BIBLIOGRAPHY

COPSIYAT, MARLON B. MAY 2010. Growth and yield response of chickpea (*Cicer arietinum L.*) To Frequency of irrigation under La Trinidad Benguet conditon. Benguet State University, La Trinidad Benguet.

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ABSTRACT

The study was conducted at Balili Experimental Station, Benguet State University, La Trinidad Benguet from November 2009 to April 2010 to determine the growth and yield response of chickpea to frequency of irrigation and to determine the best interval of irrigation that would ensure higher yield under Benguet State University, La Trinidad Benguet condition.

Results show that Kabuli type varieties used irrigated every 5 days were the earliest to attain 50% flowering while Desi type varieties significantly flowered later. Kabuli type varieties irrigated every 15 days were the earliest to attain harvesting stage. As to average plant height at flowering, ICCV 95334 irrigated every 15 days were the tallest plant at flowering. Every 15 days irrigation interval on variety ICCV 06102 produced more number of lateral branches, although comparable with the varieties ICCV 93954, ICCV 93952 and ICCV 2. As to average number of pods per plant and average number of filled pods, Kabuli type ICCV 2 irrigated every 15 days had significantly the highest number of pods per plant, number of filled pods, highest yield per plant, highest yield per plot and heaviest computed yield per hectare. As to weight of 100 seeds (g), ICCV 953394(a big-seeded Kabuli variety) irrigated every 15 days attained the heaviest 100 seeds weight (g) under Benguet Sate University, La Trinidad, Benguet conditions with an average temperature range of 16-24^{o}c and Relative Humidity of 85-94%.

TABLE OF CONTENTS

INTRODUCTION

Chickpea (*Cicer arietinum L.*) is a small bushy annual plant. The plant grows approximately 30 to 60 cm tall. It has well developed root system. The root usually include central strong tap root, with numerous lateral branches that spread out in all directions in at the upper layer of the soil (Singh, 1983).

Chickpea is widely cultivated in warm temperate and tropical areas for its edible seed. Plants only succeed outdoors in Britain in hot summers. Plants are about as hardly as broad beans but they often do not succeed in mild moist maritime climates because the seed pods are hairy and this holds moisture. Plants require 4-6months with moderately warm dry conditions if they are to crop well.

Chickpea is a very important pulse crop that grows as a seed of plant named *Cicer arietinum L.* in the Leguminosae family. This light brown colored pulse is considered to be good source of protein and is also called by the name Garbanzo beans. This plant has the capacity to stand in drought conditions; this crop doesn't have the requirement of being fed with nitrogen fertilizers.

Chickpea (*Cicer arietinum L.*) has one of the highest nutritional compositions of any dry edible legume. It is the most important legume grown globally. Because of 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. The plant is free from various anti- nutritional factors and has high protein (23%), total carbohydrates (64%) and dietary fiber content. Chickpeas are rich in minerals and vitamins.

Chickpea is mainly used for human consumption and only a small proportion is used as food. The kabuli type (white or cream seed coat) is generally used as a whole

grains, while desi type (colored seed coat) requires a specialized process called decortications, to remove its seed coat if it is used for human food. Chick pea is also known for its use in herbal medicine and cosmetics.

Chickpea however, have not been introduced in the Cordilleras especially in Benguet. This is 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 become a major cash earner.

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

The objectives of the study were to determine the growth and yield response of chickpea to frequency of irrigation under Benguet State University, La Trinidad Benguet condition and to determine the best interval of irrigation that would ensure higher yield under BSU, La Trinidad condition.

The study was conducted from November to April 2010 at Balili Experimental Station, Benguet State University, La Trinidad, Benguet.

REVIEW OF LITERATURE

Botany of Chickpea

Chickpea *(Cicer arietinum L.*) is erect or spreading, stems are branched, sometimes shrubby much branched, 0.2-1 m tall, glandular pubescent olive, dark green or bluish green in color. Root system is robust, up to 2 m deep, but major portion up to 60 cm. leaves imparipinnate, glandular pubescent with 3 to 8 pairs of leaflets and a top leaflet (rachis ending in a leaflet); leaflets ovate to elliptic, 0.6-2.0 cm long,.3-1.4 cm wide; margin serrate, apex acumenate to aristate, base cuneate stipules 2-5 toothed, stipules absent. Flowers solitary, sometimes 2 per inflorescence axillary, peduncles 0.6-3 cm long , pedicels .5-1.3 cm long, braces triangular calyx 7-10 mm long; corolla white, pink, purplish or blue, .8-1.2 cm long. The staminal column is diadelphous (9-1) and the ovary is sessile, inflated and pubescent (Duke, 1981; Cubero, 1987; cleaning, drying, and aeration are necessary to control seed beetles. A thin coating with vegetable 1987, Van der Maesen, 1987). Pod rhomboid ellipsoid, 1-2 with three seeds as a maximum, and inflated, glandular pubescent. Color of seeds may vary from cream, yellow, brown, white, dark brownish, rounded to angular, seed coat smooth or wrinkled, laterally compressed with a median groove around two-thirds of the seed, anterior baked; germination cryptocotylar (Duke, 1981; Cubero, 1987, Van der Maesen, 1987).

Importance and Medicinal Uses

Chickpeas are helpful source of zinc, folate and protein. They are also very high in dietary fiber and hence a healthy source of carbohydrates for persons with insulin sensitivity or diabetes. Chickpeas are low in fat and most of this is polyunsaturated. One

hundred grams of dietary fiber and 8.9 grams protein. Chickpeas also provide dietary calcium content as about the same yogurt and close to milk.

Chickpea is the most hypocholesteremic agent; germinated chickpea was reported to be effective in controlling cholesterol level in rats (Geervani, 1991). Glandular secretion of the leaves, stems and pods consists of malic and oxalic acids, giving a sour taste. In India these acids used to be harvested by spreading thin Muslim over the crop during the night. In the morning the soaked cloth is wrung out, and the acids are collected in bottles. Medicinal applications include use for aphrodisiac, bronchitis, catarrh, cutamenia, cholera, constipation, diarrhea, dyspepsia, flatulence, snakebite, sunstroke, and warts. Acids are supposed to lower the blood cholesterol levels. Seeds are considered antibilious (Duke, 1981).

Water Requirement

Better adapted to low water supply, Meets its water requirement from conserved moisture in deep soils. In heavy soils and under late-sown conditions, it is better to provide two irrigations, one at branching and another at the pod-initiation stage.

Moisture stress in the early stages will result in low and non-uniform plant stands, Stunted plants reduced branching and pale-colored lower leaves

Harvesting and Threshing

Chickpeas mature in 3-7 months and the leaves turn brown/yellow 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 flails. The chaff is separated from the grain by winnowing. Tall cultivars are suitable for mechanized

harvesting in which case combines can be used. Chickpeas are usually stored in bags, but are more subject to insect damage than when stored in bulk. Proper oil can reduce storage damage. Sometimes baskets, made from twisted rice straw, are used as storage containers (Cubero, 1987).

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

Irrigation

Irrigation is the artificial application of water to land for the purpose of agricultural production. Effective irrigation will influence the entire growth process from seedbed preparation, germination, root growth, nutrient utilization, plant growth and regrowth, yield and quality. Irrigation systems should encourage plant growth while minimizing salt imbalances, leaf burns, soil erosion, and water loss. Losses of water will occur due to evaporation, wind drift, run-off and water (and nutrients) sinking deep below the root zone.

Ware (1975) found that to maintain succulence and tenderness, the plant usually requires continues supply of water through its development. Furthermore, Buckman and Brady (1969) reported that large quantities of water must be supplied to satisfy the water requirements of growing plants. Soil moisture helps control other important components essential to normal plant growth: soil erosion and soil temperature. This confirms the statement of Briggs and Shants (1973) that water requirement is profoundly affected by atmosphere conditions. One of the conditions is relative different periods of the year

show great differences. The lower the relative humidity at a given temperature, evaporation and transpiration rates increased and decreased with higher relative humidity.

In addition to these, Chapman and Carter (1976) also stated that the amount of water used directly is related to the yield in all crops. All yield increase, total water used increased because more water is needed for increased plant growth within the limits of available moisture and others. However they added that excessive moisture can reduce crop yield. They pointed that yield reduction is due to excessive moisture. Related to poor aeration of the soil and reduced oxygen supply for the plants respiratory needs. According to Knott (1957), frequency of irrigation depends on the total supply of available moisture reached by the roots and the amount of water used. The first is affected by soil types, the depth of watered soil and dispersion of roots. The latter is influenced by weather conditions and the age of the crop.

Though scientists have determined water requirement of most common crops, Donahue and Shickluna (1971) reported that there are still variations due to the difference in the soil temperature, related humidity, wind movement, and soil fertility. Plant growth is affect by the concentration of the soil solution is saline soils as well as the lack of moisture tension and absorption.

