0.4056	1.8243	0.61
ICCV 06102	0.9123	1.21630	0.6083	2.7369	0.91
ICCV 06104	1.0566	1.40870	0.7045	3.1698	1.06
ICCV 06105	0.755	1.00660	0.5034	2.2650	0.76
ICCV 06106	0.3259	0.43440	0.2174	0.9777	0.33
ICCV 06107	0.8482	1.13080	0.5656	2.5496	0.85
ICCV 06108	1.0490	1.39850	0.6995	3.1470	1.05
ICCV 07107	0.4006	0.50740	0.2938	1.2018	0.40
ICCV 07114	0.9412	1.25490	0.6275	2.8336	0.44
ICCV 07115	0.6670	0.88920	0.0444	2.0002	0.67
Kabuli Type					
ICCV 2	0.6254	0.83380	0.4170	1.8762	0.63
ICCV 92311	0.9651	1.28670	0.6435	2.8953	0.97
ICCV 92337	0.3940	0.54190	0.2461	1.1820	0.39
ICCV 95311	0.5715	0.71010	0.4329	4.7145	0.57
ICCV 95332	0.8374	1.11660	0.5582	2.5122	0.84
ICCV 95333	0.4332	0.57760	0.2888	1.2996	0.43
ICCV 95334	0.7140	0.61400	0.6900	2.0180	0.67
ICCV 06301	0.9900	1.32000	0.6600	2.9700	0.99
ICCV 06306	0.8342	1.11220	0.5562	2.5026	0.83
ICCV 07304	0.9138	1.21830	0.6093	2.7414	0.91
ICCV 07306	0.6666	0.88850	0.4447	1.9998	0.67
ICCV 07307	1.3070	1.74260	0.8714	3.9210	1.31
ICCV 07309	0.6209	0.82770	0.4141	1.0627	0.62
ICCV 07312	0.5242	0.69890	0.3495	1.5726	0.52
ICCV 07313	0.4419	0.58910	0.2947	1.3257	0.44

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	6.501	0.224		1.65	2.03
Treatment	2	3.622	1.811	19.998**		
Error	58	0.650	0.011			
TOTAL	89	10.773				

** - Highly significant

Coefficient of variation = 0.45%

Appendix Table 12. Mean yield per hectare

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	1129.80	1439.66	819.94	3389.4	1129.80
ICCV 10	1198.00	1595.70	800.30	3594.0	1198.00
ICCV 93952	1302.30	1736.30	868.30	3906.6	1302.30
ICCV 93954	816.80	1072.30	561.30	2450.4	816.80
ICCV 94954	536.20	714.80	357.60	1608.6	536.20
ICCV 06101	608.10	810.60	405.60	1824.3	608.10
ICCV 06102	912.30	1216.30	608.30	2736.9	912.30
ICCV 06104	1056.60	1408.70	704.50	3169.8	1056.60
ICCV 06105	755.00	1006.60	303.40	226.5	755.00
ICCV 06106	325.90	434.40	217.40	977.7	325.90
ICCV 06107	848.20	1130.80	565.60	2544.6	848.20
ICCV 06108	1049.00	1398.50	699.50	3147.0	1049.00
ICCV 07107	400.60	507.40	293.80	1201.0	400.60
ICCV 07114	941.20	1254.90	627.50	28.33.6	941.20
ICCV 07115	667.00	889.20	444.00	2000.2	666.73
Kabuli Type					
ICCV 2	625.40	833.80	417.00	1876.2	625.40
ICCV 92311	965.10	1286.70	643.50	2895.3	965.10
ICCV 92337	394.00	541.90	246.10	1182.0	394.00
ICCV 95311	571.50	710.10	432.90	1714.5	571.50
ICCV 95332	837.40	1116.60	558.20	2512.2	837.40
ICCV 95333	433.20	577.60	288.80	1299.6	433.20
ICCV 95334	714.00	614.00	690.00	2018.0	672.67
ICCV 06301	990.00	1320.00	660.00	2970.0	990.00
ICCV 06306	834.20	1112.20	556.200	2502.6	834.20
ICCV 07304	913.80	1218.30	609.30	27414.0	613.80
ICCV 07306	666.60	888.50	444.70	1999.8	666.60
ICCV 07307	1307.00	1742.60	871.40	3921.0	1307.00
ICCV 07309	620.90	827.70	414.10	1862.7	620.90
ICCV 07312	524.20	698.90	349.50	1572.6	524.20
ICCV 07313	441.90	589.10	294.70	1325.7	441.90

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	6501116.751	224176.440	19.998**	1.65	2.03
Treatment	2	3621566.963	180783.483			
Error	58	650189.349	11210.161			
TOTAL	89	10772873.063				

** - Highly significant

Coefficient of variation = 0.45%

Appendix Table 13. Weight of 100 seeds (g)

