BIBLIOGRAPHY

BULANGEN, DIEGO JR S. MAY 2010. Response of Chickpea (*Cicer arietinum L.*) to Different Sources of Organic Fertilizers under La Trinidad, Benguet Condition. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted at BSU Experimental Station, Benguet State University, La Trinidad, Benguet from November 2009 to March 2010 to determine the growth and yield of chickpea as affected by different sources of organic fertilizers, to identify the chickpea accessions that would respond favorably to the application of different organic fertilizers and to determine the economics using the different organic fertilizer treatments in chickpea production.

There were significant differences observed on the average number of pods per plant, average number of filled and unfilled pods, total yield per plot and computed yield per hectare, total yield per sample and weight of 100 seeds as affected by the different sources of organic matter of plants applied with ½ kg/m² (5T/ha). BSU compost attained the highest number of pods, number of filled pods and total yield per sample while plants applied with sagana 100 attained the highest number of unfilled pods, total yield per plot, computed yield per hectare and weight of 100 seeds.

Plants applied with unprocessed chicken manure on the other hand, had the lowest number of pods per plant, average number of filled and unfilled pods while those applied with

processed chicken manure had the lowest total yield per plot, total yield per hectare and weight of 100 seeds. Unprocessed chicken manure application attained the lowest yield per sample.

In terms of the different varieties used in the study, ICCV 93952 (Desi type) were the earliest to reach 50% flowering, tallest plants at flowering, had the highest number of pods per plant, had the highest average number of filled and unfilled pods, had the highest total yield per plot, highest yield per sample, and highest computed yield per hectare while ICCV 06102 (Desi type) were the latest to be harvested. ICCV 2 (Kabuli type) produced the highest number of main stems at flowering and ICCV 95334 (Kabuli type) had the highest weight of 100 seeds.

On the other hand ICCV 2 (Kabuli type) was the earliest to reach 50% flowering and days from planting to harvesting. ICCV 07307 (Kabuli type) were the shortest plants at flowering, ICCV 06102 (Kabuli type) had the lowest number of main stems at flowering and ICCV 95334 (Kabuli type) attained the lowest yield per plot, yield per sample and computed yield per hectare.

ICCV 93952 applied with processed chicken manure were the tallest at flowering; When applied with BSU compost produced the most number of pods per plant and it produced the most number of filled pods, when applied with sagana 100, it produced the highest yield per plot and computed yield per hectare and it had the highest return on investment with 69.96% when applied with unprocessed chicken manure.

Based on the findings and conclusion of the study, it is therefore recommended that ICCV 93952 (Desi type), ICCV 06102 (Desi type), and ICCV 2 (Kabuli type) can be productively grown and have a highest return on investment with the application of .5kg/sq.m (5tons/ha) of unprocessed chicken dung under La Trinidad, Benguet condition.

TABLE OF CONTENTS

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. Chickpeas are an important food plant in India, Africa and Central and South America. They are the main ingredient of humus, a sauce originating in the Middle East. In southern Europe, chickpeas are a common ingredient in soups, salads and stews. A kind of meal or flour is also made from chickpeas.

Chickpea is commonly known as Bengal gram (Indian), Chickpea (English), Garbanzo (Latin America), Hommes, Hamaz (Arab world), Nohud, Lablabi (Turkey), and Shimbra (Ethiopia). Chick pea is an important food item for from the Mediterranean countries to India; they are full of protein and starch. Mature Chickpeas can be cooked and eaten cold in salads, cooked in stews, ground into a flour called gram flour (also known as besan and used primarily in Indian cuisine), ground and shaped in balls and fried as falafel, fermented to make an alcoholic drink similar to sake, stirred inato a batter and baked to make farinata, cooked and ground into a paste called humus or roasted, spiced and eaten as a snack (such as leblebi). Chickpeas and Bengal grams are used to make curries and are of the most popular vegetarian foods in India, Pakistan, Bangladesh and the UK.