The concentration depends on the amount of water to dissolve salts. On the other hand, Thompson (1969) claimed that frequency of watering and the quantity of water that should be applied depend on the depth of the soil which the root penetrates, utilization of H_20 by the crop and loss of proportion from the surface of the soil. Similarly, the Agro-industrial Guide (1970) as cited by Somera (1981), reported that frequency of irrigation is dependent upon the type of soil, amount of rainfall, condition of the crop and variety.

This aggress will with the statement of Chapman and Carter (1976) who reported that the condition of drought due to moisture stress, total plant growth is reduced. Therefore, yield increases as the amount of available water increases. The total development of plants is restricted if photosynthesis limits vegetative growth and total growth, is reduced proportionately.

MATERIALS AND METHODS

The materials used in the study were seeds of chickpea, fertilizers, fungicide, insecticide, knapsack sprayer, and meter stick, ruler, weighing scale, record books and other requirements.

The experiment was laid out in a Randomized Complete Block Design (RCBD) with frequency of irrigation as Factor A and cultivar as Factor B. The seeds were planted singly at a distance of 30 cm between rows and 20 cm between hills. There are 3 replication per treatment with 3 sample plants per 1x3 m plot. The volume of water applied was 32 liters per plot from planting until harvesting. The treatments were as follows:

Factor A (Frequency of Irrigation)

F_1 After sowing, branching stage, flowering stage (from ICRISAT). Flooding (Field moisture capacity).

F_2 Every 5 days

F_3 Every 10 days

F_4 Every 15 days

Factor B (Type of cultivar)

"Desi Type"	"Kabuli Type"
V_1- ICCV 93952	V_4-ICCV 92311
V_2- ICCV 94954	V_5-ICCV 95334
V_3- ICCV 06102	V_6- ICCV 07307

Care and maintenance This was done to all samples throughout the duration of the study. There are 3 samples per plot.

Data Gathered

The data gathered are the following:

1. Vegetative growth

A. Days from planting to 50% flowering. This was taken at flowering stage from sowing to the stage when 50% of plants had opened to flower.

B. Average plant height at flowering (cm). This was taken at flowering stage (1st flowers).

C. Days from planting to harvesting. This was gathered by counting the number of days from planting to harvesting.

D. Number of lateral stems at flowering. This was taken at flowering (1st flower).

$$\text{Average Number of Lateral Stems} = \frac{\text{Number of Lateral Stems of Sample Plants}}{\text{Sample Plant}}$$

2. Yield

A. Average number of pod/plant. This was computed by dividing the number of pods produced by sample plants after which the average was solved using the formula.

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

B. Average number of filled pods/plant. This was computed as follows:

$$\text{Average Number of Filled Pods/Plant} = \frac{\text{Total Number of Filled Pods Produced by sample}}{\text{Number of sample plants}}$$

C. Average number of unfilled pods/plant. Unfilled pods taken from the average of 3 sample plants per plot.

D. Total yield per plant. This is the total yield per plant.

E. Total yield per plot ($3m^2$). Total yield of experimental plot

F. Computed yield/ha. This was the total yield of experimental plot. ($3m^2$) x 3, 333.33.

3. Seed Quality

A. Weight of 100 seeds (grams). This was taken by weighing 100 seeds (g) of small, medium, and big at 14% Moisture Content.

4. Meteorological Data (taken at BSU- PAGASA) (Figure 1)

A. Temperature (minimum and maximum °C)

B. Relative humidity (%)

C. Rainfall (mm)

5. Documentation- This was taken through pictures (Figure 2-8)

Meteorological Data

Figure 1 shows the temperature, relative humidity and rainfall during the conduct of the study under La Trinidad, Benguet condition from November 2009 to March 2010. The temperature ranged from 21.05°C to 22.95°C. The relative humidity recorded ranged from 82.755 to 88% while no rainfall was observed during the duration of the study

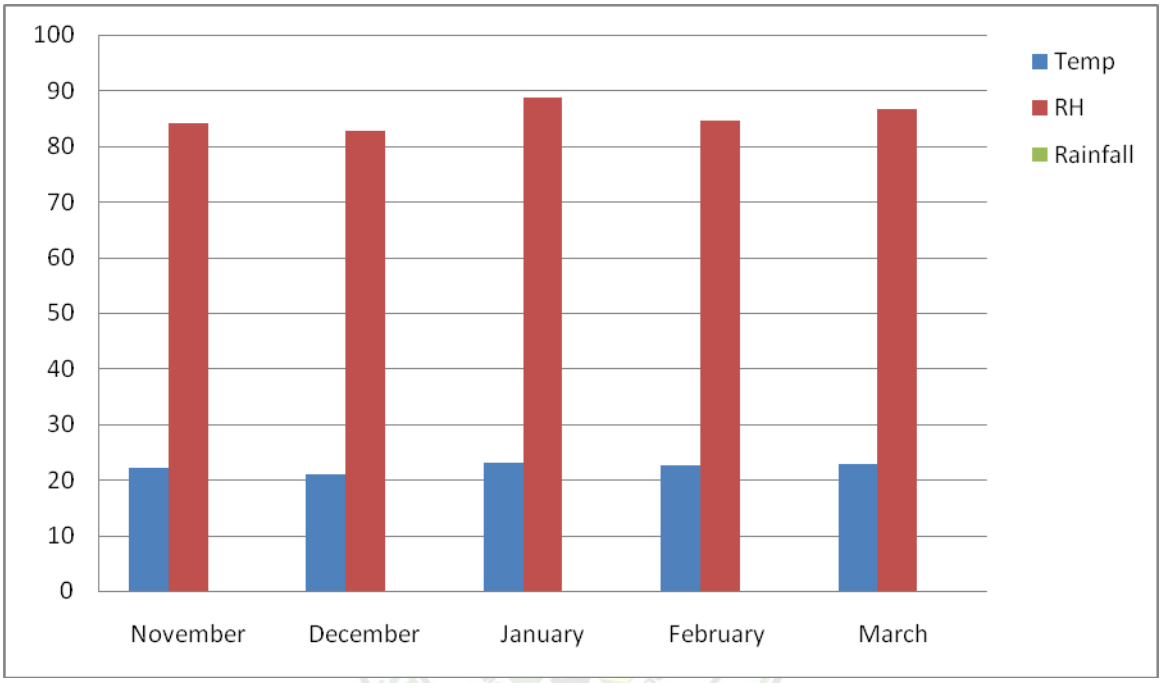

Figure 1. Meteorological data during the study

Figure 2. Overview of the experimental area during land preparation

Figure 3. Overview of the experiment at pod setting stage

Figure 4. Flowering stage of Desi type

Figure 5. Flowering stage of Kabuli type

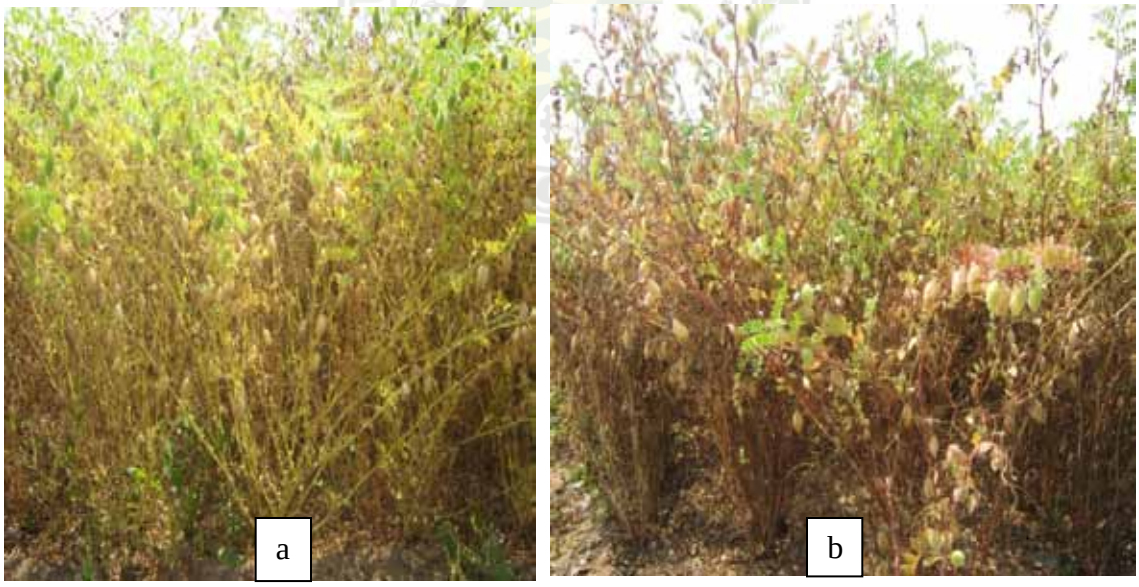

Figure 6. Harvesting stage of (a) kabuli type chickpea and (b) desi type chickpea

Figure 7. Harvesting (a) at yellow brown stage and (b) threshing

Figure 8. Harvested pods being sun dried from different treatments

RESULTS AND DISCUSSION

Days from Planting to 50% Flowering

Effect of variety. The days from planting to 50% flowering was significantly affected by different varieties used. As shown in Table 1, the Kabuli type chickpea significantly flowered earlier than the Desi type variety. Apparently, the ICCV 2 Kabuli type variety were the earliest to produce flower after 45.19 days followed by ICCV 07307 and ICCV 95334 with means of 45.22 and 45.64 while Desi type ICCV 93952 was

Table 1. Days from planting to 50% flowering

TREATMENT	MEAN (Days)
Variety	
ICCV 93952	66.72[a]
ICCV 93954	65.64[b]
ICCV 06102	65.81[b]
ICCV 2	45.19[c]
ICCV 95334	45.64[c]
ICCV 07307	45.22[c]
Frequency of Irrigation	
After sowing, branching stage, flowering stage (from ICRISAT)	58.22[a]
Every 5 days	53.35[d]
Every 10 days	54.39[c]
Every 15 days	56.85[b]
CV (%)	1.44

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

the latest to attain 50% flowering after 66.72 days.