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	14.2	15	14.8	44.0	14.67
ICCV 10	15.0	13	11.7	39.7	13.23
ICCV 93952	19.5	21	22.5	63.0	21.00
ICCV 93954	17.9	17.3	18.0	53.2	17.73
ICCV 94954	20.7	20.5	22.1	63.3	21.10
ICCV 06101	20.6	20.8	22.7	64.1	21.37
ICCV 06102	21.0	21.7	19.3	62.0	20.67
ICCV 06104	17.2	17.4	17.9	52.5	17.50
ICCV 06105	35.4	36.6	38.4	110.4	36.80
ICCV 06106	18.2	18.5	18.5	55.2	18.40
ICCV 06107	22.7	22.0	22.7	67.4	22.47
ICCV 06108	23.4	22.5	22.7	68.6	22.87
ICCV 07107	15.8	15.4	15.3	46.5	15.50
ICCV 07114	25.7	22.1	24.6	72.4	24.13
ICCV 07115	15.3	16.3	16.8	48.4	16.13
Kabuli Type					
ICCV 2	20.4	20.8	21.1	62.3	20.77
ICCV 92311	35.7	32.7	36.0	104.4	34.80
ICCV 92337	23.0	23.2	28.6	74.8	24.93
ICCV 95311	26.1	26.7	25.4	78.2	26.07
ICCV 95332	30.1	29.1	28.0	87.4	29.07
ICCV 95333	23.7	27.6	27.7	79.0	26.33
ICCV 95334	2.44	23.4	25.6	73.4	24.47
ICCV 06301	23.7	25.1	27.1	75.9	25.30
ICCV 06306	22.3	24.3	25.0	71.6	23.87
ICCV 07304	28.4	28.8	26.4	83.6	27.87
ICCV 07306	30.6	23.7	23.2	77.5	25.83
ICCV 07307	39.1	33.2	32.2	104.5	34.83
ICCV 07309	25.6	31.2	26.8	83.6	27.87
ICCV 07312	28.8	22.0	22.8	73.6	24.53
ICCV 07313	27.2	25.1	27.7	80.0	26.67

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	2911.371	100.392		1.65	2.03
Treatment	2	4.770	2.385	30.046**		
Error	58	193.797	3.341			
TOTAL	89	3109.938				

** - Highly significant

Coefficient of variation = 0.26%

Appendix Table 14. Germination test (%)

TREATMENT	TREATMENT I	II	III	TOTAL	MEAN
Desi Type					
ICCC 37	72.00	42.00	70.00	184.00	61.33
ICCV 10	48.00	40.00	46.00	134.00	49.67
ICCV 93952	14.00	32.00	30.00	76.00	25.33
ICCV 93954	80.00	82.00	82.00	244.00	81.33
ICCV 94954	66.00	66.00	84.00	216.00	72.00
ICCV 06101	80.00	62.00	30.00	172.00	57.33
ICCV 06102	82.00	94.00	86.00	262.00	87.33
ICCV 06104	74.00	44.00	62.00	180.00	60.00
ICCV 06105	62.00	64.00	78.00	204.00	68.00
ICCV 06106	32.00	28.00	52.00	112.00	37.33
ICCV 06107	26.00	38.00	28.00	92.00	30.67
ICCV 06108	54.00	38.00	58.00	150.00	50.00
ICCV 07107	78.00	76.00	84.00	238.00	79.33
ICCV 07114	70..00	82.00	76.00	228.00	76.00
ICCV 07115	58.00	56.00	68.00	182.00	60.67
Kabuli Type					
ICCV 2	90.00	84.00	88.00	262.00	87.33
ICCV 92311	53.00	60.00	74.00	186.00	62.00
ICCV 92337	64.00	56.00	64.00	184.00	61.33
ICCV 95311	94.00	88.00	78.00	260.00	86.67
ICCV 95332	84.00	68.00	70.00	222.00	74.00
ICCV 95333	72.00	56.00	62.00	190.00	63.33
ICCV 95334	49.33	44.33	56.33	149.90	50.00
ICCV 06301	54.00	72.00	58.00	184.00	61.33
ICCV 06306	68.00	60.00	80.00	208.00	69.33
ICCV 07304	64.00	48.00	48.00	166.00	53.33
ICCV 07306	50.00	48.00	56.00	154.00	51.33
ICCV 07307	30.00	36.00	44.00	110.00	36.67
ICCV 07309	72.00	76.00	60.00	208.00	69.33
ICCV 07312	70.00	62.00	54.00	186.00	62.00
ICCV 07313	66.00	84.00	80.00	230.00	76.67

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULAR F	
					0.05	0.01
Replication	29	23246.637	801.608		1.65	2.03
Treatment	2	258.689	129.344	5.500**		
Error	58	5469.978	94.310			
TOTAL	89	28975.304				

** - Highly significant

Coefficient of variation = 0.52%