In the Indian sub continent chickpeas are called kadake kaalu in kanada, shanaga in telugu, chana in hindi and other Indic Languages, Chhola in Bengale and konda kadalai in tamil, where they are a major source of protein in mostly vegetarian culture. Organic farming generally falls within the accepted definition of sustainable agriculture.

However, it is important to distinguish between the two, since organic products can be (unsustainably) produced on large industrial farms, and farms that are not certified organic can produce food using methods that will sustain the farm's productivity for generations. Some organic dairy farms, for example, raise cows in large confinement facilities but are able to meet the bare minimum requirements for organic certification, while a non-organic certified small farm could use organic guidelines and be self-sufficient by recycling the entire farm's waste to meet its fertility needs.

Although the Density of nutrients in Organic material is comparatively modest, they have many advantages; the majority of Nitrogen supplying organic fertilizers contains insoluble Nitrogen and act as a slow-release fertilizer. Additionally data analysis for soil Physical Properties , Soil Chemistry and Soil Biology showed that nearly all chemical (PH, P, K, Mg, C and N) and biological parameters (respiration, DNA, urease, earthworms) assessed were improved by Organic Fertilization.

Organic agriculture is becoming more popular because consumers are demanding healthful and environmentally-friendly food. This shift in consumer behavior is good news, but unfortunately, increased demand for organic foods has attracted large agribusiness corporations that intend to profit from the trend. Organic farming is an agricultural system that seeks to provide you, the consumer, with fresh, tasty and authentic food while respecting natural life-cycle systems.

Renewed concern about the environment has stipulated interest in the use of Organic Fertilizers. Organic Farming is a farming system which promotes, among other practices the use of organic fertilizer. Soil organic matter contributes greatly to soil quality and plant health. Managing soil organic matter entails consideration of a range of factors that influence carbon cycling and ultimately the long term health of the soil. As ecological, organic and sustainable farmers of the future, growing our understanding of organic matter is indeed at the foundation of soil ecology and management. Organic matter provides the soil with the right components to build soil structure, tilth and friability of the soil, something that inorganic fertilizers really cannot do. Organic matter also provides those other lesser-used nutrients called micro nutrients, think one-a-day vitamins for plants." Organic matter also will help sandy soils hold more water and nutrients and will aid the ability of a heavy clay soil to drain excessive soil moisture by adding porosity. To be effective in supplying all the nutrients a plant will need, applications of organic matter need to be done annually.

Garbanzo beans (chickpeas) provide an excellent source of molybdenum. They are a very good source of folic acid, fiber, and manganese. They are also good source of protein, as well as minerals such as iron, copper, zinc, and magnesium. As a good source of fiber, garbanzo beans can help lower cholesterol and improve blood sugar levels. This makes them a great food especially for diabetics and insulin-resistant individuals. When served with high quality grains, garbanzo beans are an extremely-low-fat, complete protein food. One hundred grams of mature boiled chickpeas contains 164 calories. 2.6 grams of fat (of which only 0.27 grams is saturated), 7.6 grams of dietary fiber and 8.9 grams of protein. Chickpea also provide dietary calcium (49-53mg/100g), with same sources citing the garbanzo's calcium content as about th same as yugort and close to milk. According to the International Crops Research Institute, for the semi-arid tropics, chickpea seeds contain an average: 23% Protein, a64% total Carbohydrates (47% starch, 6% soluble sugar), 5% fat, 6% Crude Fiber and 3% Ash. There is also a high reported mineral content: Phosphorous (340mg/100g), Calcium (190mg/100g), Magnesium (140mg/100g), iron (7mg/100g) and Zinc (3mg/100g). Recent studies by government agencies have also shown that they can assist in lowering of cholesterol in the bloodstream.

The study was conducted to determine the growth and yield performance of chickpea as affected by different organic fertilizers, to identify the chickpea accessions that would respond favorably to the application of different organic fertilizers and to determine the economics using the different organic fertilizer treatments in chickpea production.