Effect of frequency of irrigation. Result shows that there were significant differences on the days from planting to 50% flowering as affected by frequency of irrigation. Table 1 show that, the chickpea plant irrigated every 5 days were significantly the earliest to flower with a mean of 53.35 days. While those irrigated after sowing, branching stage, flowering stage (ICRISAT recommendation) were the latest to attain 50% flowering of 58.22 days.

Interaction effect. There were no significant interaction effects observed between the variety and frequency of irrigation on the days from planting to 50% flowering.

Average Plant Height at Flowering

Effect of variety. Significant differences were observed on the average plant height at flowering as affected by chickpea varieties. Table 2 showed that, ICCV 95334 were the tallest among the varieties with a mean of 45.12 cm. while ICCV 07307 were the shortest with 34.41cm. mean.

The observed differences among the chickpea varieties maybe attributed to their differential adaptability to local conditions as well as their inherent height potentials.

Effect of frequency of irrigation. Significant differences were noted on the average plant height at flowering as affected by frequency of irrigation. Plants irrigated every 15 days produced the tallest plant at flowering with 42.59 cm. mean while those plants that were irrigated every 5 days were the shortest at flowering with a mean of 38.91 cm.

Table 2. Average plant height at flowering

TREATMENT	MEAN (cm)
Variety	
ICCV 93952	44.47[ab]
ICCV 93954	41.56[c]
ICCV 06102	43.93[b]
ICCV 2	35.68[d]
ICCV 95334	45.12[a]
ICCV 07307	34.41[e]
Frequency of Irrigation	
After sowing, branching stage, flowering stage (from ICRISAT)	40.14[c]
Every 5 days	38.91[d]
Every 10 days	41.81[b]
Every 15 days	42.59[a]
CV (%)	1.95

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

Interaction effect. Statistical analysis revealed that there were no significant interaction effects noted between the variety and frequency of irrigation as to the average plant height at flowering.

Days from Planting to Harvesting

Effect of variety. Days from planting to harvesting is presented in Table 3. Results show that there were significant differences noted among the different chickpea varieties studied. The Desi type (ICCV 93952, ICCV 93954, and ICCV 06102) were the latest to be harvested with a mean of 137.5 days while Kabuli varieties were the earliest to be harvested after 123.5 days under Benguet State University, La Trinidad, Benguet with an average temperature of 16-24^{o}c and relative humidity of 85-94%.

Table 3. Days from planting to harvesting

TREATMENT	MEAN (Days)
Variety	
ICCV 93952	137.5[a]
ICCV 93954	137.5[a]
ICCV 06102	137.5[a]
ICCV 2	123.5[b]
ICCV 95334	123.5[b]
ICCV 07307	123.5[b]
Frequency of Irrigation	
After sowing, branching stage, flowering stage (from ICRISAT)	132.0[a]
Every 5 days	131.0[b]
Every 10 days	130.0[c]
Every 15 days	129.0[d]
CV (%)	0

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

Effect of frequency of irrigation. Significant differences were noted on the days from planting to harvesting as affected by frequency of irrigation. Plants irrigated every 15 days were significantly harvested earlier after 129.0 days; while irrigation of chickpea after sowing, branching stage, flowering stage (from ICRISAT) were the latest to be harvested with a mean of 132.0 days from sowing the seeds.

Interaction effect. Desi type irrigated every 15 days were the earliest to be harvested while Kabuli type irrigated from planting, branching stage, flowering stage (from ICRISAT) were the latest to be harvested as shown in Figure 9.

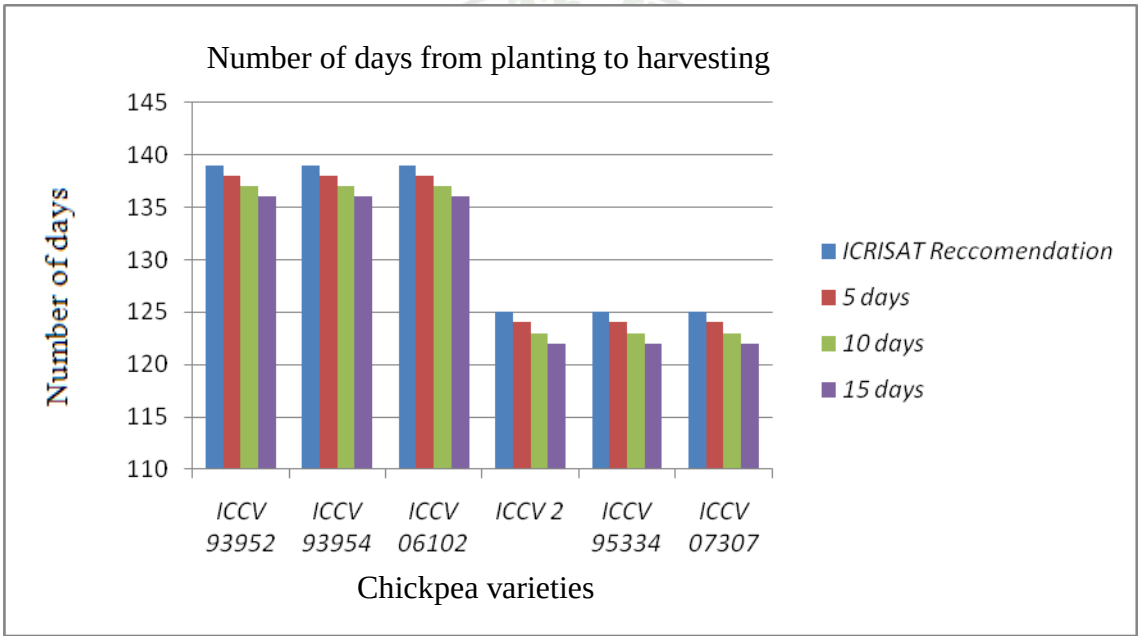

Figure 9. Number of days from planting to harvesting

Varieties

Number Lateral Stems at Flowering

Effect of variety. Table 4 shows that ICCV 06102 had significantly produced the highest number of lateral stems at flowering with an average of 4.25 which is comparable to ICCV 2, ICCV 93952 and ICCV 93954 while chickpea variety ICCV 95334 had produced the lowest lateral stems of 3.36 but was statistically comparable to ICCV 07307. It was observed that Desi type produces more lateral stems than the Kabuli type.

Table 4. Number of lateral stems at flowering

TREATMENT	(MEAN)
Variety	
ICCV 93952	4.06[a]
ICCV 93954	4.22[a]
ICCV 06102	4.28[a]
ICCV 2	3.92[a]
ICCV 95334	3.36[b]
ICCV 07307	3.39[b]
Frequency of Irrigation	
After sowing, branching stage, flowering stage (from ICRISAT)	3.93[ab]
Every 5 days	3.81[ab]
Every 10 days	3.59[b]
Every 15 days	4.15[d]
CV (%)	12.27

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

Effect of frequency of irrigation. The average number of lateral stems at flowering is presented in Table 4. Result shows that there were significant differences as affected by the frequency of irrigation. Chickpea plants irrigated every 15 days produced the highest number of lateral stems at flowering with a mean of 4.15 followed by the varieties irrigated following the ICRISAT recommendation (planting, branching sage, flowering stage) and every 5 days interval while irrigating plant every 10 days had produced the lowest number of lateral stems but was statistically comparable to those plants irrigated every 5 days and ICRISAT recommendation (planting, branching sage, flowering stage).

Interaction effect. Statistical analysis revealed that there were no significant interaction effects between the chickpea varieties and different frequencies of irrigation used in the study with regards to the average number of lateral stems at flowering.