The study was conducted at BSU Experimental Station, Benguet State University, La Trinidad, Benguet from November 2009 to March 2010.

REVIEW OF LITERATURE

Botany of Chickpea

Chickpea (species *Cicer arietinum*), annual plant of the pea family (*Fabaceae*), widely grown for its nutritious seeds. The bushy, 60-centimetre (2-foot) plants bear pinnate leaves and small white or reddish flowers. The yellow-brown peas are borne one or two to a pod. Chick-peas are an important food plant in India, Africa, and Central and South America. Hummus, or hummous. Chickpea plant is multiple branched. Some chickpea varieties have compounded leaves and some have simple leaves, which are pubescent (hairy) in appearance. Chickpea leaves exude malic and oxalic acids. Flowers which are self pollinated are borne in groups of two or three are ½ to 1 in. long and come in purple, white, pink and blue color depending upon variety. Each flower produces a short pubescent pod which is ¾ to 2 in. long and which appears to be flatted. One or two seeds that has a size of ½ to 1in diameter are present in each pod. The seeds come with either rough or smooth surfaces and can be crème, yellow, brown, black or green in color. There is a definite groove visible between the cotyledons about two-thirds of the way around the seed, with a beak-like structure presents.

An article from Wikipedia (2008) the free encyclopedia states that there are two main kinds of chickpea: Desi, which has small, darker seeds and a rough coat, cultivated mostly in the Indian subcontinent, Ethiopia, Mexico, and Iran. Kabuli, which has lighter coloured, larger seeds and a smoother coat, mainly grown in Southern Europe, Northern Africa, Afghanistan, and Chile, also introduced during the 18th century to the Indian subcontinent. The Desi (meaning *country* or *local* in Hindi) is also known as Bengal gram or kala chana. Kabuli (meaning *from Kabul* in Hindi, since they were thought to have come from Afghanistan when first seen in India) is the kind widely grown throughout the Mediterranean. Desi is likely the earliest form since it closely resembles seeds found both on archaeological sites and the wild plant ancestor of domesticated chickpeas (*Cicer reticulatum*) which only grows in southeast Turkey, where it is believed to have originated. Desi chickpeas have markedly higher fiber content than Kabulis and hence a very low glycemic index which may make them suitable for people with blood sugar problems. The desi type is used to make Chana Dal, which is a split chickpea with the skin removed.

Environmental Requirement

Chickpea is a cool season annual crop performing optimally in 70 to 80 F daytime temperatures and 64 to 70 F night temperature. They produce good yields in drier conditions because of the deep tap root. Heavier rainfall season (over 30 in. annually) show reduced yield due to disease outbreaks and stem lodging problems from the excessive vegetative growth. Areas with lighter, well distributed rainfall patterns have produced the highest yield and quality chickpea seed. 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 rots

Cultural Practice

Optimum yield potential and success in chickpea production is obtained by giving complete attention to field selection, seeding, inoculation, disease control, weed management, insects, harvesting and crop rotation. According to Oplinger *et al*. (1990) a firm, smooth seedbed with most of the previous crop residue incorporated is best. This will allow proper depth of planting as well as good seed-soil contact, which is essential for rapid germination and emergence. If moisture is short keep deep preplan" tillage to a minimum to prevent excessive drying in the top 2 to 3 in. of soil. Chickpea is typically seeded in narrow row spacing of 6 to 12 inches. Target stand densities range from 3 plants per square foot for large kabuli types to 4 plants per square foot for desi and small kabuli types. This will typically require planting 4 seeds/sq.ft. for large kabuli and 5 seeds/sq.ft for desi chickpea. Depending on seed size this often translates into seeding rates of 80-100 lb/a for desi types and 125-150 lb/a for large kabuli types. Seeding depth recommendations are 1 inch below moist soil for small-seeded types and 2 inches below moist soil for large-seeded types. Chickpea can be seeded to a depth of 4 inches to utilize available soil moisture for germination.

Chickpea is a poor competitor with weeds at all stages of growth. Slow growth during the seedling stages, in addition to a relatively sparse optimum plant population of three to four plants per square foot, causes an open crop canopy which requires season-long weed management. Crop rotation and field selection are cultural methods that should be used as part of an integrated weed management system. Cultural weed control begins with avoidance. Avoid fields where perennial and annual broadleaf weeds are a major problem, and be sure to control these weeds in the preceding crop. Kochia, Russian thistle, wild mustard and wild buckwheat are the most problematic in chickpea, and can cause major problems for direct-harvesting.

Harvesting

Chickpea can be harvested direct or swathed prior to combining depending upon uniformity of maturity and weed problems. About 1 week of good drying weather is required in the swath. Chickpea is sold as a high quality human food product. While seed size is a major factor in economic returns for the kabuli type, seed color is the single most important factor in determining if your crop is marketable. If the seed coats are dark or discolored the crop will not be accepted by the food processors. Harvesting decisions such as timing and harvesting methods are the major factors in harvesting seeds with the light yellowish-cream color demanded by the processor. Chickpea normally has a low shattering potential, although pod drop has occurred in some instances when harvesting was delayed, and pod shattering has occurred in unusually hot late August and early September temperatures. The lowest pod height is typically four inches above the ground, making direct harvesting possible but requiring an experienced combine operator. In some regions it is advantageous to swath and combine, due to fact that delayed harvests can result in darkening of the seed coat.

Drying and Storage

Moisture content should be around 10 to 12% to prevent insect and or disease outbreaks in storage. Because of their relatively large seed size, chickpea can be dried slightly with ambient temperature air flow through thin layers in a regular storage bin. Storage system should be carefully fumigated before storing chickpea and all storage areas should be monitored regularly to identify potential problems early.

<u>Fertilizer</u>

Fertilizers are chemical compounds applied to promote plant and fruit growth. Fertilizers are usually applied either through the soil for uptake by plant roots or, by foliar feeding for uptake through leaves. Fertilizers contain nutrients (nourishing substances) that are essential for plant growth. Some fertilizers are made from organic waste such as manure or sewage. Others are manufactured from certain minerals or from synthetic compounds produced in factories (Magciano, 2009). Fertilizers can be placed into the categories of organic fertilizers (composed of decayed plant/animal matter), or inorganic fertilizers (composed of simple chemicals and minerals). Organic fertilizers are 'naturally' occurring compounds, such as peat, manufactured through natural processes (such as composting), or naturally occurring mineral deposits; inorganic fertilizers are manufactured through chemical processes (such as the Haber process), also using naturally occurring deposits, while chemically altering them (e.g. concentrated triple superphosphate). Properly applied, organic fertilizers can improve the health and productivity of soil and plants, as they provide different essential nutrients to encourage plant growth. Organic nutrients increase the abundance of soil organisms by providing organic matter and micronutrients for organisms such as fungal mycorrhiza, which aid plants in absorbing nutrients. Chemical fertilizers may have long-term adverse impact on the organisms living in soil and a detrimental long term effect on soil productivity of the soil.

Organic and Inorganic or chemical fertilizers are the two types of Fertilizers. Organic fertilizer are derived from organic wastes such as plant residues and animal wastes while Inorganic fertilizers consist of chemically prepared substance containing varying amount of Nitrogen, Phosphorous Acid and Potash. Organic materials must not and decay before they become beneficial to plants while inorganic fertilizers are available for the plants as it is dissolve. According to Bautista *et al*. (1983), organic fertilizers release great quantities of nutrient elements that can easily absorbed by the root stand and its result can be seen within few days. Gardeners need to understand that it will take several growing seasons of applying composts and organic matter before the beds become nutritionally self sufficient and that making applications annually is the best way to maintain those nutrient levels in the soil, Hentschel (2009) said.