Average Number of Pods per Plant

Effect of variety. The average number of pods per plant is presented in Table 5. Result shows that there were significant differences among the chickpea varieties. ICCV 2, a Kabuli type produced the highest number of pods per plant with an average of 304.17 but was statistically comparable to the variety ICCV 93952. While ICCV 95334 produced the lowest number of pods with 131.61 average per plant

Effect of frequency of irrigation. Result shows that there were significant differences as affected by the frequency of irrigation. Chickpea that were irrigated every 15 days interval produced the highest number of pods per plant (379.63) while chickpea irrigated every 5 days produced the lowest number of pods per plant of 136.52.

Table 5. Average number of pods per plant

TREATMENT	MEAN
Variety	
ICCV 93952	292.42[a]
ICCV 93954	240.53[c]
ICCV 06102	271.72[b]
ICCV 2	304.17[a]
ICCV 95334	131.61[d]
ICCV 07307	231.28[c]
Frequency of Irrigation	
After sowing, branching stage, flowering stage (from ICRISAT)	229.89[b]
Every 5 days	136.52[c]
Every 10 days	235.11[b]
Every 15 days	379.63[a]
CV (%)	6.29

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

Interaction effect. There were significant differences observed between the two factors; variety and frequency of irrigation on the average number of pods per plant. Chickpea varieties irrigated every 15 days had significantly produced more number of pods per plant while chickpea varieties used in the study that was irrigated every 5 days had the lowest number of pods per plant (Figure 10).

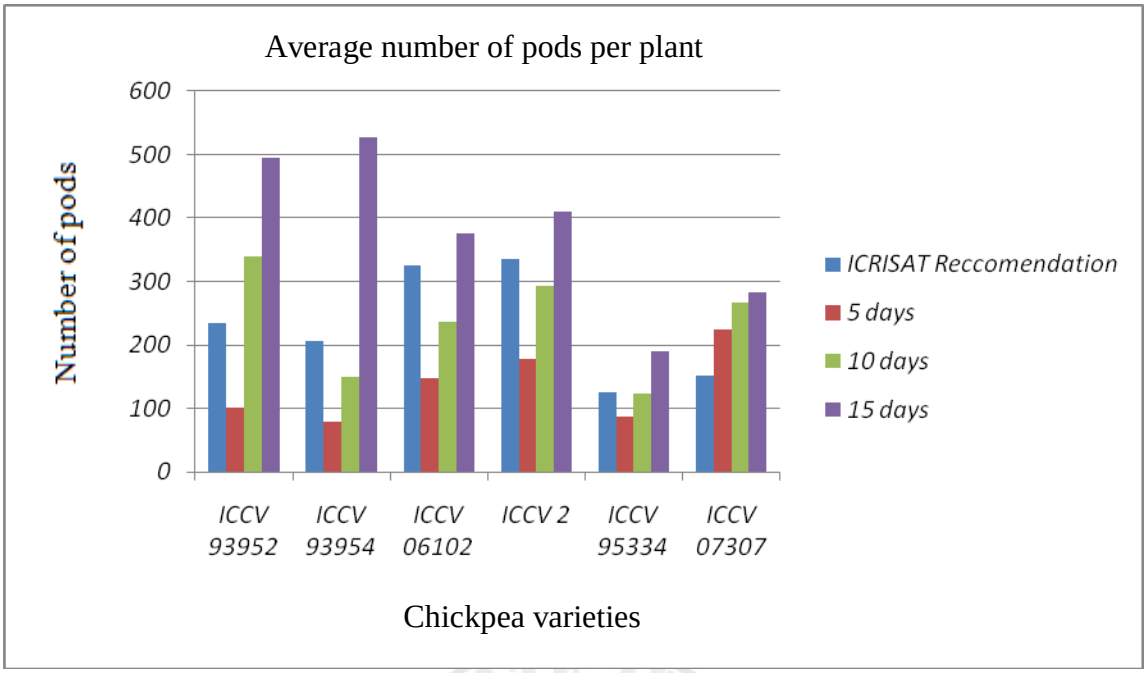

Figure 10. Average number of pods per plant

Average Number of Filled Pods

Effect of variety. Table 6 shows significantly differences on the average number of filled pods per plant. ICCV 2 had significantly the highest average number of filled pods with 289.61 mean per plant while variety ICCV 95334 had produced the lowest number of filled pods with an average of 121.61 plants. The observed differences in the number of filled pods may be inherent characteristics of each cultivar as explained by Thompson and Kelly (1959) that testing of varieties is essential since great difference exists between strains of the same variety in yield, earliness to maturity, size and other performances.

Effect of frequency irrigation. Result shows significant differences on the average number of filled pods as affected by frequency of irrigation. Chickpea irrigated every 15 days had significantly produced the highest average number of filled pods with a mean of

Table 6. Average number of filled Pods

TREATMENT	MEAN
Variety	
ICCV 93952	275.14[b]
ICCV 93954	223.14[d]
ICCV 06102	253.64[c]
ICCV 2	289.61[a]
ICCV 95334	121.61[e]
ICCV 07307	218.53[d]
Frequency of Irrigation	
After sowing, branching stage, flowering stage (from ICRISAT)	214.54[b]
Every 5 days	125.48[c]
Every 10 days	218.98[b]
Every 15 days	362.11[a]
CV (%)	6.69

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

362.11 while those plants irrigated every 5 days had the lowest number of filled pods of 125.48 per plant. As stated by Chapman and Carter (1976), excessive irrigation limits plant survival due to poor aeration of the soil that reduced oxygen supply for plants respiratory activities.

Interaction effect. Figure 11 shows significant differences on the average number of filled pods/plant as affected by the two factors, variety and frequency of irrigation. Chickpea ICCV 2 irrigated every 15 days had the highest number of filled pods while

Figure 11. Average number of filled pods per plant

ICCV 95334 irrigated every 5 days had the lowest number of filled pods produced per plant.

Average Number of Unfilled Pods

Effect of variety. The average number of unfilled pods per plant is presented in Table 7. ICCV 93952 had significantly the highest number of unfilled pods per plant with a mean of 18.11 followed by ICCV 06102 and ICCV 93954 while the variety ICCV 95334 had the lowest number of unfilled pods per plant with a mean of 10.00. This result may be due to the different response of various chickpea cultivars to the existing locality.

Effect of frequency of irrigation. Significant differences were noted on the average number of unfilled pods per plants as affected by frequency of irrigation. Chickpea irrigated every 15 days had the highest number of unfilled pods (17.52) while chickpea plants irrigated every 5 days had the lowest number of unfilled pods per plant (11.59).

Table 7. Average number of unfilled pods

TREATMENT	MEAN
Variety	
ICCV 93952	18.11[a]
ICCV 93954	17.39[a]
ICCV 06102	18.08[a]
ICCV 2	14.56[b]
ICCV 95334	10.00[d]
ICCV 07307	12.75[c]
Frequency of Irrigation	
After sowing, branching stage, flowering stage (from ICRISAT)	15.35[b]
Every 5 days	11.59[c]
Every 10 days	16.13[b]
Every 15 days	17.52[a]
CV (%)	10.01

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

Interaction effect. Significant differences on the average number of unfilled pods were observed as affected by the two factors; variety and frequency of irrigation. ICCV 93952 variety irrigated every 15 days had the highest average number of unfilled pods per plant having a mean of 26.11, while ICCV 95334 variety irrigated from ICRISAT had the lowest number of unfilled pods (Figure 12).

Figure 12. Average number of unfilled pods

Total Seed Yield per Plant

Effect of variety. Total seed yield per plant is presented in Table 8. Result shows that there were significant differences observed among the different varieties of chickpea used. Kabuli type ICCV 2 had produced the heaviest yield per plant with a mean of 78.12g. while Desi type ICCV 93954 had attained the lowest yield per plant of 57.43g. The result clearly supports the statement of Edmund and Andrews (1957) that varieties differ in productivity as an expression of the hereditary genes influenced by the environment. The variety best adapted to the environment reflects the high yield potential according to Villareal (1969).

Table 8. Total seed yield per plant

TREATMENT	MEAN (g)
Variety	
ICCV 93952	66.52[c]
ICCV 93954	57.43[e]
ICCV 06102	65.42[c]
ICCV 2	78.12[a]
ICCV 95334	59.94[d]
ICCV 07307	71.55[b]
Frequency of Irrigation	
After sowing, branching stage, flowering stage (from ICRISAT)	64.61[b]
Every 5 days	34.37[d]
Every 10 days	63.24[c]
Every 15 days	103.78[a]
CV (%)	2.86

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

Effect of frequency of irrigation. The different frequency of irrigation showed significant effects on the total yield per plant. It was noted that chickpea being irrigated every 15 days interval obtained the highest yield per plant of 103.78 while chickpea irrigated every 5 days had the lowest yield per plant of 34.37 mean. As stated by Chapman and Carter (1976), excessive irrigation limits plant survival due to poor aeration of the soil that reduced oxygen supply for plants respiratory activities.

Results further shows that chickpea plants can tolerate low levels of soil water moisture and can still produce high yield.

Interaction effect. Significant differences on the total yield per plant were observed as affected by the two factors; variety and frequency of irrigation were attained. Results showed that ICCV 2 irrigated every 15 days produced the heaviest yield per plant while ICCV 93954 irrigated every 5 days had produced the lowest yield per plant (Figure 13).

Results showed that chickpea can not tolerate excessive moisture which usually leads to lower yield.

Figure 13. Yield per sample plant

Total Yield per Plot

Effect of variety. Result shows that total yield per plot (1 x 3m) were significantly affected by varieties of chickpea used. Variety ICCV 2 had the highest yield per plot ($3m^2$) with a mean of 736.83 grams while variety ICCV 95334 had the lowest total yield per $3m^2$ plot of 386.61g.

Table 9. Total yield per plot

TREATMENT	MEAN (g)
Variety	
ICCV 93952	548.93[c]
ICCV 93954	485.83[d]
ICCV 06102	605.18[b]
ICCV 2	736.83[a]
ICCV 95334	386.61[e]
ICCV 07307	555.22[c]
Frequency of Irrigation	
After sowing, branching stage, flowering stage (from ICRISAT)	589.23[b]
Every 5 days	312.81[d]
Every 10 days	454.36[d]
Every 15 days	856.00[c]
CV	5.66

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

Effect of frequency of irrigation. Table 9 shows that there were significant differences noted on the total yield per plot as affected by frequency of irrigation. Chickpea plants irrigated every 15 days had obtained the heaviest total yield per plot ($3m^2$) of 856.00g while chickpea irrigated every 5 days had the lowest total yield per plot of 312.81 grams.

Interaction effect. There were significant differences observed between the variety and different frequencies of irrigation applied on the total yield per plot (Figure 14). ICCV 2 variety responded when it is irrigated every 15 days by producing the heaviest yield per plot having a mean of 1072.07 grams while ICCV 95334 irrigated every 5 days had the lowest yield per plot ($3m^2$) with a mean of 277.33g.

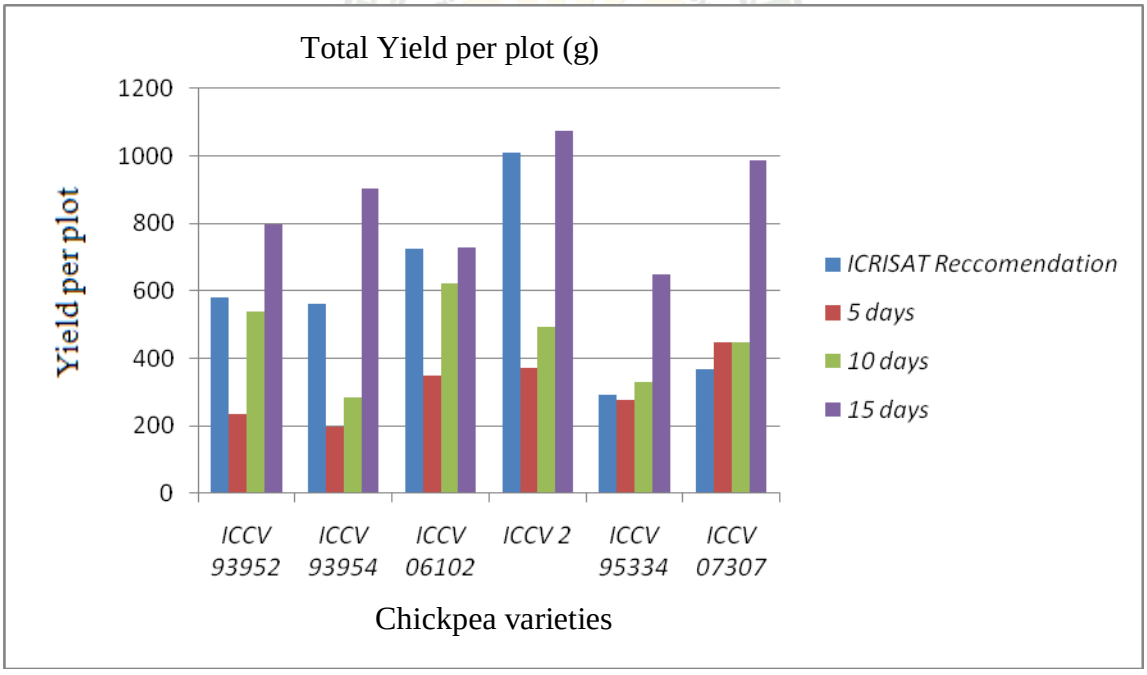

Figure 14. Total yield per plot (g)

Computed Yield per Hectare

Effect of variety. Table 10 shows the computed yield per hectare. Statistical analysis showed that there were significant differences among the different chickpea varieties studied. ICCV 2, a Kabuli type had the highest computed yield per hectare of 2456.11 kilograms while variety ICCV 95334 also a Kabuli type had obtained the lowest yield per hectare. The yield differences could be due to their inherent yield potentials.

Table 10. Computed yield per hectare

TREATMENT	MEAN (kg/ha)
Variety	
ICCV 93952	1843.75[c]
ICCV 93954	1619.44[d]
ICCV 06102	2017.25[b]
ICCV 2	2456.11[a]
ICCV 95334	1288.69[e]
ICCV 07307	1850.72[c]
Frequency of Irrigation	
After sowing, branching stage, flowering stage (from ICRISAT)	1964.09[b]
Every 5 days	1042.69[d]
Every 10 days	1548.87[c]
Every 15 days	2828.33[a]
CV (%)	8.10

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

Effect of frequency of irrigation. The different frequencies of irrigation have significant effect on the computed yield per hectare (kg/ha). Chickpea that were irrigated every 15 days produced the highest yield per hectare with a mean of 2828.33 kg/ha. While chickpea irrigated every 5 days had the lowest yield per hectare of 1042.69. These results may be due to the lower number of pods produced.

Interaction effect. There were significant differences observed between the chickpea varieties and different frequencies of irrigation on the computed yield per hectare. Chickpea variety ICCV 2 had the highest computed yield per hectare (kg/ha) with a mean of 3573.6 at every 15 days irrigation. While ICCV 95334 had the lowest yield per hectare of 924.4 (kg/ha) and this was irrigated every 5 days (Figure 15).

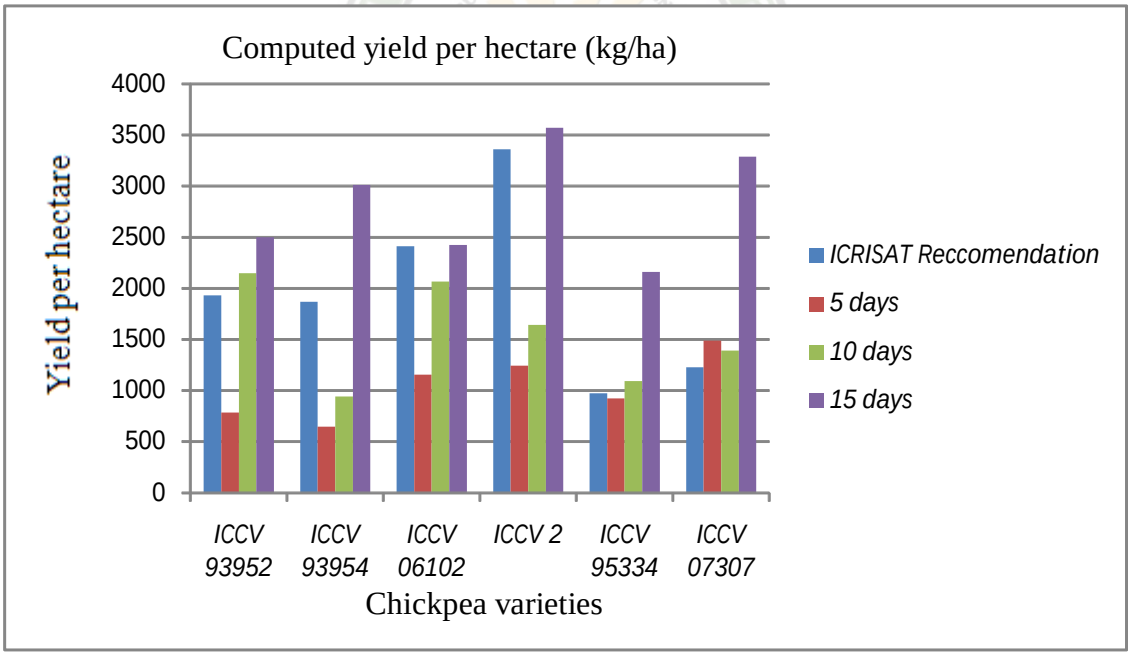

Figure 15. Computed yield per hectare (kg/ha)

Weight of 100 Seeds

Effect of variety. As presented in Table 11, results show that there were significant differences on the weight of 100 seeds (g) as affected by variety of chickpea used. Statistical analysis showed that ICCV 95334 a large seeded Kabuli type had the heaviest weight of 41.13 g/100 seeds while ICCV 2 had the lowest 100 seed weight of 24.16 but was comparable to ICCV 93954 with a mean of 24.47. Thus, these results indicate that seed weight depends on the seed size. The bigger the seed the heavier the weight and the smaller the seed the lower the weight.