Organic Fertilizer

Organic fertilizers are made from materials derived from living things. Animal manures, compost, bone meal and blood meal are organic fertilizers. Organic fertilizers can be more expensive and less accessible than inorganic fertilizers. Blood meal, bone meal, and fresh and dried manures were at one time inexpensive by-products of slaughter houses and farms. Organic fertilizers are not immediately available to plants. Before the plants can use them, they must be broken down by soil micro-organisms into simpler, inorganic molecules and ions. In contrast, the nutrients in chemical fertilizers are already in inorganic form and so can be immediately used by the plants. Balco (1986) stated that Organic fertilizers have an advantage over chemical because they are renewable, and soil fertility gradually declines as a result of their continued application. It is important to understand that there is no fundamental difference in nutritional quality between organic and inorganic fertilizers. It makes no difference to the beet root if the atoms of potassium it absorbs are from an organic fertilizer such as wood ash or an inorganic one such as muriate of potash. Unlike chemical fertilizers, organic material does more than provide organic nutrients. It also improves the soil structure, or tilt, and increases its ability to hold both water and nutrients. Knott (1976) mentioned that the application of organic fertilizer in soil prior to planting or sowing time results high yield. With organic fertilizers a buildup of toxicity in the soil is unlikely, as long as the amount of organic material incorporated into the soil is fully decomposed.

On the other side of the coin, there are some disadvantages to the use of organic fertilizers. As noted above, they are not immediately available to the plants. The manure which is applied to a vegetable garden in the spring may not be broken down into organic form by soil bacteria (and therefore available to plants) until mid-summer. If organic nutrients have been added to soils continually on an on-going basis, this may not be a problem. However, if you are just beginning to rely solely on organic material as a nutrient source, your garden may experience an initial nutrient deficiency until the system is in place. The amount of nutrients and the exact type of elements available from a given amount of manure, compost or other inorganic fertilizer can only be guessed at. It is dependent on such factors as: the age of the manure or compost; its origin (chicken, cow, horse, sawdust, garden residue, grass clippings); and weather conditions such as temperature and rainfall. It is therefore a less exact way of providing for a plant's nutritional needs (Williams, 2009).

MATERIALS AND METHODS

Materials

The materials used in the study were seeds of Chickpea, organic fertilizers, meter stick, ruler, weighing scale, watering can, garden tools, record book and other materials needed for the experiment.

Methods

The Experiment was laid out in a Randomized Complete Block Design (RCBD) in factorial arrangement with the cultivar as Factor A and the different organic fertilizers as Factor B. There were three replications per treatment combination; with three samples per treatment in a 1m x 3m plot. The seeds were planted with a planting distance of 30 cm between rows and 20cm between hills. The amount of Organic matter applied was based in 5 tons/ha (P.D. Sangatanan). The treatments were represented as follows:

Factor A (Type of cultivar)

"DESI Type"	"KABULI Type"
ICCV 93952	ICCV 2
ICCV 93954	ICCV 95334
ICCV 06102	ICCV 07307

Factor B (Organic fertilizers)	Nutrient Composition
S_1 – Chicken Manure (Unprocessed)	N – 6.6% P_20_5 – 2.7% K_20 – 1.5%
S_2 – BSU Compost	N – 2.0% P_20_5 – 2.7% K_20 – 2.4%
S_3 – Processed Chicken Manure	N – 4.0% P_20_5 – 4.0% K_20 – 4.0%

S_4 – Sagana 100 (Commercial OF) N – 7.0% P_2O_5 – 7.0% K_2O – 7.0%

Data Gathered

The data gathered were as follows:

A. Vegetative Growth

1. Days from planting to 50% flowering. The data was gathered from the date of sowing the seeds up to 50% flower opening.

2. Average plant height at flowering (cm). It was taken at the first stage of flowering.

3. Days from planting to first harvests. It was determined by counting the number of days from sowing to first harvest.

4. Number of lateral stems at flowering. It was taken at flowering stage and determined by using the formula:

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

B. Yield

1. Average number of pods per plant. It was computed by using the formula:

$$\text{Average Number of Pods} = \frac{\text{Total Number of Pods Produced Per Sample}}{\text{Number of Sample Plant}}$$

2. Average number of filled pods. It was the total number of filled pods taken from sample plants per plot divided by the number of sample plant.