Table 11. Weight of 100 seeds

TREATMENT	MEAN (g)
Variety	
ICCV 93952	25.33[d]
ICCV 93954	24.47[e]
ICCV 06102	26.42[c]
ICCV 2	24.16[e]
ICCV 95334	41.13[a]
ICCV 07307	34.14[b]
Frequency of Irrigation	
After sowing, branching stage, flowering stage (from ICRISAT)	29.33[b]
Every 5 days	27.62[c]
Every 10 days	29.21[b]
Every 15 days	30.94[a]
CV (%)	1.46

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

Effect of frequency of irrigation. Significant differences were observed on the weight of 100 seeds (g) as affected by frequency of irrigation. Chickpea plants irrigated every 15 days had obtained the heaviest 100 seeds weight with a mean of 30.94 (g) compared to those plant irrigated every 5 days with 27.62g/100 seed.

Interaction effect. Statistical analysis revealed that there were no significant interaction effects between the different varieties and different frequency of irrigation on the weight of 100 seeds.

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted to determine the growth and yield of chickpea to frequency of irrigation under Benguet State University La Trinidad Benguet condition and to determine the best interval of irrigation that would ensure higher yield under Benguet State University La Trinidad Benguet condition. The study was conducted from November 2009 to April 2010.

Results showed significant differences between the chickpea varieties and frequency of irrigation. Kabuli type ICCV 2 irrigated every 5 days interval were the earliest to attain 50% flowering and irrigated every 15 days Kabuli type variety were the earliest to attain harvesting sage while Desi type ICCV 93952 irrigated after sowing, branching stage and flowering stage (from ICRISAT) took longer days to flower and harvesting stage. On the average plant height at flowering (cm), results showed significant differences wherein ICCV 95334, a Kabuli type irrigated every 15 days were the tallest plants at flowering while ICCV 07307 irrigated every 5 days had the shortest plants at flowering. With regards the average number of lateral stems at flowering, ICCV 0610 irrigated every 15 days produced more lateral stems. However it was comparable to ICCV 93954, ICCV 93952 and ICCV

On the average number of pods per plant and number of filled pods per plant, a kabuli type variety ICCV 2 that was irrigated every 15 days had significantly higher number of pods and number of filled pods per plant and outyielding the chickpea varieties evaluated. But as to the number of unfilled pods, desi type ICCV 93952 irrigated every 15 days had the highest number of unfilled pods but were comparable to ICCV

06102 and ICCV 93954 as compared to Kabuli varieties. For the total yield per plant, total yield per plot and computed yield per hectare significantly higher yield was noted in ICCV 2 irrigated every 15 days and out yielding the rest of the varieties evaluated.

Kabuli type variety ICCV 95334 irrigated every 15 days significantly had the heaviest weight of 100 seeds (g) as compared to ICCV 2 irrigated every 5 days which produced the lightest weight of 100 seeds.

Conclusion

Based on the results and discussions presented, chickpea desi and kabuli type varieties were adopted under Balili experimental station, Benguet State University La Trinidad Benguet condition grown with different frequencies of irrigation. Kabuli type ICCV 2 irrigated every 5 days were the earliest to attain flowering followed by ICCV 07307 and ICCV 95334. Kabuli type variety 95334 was the tallest variety irrigated every 15 days. On the number of days from planting to first harvest, kabuli types irrigated every 15 days interval were the once harvested earlier. ICCV 06102 a desi type irrigated every 15 days produced the highest number of lateral branches. It was noted that kabuli type variety ICCV 2 irrigated every 15 days produced the highest number of pods per plant, highest number of filled pods, highest yield per plant, highest yield per plot and had the heaviest yield per hectare.ICCV 95334, a kabuli type obtained the heaviest weight of 100 seeds (grams) irrigated every 15 days interval.

Recommendation

Based on the results of the study, it is therefore recommended that irrigation every 15 days should be done on chickpea Desi type ICCV 06102 and Kabuli type ICCV 2 as the best suited interval of irrigation with zero rainfall under Balili Experimental Station, Benguet State University, La Trinidad Benguet.

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APPENDICES

Appendix Table 1. Days from planting to 50% flowering

TREATMENT		REPLICATION I	REPLICATION II	REPLICATION III	TOTAL	MEAN
V_1	F_1	65.33	65.00	65.33	196.66	65.55
	F_2	59.00	59.00	60.33	178.33	59.44
	F_3	70.00	71.00	70.67	211.67	70.56
	F_4	72.00	71.00	72.00	215.00	71.67
V_2	F_1	67.33	65.67	66.67	199.67	66.56
	F_2	59.00	61.33	60.00	180.33	60.11
	F_3	65.67	65.67	65.33	196.67	65.56
	F_4	70.00	70.00	71.00	211.00	70.33
V_3	F_1	65.00	65.00	66.67	196.67	65.56
	F_2	66.67	64.33	65.33	196.33	65.44
	F_3	61.00	62.33	62.33	185.66	61.89
	F_4	70.00	71.00	70.00	211.00	70.33
V_4	F_1	58.00	59.00	58.00	175.00	58.33
	F_2	43.33	42.00	42.00	127.33	53.44
	F_3	41.00	40.00	40.00	121.00	40.33
	F_4	39.00	40.00	40.00	119.00	39.67
V_5	F_1	42.00	42.00	42.00	126.00	42.00
	F_2	50.00	48.00	49.00	147.00	49.00
	F_3	45.00	45.00	45.00	135.00	45.00
	F_4	45.00	47.33	47.33	139.66	46.55
V_6	F_1	50.00	53.00	52.00	155.00	51.67
	F_2	43.00	43.00	45.00	131.00	43.67
	F_3	43.00	43.00	43.00	129.00	43.00
	F_4	42.33	43.33	42.00	127.66	42.55

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARE	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Block	2	1.446	0.723			
Variety (A)	5	7725.363	1545.073	2415.96		<.00
Frequency of Irrigation (B)	3	268.612	89.537	140.01		<.00
A X B	15	1231.619	82.108	128.39		<.00
Error	46	29.418	0.640			
TOTAL	7I	9256.459				

Not significant Coefficient of variation = 1.44 %

Appendix Table 2. Average plant height at flowering (cm)

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	F_1	45.60	45.00	44.40	135.00	45.00
	F_2	35.20	35.50	37.13	107.83	35.94
	F_3	49.67	49.70	47.33	146.70	48.9
	F_4	48.33	47.67	48.67	144.67	48.22
V_2	F_1	39.67	38.33	40.67	118.67	39.56
	F_2	68.43	38.33	36.67	113.43	37.81
	F_3	39.97	40.63	40.33	120.93	40.31
	F_4	48.17	48.63	48.83	145.63	48.54
V_3	F_1	46.83	46.67	47.17	140.67	46.89
	F_2	41.83	42.50	41.00	125.33	41.78
	F_3	40.00	41.77	40.50	122.27	40.76
	F_4	46.33	46.00	46.60	138.93	46.31
V_4	F_1	40.00	38.43	39.00	117.43	39.14
	F_2	34.33	33.93	33.33	101.59	33.86
	F_3	38.27	38.50	37.20	113.97	37.99
	F_4	31.50	31.50	32.17	95.17	31.72
V_5	F_1	36.91	36.47	37.27	110.65	36.88
	F_2	49.53	51.93	48.97	150.43	50.14
	F_3	47.50	47.33	48.33	143.16	47.72
	F_4	45.33	45.57	46.27	137.17	45.72
V_6	F_1	34.2	33.93	32.00	100.13	33.38
	F_2	34.53	33.23	33.93	101.69	33.90
	F_3	35.67	35.57	34.80	106.04	35.35
	F_4	34.17	35.10	35.77	105.04	35.01

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQAURE	COMPUTED F	TABULAR 0.05	TABULAR 0.01
Block	2	0.340	0.170			
Variety (A)	5	1314.735	262.947	414.60	<.00	
Frequency of Irrigation (B)	3	148.052	49.351	77.81	<.00	
A X B	15	877.230	58.482	92.21	<.00	
Error	46	29.174	0.634			
TOTAL	71	2369.531				

Not significant Coefficient of variation = 1.95 %

Appendix Table 3. Days from planting to first harvest

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	F_1	139	139	139	417	139
	F_2	138	138	138	414	138
	F_3	137	137	137	411	137
	F_4	136	136	136	408	136
V_2	F_1	139	139	139	417	139
	F_2	138	138	138	414	138
	F_3	137	137	137	411	137
	F_4	136	136	136	408	136
V_3	F_1	139	139	139	417	139
	F_2	138	138	138	414	138
	F_3	137	137	137	411	137
	F_4	136	136	136	408	136
V_4	F_1	125	125	125	375	125
	F_2	124	124	124	372	124
	F_3	123	123	123	369	123
	F_4	122	122	122	366	122
V_5	F_1	125	125	125	375	125
	F_2	124	124	124	372	124
	F_3	123	123	123	369	123
	F_4	122	122	122	366	122
V_6	F_1	125	125	125	375	125
	F_2	122	122	122	366	122
	F_3	121	121	121	363	121
	F_4	120	120	120	360	120

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQAURE	COMPUTED F	TABULAR F	
					0.05	0.01
Block	2	0.000	0.000			
Variety (A)	5	3528.000	705.600	Infty		<.00
Frequency of Irrigation (B)	3	90.000	30.000	Infty		<.00
A X B	15	0.000	0.000	.		.
Error	46	0.000	0.000			
TOTAL	71	3618.000				

Highly significant Coefficient of variation = 0 %

Appendix Table 4. Number of lateral branches at flowering

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	F_1	3.67	4.00	4.67	12.34	4.11
	F_2	4.00	3.67	4.00	11.67	3.89
	F_3	4.00	3.67	4.67	12.34	4.11
	F_4	4.67	3.67	4.00	12.34	4.11
V_2	F_1	4.67	4.67	4.67	14.01	4.67
	F_2	4.33	4.67	3.33	12.33	4.11
	F_3	3.67	3.67	3.33	10.67	3.56
	F_4	4.00	4.67	5.00	13.67	4.56
V_3	F_1	4.67	5.67	4.00	14.34	4.78
	F_2	5.00	3.67	3.67	12.34	4.11
	F_3	3.00	4.33	4.00	11.33	3.78
	F_4	4.00	4.33	5.00	13.33	4.44
V_4	F_1	5.00	4.33	4.00	13.33	4.44
	F_2	4.00	4.00	3.33	11.33	3.78
	F_3	3.33	3.00	3.33	9.66	3.22
	F_4	4.00	4.67	4.00	12.67	4.22
V_5	F_1	2.67	3.00	2.33	8.00	2.67
	F_2	4.00	3.33	3.33	10.66	3.55
	F_3	3.67	4.00	3.33	11.00	3.67
	F_4	3.67	3.67	3.33	10.67	3.56
V_6	F_1	3.00	3.33	2.33	8.66	2.89
	F_2	4.00	3.33	3.00	10.33	3.44
	F_3	3.33	3.67	2.67	9.67	3.22
	F_4	3.67	4.00	4.33	12.00	4.00

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQAURE	COMPUTED F	TABULAR F	
					0.05	0.01
Block	2	0.680	0.340			
Variety (A)	5	9.841	1.968	8.72	<.00	
Frequency of Irrigation (B)	3	2.897	0.966	4.28	.01	
A X B	15	7.742	0.516	2.29	.02	
Error	46	10.377	0.226			
TOTAL	71	31.537				

Not significant Coefficient of variation = 12.7 %

Appendix Table 5. Average number of pods per plant

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	F_1	243.67	223.67	237.67	705.01	235.00
	F_2	101.00	100.83	101.50	303.33	101.11
	F_3	344.00	328.34	346.33	1018.67	339.56
	F_4	492.67	520.00	469.34	1482.01	494.00
V_2	F_1	218.00	186.34	212.33	616.67	205.56
	F_2	79.00	7 8.00	82.67	239.67	79.89
	F_3	156.34	150.00	145.34	451.68	150.56
	F_4	518.34	531.00	529.00	1578.34	526.11
V_3	F_1	338.33	324.34	314.33	977.00	325.67
	F_2	136.00	143.33	166.00	445.33	148.44
	F_3	246.66	235.33	229.67	711.66	237.22
	F_4	404.34	352.00	370.33	1126.67	375.56
V_4	F_1	380.33	313.34	314.00	1007.67	335.89
	F_2	175.00	176.67	181.67	533.34	177.78
	F_3	316.67	293.33	269.33	879.33	293.11
	F_4	422.33	395.00	412.33	1229.66	409.89
V_5	F_1	139.00	112.00	126.67	377.67	125.89
	F_2	85.00	93.66	81.00	259.66	86.55
	F_3	118.33	125.66	128.00	371.99	124.00
	F_4	206.67	179.33	184.00	570.00	190.00
V_6	F_1	158.34	166.66	129.00	454.00	151.33
	F_2	215.00	244.66	216.33	675.99	225.33
	F_3	251.67	274.34	272.67	798.68	266.23
	F_4	278.00	297.33	271.34	846.67	282.22

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQAURE	COMPUTED F	TABULAR F 0.05	0.01
Block	2	1247.735	623.868			
Variety (A)	5	234346.438	46869.288	196.67		<.00
Frequency of irrigation (B)	3	543952.324	181317.441	760.85		<.00
A X B	15	276748.628	18449.909	77.42		<.00
Error	46	10962.183	238.308			
TOTAL	71	1067257.309				

Significant Coefficient of variation = 6.29 %

Appendix Table 6. Average number of filled pods

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	F_1	231.67	210.00	224.67	666.34	222.11
	F_2	92.67	92.83	92.83	278.33	92.78
	F_3	321.67	306.67	325.00	953.34	317.78
	F_4	466.67	493..33	443.67	1403.67	467.89
V_2	F_1	203.33	171.67	198.33	573.33	191.11
	F_2	68.00	66.33	70.67	205.00	68.33
	F_3	141.67	136.67	131.67	410.01	136.67
	F_4	489.67	500.67	499.00	1489.34	496.45
V_3	F_1	315.33	300.67	294.33	910.33	303.44
	F_2	121.00	129.00	150.33	400.33	133.44
	F_3	223.33	210.00	205.00	638.33	212.78
	F_4	392.67	342.00	360.00	1094.67	364.89
V_4	F_1	368.33	301.67	301.67	971.67	323.89
	F_2	163.33	166.67	170.00	500.00	166.67
	F_3	301.67	278.00	255.00	834.67	278.22
	F_4	402.33	373.33	393.33	1168.99	389.66
V_5	F_1	131.00	103.33	119.00	353.33	117.78
	F_2	73.33	83.33	71.00	227.66	75.89
	F_3	106.00	114.33	116.67	337.00	112.33
	F_4	197.67	169.33	174.33	541.33	180.44
V_6	F_1	136.67	143.33	106.67	386.67	128.89
	F_2	205.00	236.33	206.00	647.33	215.78
	F_3	241.67	263.67	263.00	768.34	256.11
	F_4	270.00	288.33	261.67	820.00	273.33

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQAURE	COMPUTED F	TABULAR F 0.05	0.01
Block	2	1238.189	619.095			
Variety (A)	5	216918.008	43383.602	182.75		<.00
Frequency of irrigation (B)	3	517293.474	172431.158	726.34		<.00
A X B	15	255883.949	17058.938	71.86		<.00
Error	46	10920.229	237.396			
TOTAL	71	1002253.849				

Significant Coefficient of variation = 6.69 %

Appendix Table 7. Average number of unfilled pods

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	F_1	12.00	13.67	13.00	38.67	12.89
	F_2	8.33	8.00	8.67	25.00	8.33
	F_3	22.33	21.67	21.33	65.33	21.78
	F_4	26.00	26.67	25.67	78.34	26.11
V_2	F_1	14.67	14.67	14.00	43.34	14.45
	F_2	11.00	11.67	12.00	34.67	11.56
	F_3	14.67	13.33	13.67	41.67	13.89
	F_4	28.67	30.33	30.00	89.00	29.67
V_3	F_1	23.00	23.67	20.00	66.67	22.22
	F_2	15.00	14.33	15.67	45.00	15.00
	F_3	23.33	25.33	24.67	73.33	24.44
	F_4	11.67	10.00	10.33	32.00	10.67
V_4	F_1	12.00	11.67	12.33	36.00	12.00
	F_2	11.67	10.00	11.67	33.34	11.11
	F_3	15.00	15.33	14.33	44.66	14.89
	F_4	20.00	21.67	19.00	60.67	20.22
V_5	F_1	8.00	8.67	7.67	24.34	8.11
	F_2	11.67	10.33	10.00	32.00	10.67
	F_3	12.33	11.33	11.33	34.99	11.66
	F_4	9.00	10.00	9.67	28.67	9.56
V_6	F_1	21.67	23.33	22.33	67.33	22.44
	F_2	10.00	8.33	10.33	28.66	9.55
	F_3	10.00	10.67	9.67	30.34	10.11
	F_4	8.00	9.00	9.67	26.67	8.89

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQAURE	COMPUTED F	TABULAR F	
					0.05	0.01
Block	2	1.022	0.511			
Variety (A)	5	660.348	132.070	57.48		<.00
Frequency of irrigation (B)	3	346.814	115.605	50.31		<.00
A X B	15	1626.090	108.406	47.18		<.00
Error	46	105.697	2.298			
TOTAL	71	2739.971				

Significant Coefficient of variation = 10.01 %

Appendix Table 8. Total yield per plant (g)

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	F_1	512.40	687.60	540.70	1740.70	580.23
	F_2	218.00	228.60	262.90	709.50	236.50
	F_3	580.50	621.20	547.60	1749.30	583.10
	F_4	783.90	806.60	797.00	2387.50	795.83
V_2	F_1	526.50	565.80	590.40	1682.70	560.90
	F_2	185.00	188.60	211.70	585.30	195.10
	F_3	291.10	291.10	266.70	848.90	282.97
	F_4	903.70	900.30	909.10	2713.10	904.37
V_3	F_1	702.70	754.90	716.10	2173.70	724.57
	F_2	354.30	329.30	358.60	1042.20	347.40
	F_3	640.70	610.10	611.70	1862.50	620.83
	F_4	743.10	729.50	711.10	2183.70	727.90
V_4	F_1	944.70	1048.00	1032.40	3025.10	1008.37
	F_2	369.60	367.00	383.40	1120.00	373.33
	F_3	500.30	515.60	464.80	1480.70	493.57
	F_4	1099.00	1102.80	1014.40	3216.20	1072.07
V_5	F_1	300.70	294.50	281.70	876.90	292.30
	F_2	273.50	267.90	290.60	832.00	277.33
	F_3	348.44	307.00	328.50	983.94	327.98
	F_4	662.60	620.30	663.60	1946.50	648.83
V_6	F_1	392.30	362.80	351.90	1107.00	369.00
	F_2	449.40	415.50	476.50	1341.40	447.13
	F_3	430.60	419.50	403.10	1253.20	417.73
	F_4	1000.20	982.00	978.80	2961.00	987.00

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQAURE	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Block	2	1270.951	635.476			
Variety (A)	5	24831.206	164966.241	168.04		<.00
Frequency of irrigation (B)	3	2889799.462	963266.487	981.20		<.00
A X B	15	966253.456	64416.897	65.62		<.00
Error	46	45159.376	981.726			
TOTAL	71	4727314.450				

Significant Coefficient of variation = 5.66 %

Appendix Table 9. Total yield per plot (g)

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	F_1	1708.00	2292.00	1802.33	5802.33	1934.11
	F_2	727.00	762.00	876.33	2365.33	788.44
	F_3	1935.00	2688.66	1825.33	6448.99	2149.66
	F_4	2613.00	2688.66	2656.66	7958.32	2652.77
V_2	F_1	1755.00	1886.00	1968.00	5609.00	1869.70
	F_2	616.67	628.67	705.67	1951.01	650.34
	F_3	970.33	970.33	889.00	2829.66	943.22
	F_4	3012.33	3001.00	3030.33	9043.66	3014.55
V_3	F_1	2342.33	2516.33	2387.00	7245.66	2415.22
	F_2	1181.00	1097.67	1195.33	3474.00	1158.00
	F_3	2135.66	2033.66	2039.00	6208.32	2069.44
	F_4	2477.00	2431.66	2370.33	7278.99	2426.30
V_4	F_1	3149.00	3493.33	3441.33	10083.66	3361.22
	F_2	1232.00	1223.33	1278.00	3733.33	1244.44
	F_3	1667.66	1718.66	1549.33	4935.65	1645.22
	F_4	3663.33	3676.00	3381.33	10720.66	3573.55
V_5	F_1	1002.33	981.67	939.00	2923.00	974.33
	F_2	911.67	893.00	968.70	2773.37	924.46
	F_3	1161.33	1023.33	1095.00	3279.66	1093.22
	F_4	2208.66	2067.66	2212.00	6488.32	2162.77
V_6	F_1	1307.67	1209.33	1173.00	3690.00	1230.00
	F_2	1498.00	1385.00	1588.33	4471.33	1490.44
	F_3	1435.33	1398.33	1343.67	4177.33	1392.44
	F_4	3334.00	3273.33	3262.66	9869.99	3290.00

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQAURE	COMPUTED F	TABULAR F 0.05	0.01
Block	2	70111.64	35055.82			
Variety (A)	5	9162042.13	1832408.43	81.98	<.00	
Frequency of irrigation (B)	3	30825357.39	10275119.13	459.71	<.00	
A X B	15	11612105.18	774140.35	34.64	<.00	
Error	46	028157.56	22351.25			
TOTAL	71	52697773.89				

Significant Coefficient of variation = 8.10 %

Appendix Table 10. Computed yield per hectare (kg/ha)

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	F_1	24.00	23.20	23.50	70.70	23.57
	F_2	26.20	25.10	26.00	77.30	25.77
	F_3	24.10	24.20	24.40	72.70	24.23
	F_4	28.00	27.90	27.40	83.30	27.77
V_2	F_1	24.20	24.00	25.00	73.20	24.40
	F_2	23.00	23.70	23.60	70.30	23.43
	F_3	24.90	24.40	24.30	73.60	24.53
	F_4	25.40	25.30	25.80	76.50	25.50
V_3	F_1	26.00	25.90	26.00	77.90	25.97
	F_2	26.40	26.00	26.80	79.20	26.40
	F_3	26.00	26.30	26.80	79.10	26.37
	F_4	26.60	27.60	26.60	80.80	26.93
V_4	F_1	24.90	24.20	24.70	73.80	24.60
	F_2	22.60	23.10	23.00	68.70	22.90
	F_3	24.00	24.00	24.30	72.30	24.10
	F_4	24.70	25.80	24.60	75.10	25.03
V_5	F_1	43.00	42.30	43.10	128.40	42.80
	F_2	36.70	36.00	36.70	109.40	36.47
	F_3	40.50	41.30	41.10	122.90	40.97
	F_4	44.40	44.000	44.50	132.90	44.30
V_6	F_1	35.00	34.00	35.00	104.00	34.67
	F_2	30.10	31.20	30.90	92.20	30.73
	F_3	35.70	34.30	35.10	105.10	35.03
	F_4	36.10	36.50	35.80	108.40	36.13

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQAURE	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.461	0.230			
Variety (A)	5	2847.740	569.548	3116.79	<.00	
Frequency of irrigation (B)	3	99.816	33.272	182.08	<.00	
A X B	15	100.792	6.719	36.77	<.00	
Error	46	8.406	0.183			
Total	71	3057.215				

Significant Coefficient of variation = 1.46 %

Appendix Table 11. Weight of 100 seeds (g)

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	F_1	70.17	80.03	69.37	219.57	73.19
	F_2	22.20	22.47	21.37	66.04	22.01
	F_3	64.47	65.73	59.30	189.50	63.17
	F_4	104.23	108.83	110.10	323.16	107.72
V_2	F_1	44.07	48.40	46.17	138.64	46.21
	F_2	15.23	14.00	15.03	44.26	14.75
	F_3	33.40	34.47	33.00	100.87	33.62
	F_4	134.10	134.47	136.87	405.44	135.15
V_3	F_1	78.80	75.60	75.87	230.27	76.76
	F_2	35.17	33.90	36.80	105.87	35.29
	F_3	49.90	49.57	49.57	149.04	49.68
	F_4	98.43	100.17	101.30	299.90	99.97
V_4	F_1	83.50	83.23	82.13	248.86	82.95
	F_2	40.00	40.97	41.73	122.70	40.90
	F_3	85.03	84.30	83.60	252.93	84.31
	F_4	104.67	104.00	104.33	313.00	104.33
V_5	F_1	55.57	55.27	55.47	166.31	55.44
	F_2	31.07	31.37	30.90	93.34	31.11
	F_3	63.57	64.13	64.33	192.03	64.01
	F_4	92.23	87.40	87.97	267.60	89.20
V_6	F_1	54.43	53.43	51.53	159.39	53.13
	F_2	62.00	62.33	62.10	186.43	62.14
	F_3	86.20	83.63	84.03	253.86	84.62
	F_4	85.90	86.20	86.80	258.90	86.30

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQAURE	COMPUTED F	TABULAR F	
					0.05	0.01
Block	2	4.385	2.192			
Variety (A)	5	443.875	688.775	190.15	<.00	
Frequency of irrigation (B)	3	43852.693	14617.564	4035.48	<.00	
A X B	15	14466.123	964.408	266.24	<.00	
Error	46	166.624	3.622			
TOTAL	71	61933.700				

Not significant Coefficient of variation = .86 %