3. Average number of unfilled pods. It was the total number of unfilled pods taken from sample plants per plot divided by the number of sample plant.

4. Total yield per plot ($3m^2$). It was the total yield gathered per plot by adding the yield of sample plants and non sample plants.

5. Computed yield/ha. It was the total yield computed from the experiments per plot (1x3m) x 3,333.33.

6. Total yield per sample. It was the total yield taken from sample plants on a $3m^2$ plot divided by the number of sample plant.

C. Seed Quality

1. Weight of 100 seeds (gram). It was determined by weighing 100 seeds at 14% moisture content.

D. Documentation. It was taken through pictures during land preparation, flowering stage and harvesting (Figures 1 to 6).

Figure 1. Overview of the experimental area during land preparation

Figure 2. Overview of the newly planted experimental area

Figure 3. Overview of the experiment during flowering stage

Figure 4. Overview of the experiment during pod setting stage

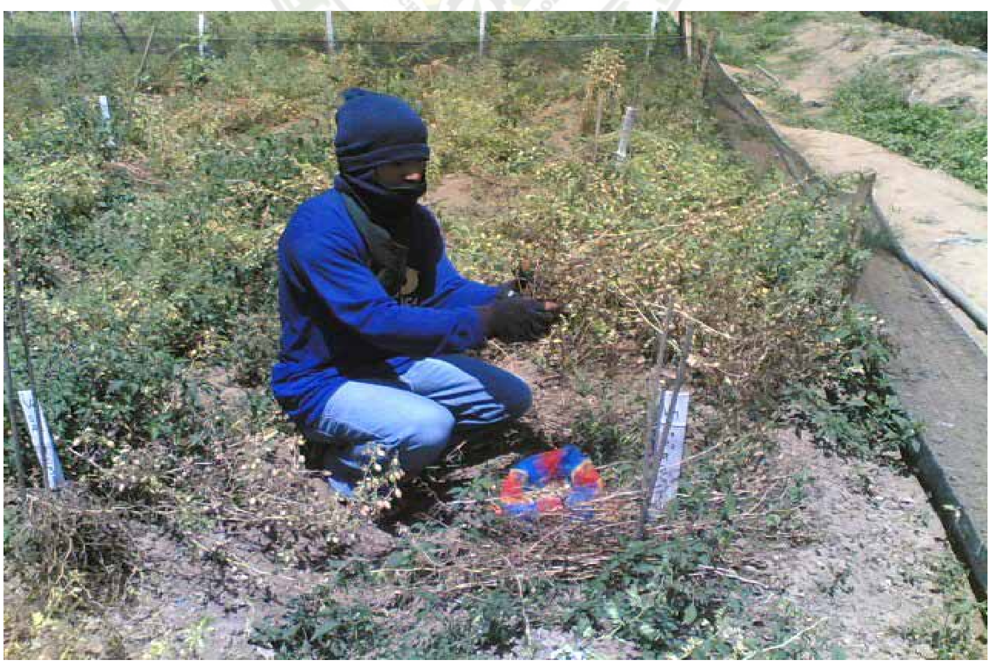

Figure 5. Harvesting time

Figure 6. Overview of the harvested sample plants at first harvest

E. Meteorological data (Taken at BSU PAG-ASA)

a) Temperature

b) Relative Humidity

c) Rainfall

Meteorological data

Figure 7 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℃ on the month of December to 22.95℃ on the month of February. The month of November recorded a temperature of 22.2℃, month of February with 22.6℃ and in the month of March with a temperature of 22.9℃.

The relative humidity recorded during the conduct of the study ranged from 82.75% on December to 88% on the month of January. The month of November had a relative humidity of 84%, month of February with 84.5% and month of March with a relative humidity of 86.75%.

There was no recorded rainfall during the duration of the study.

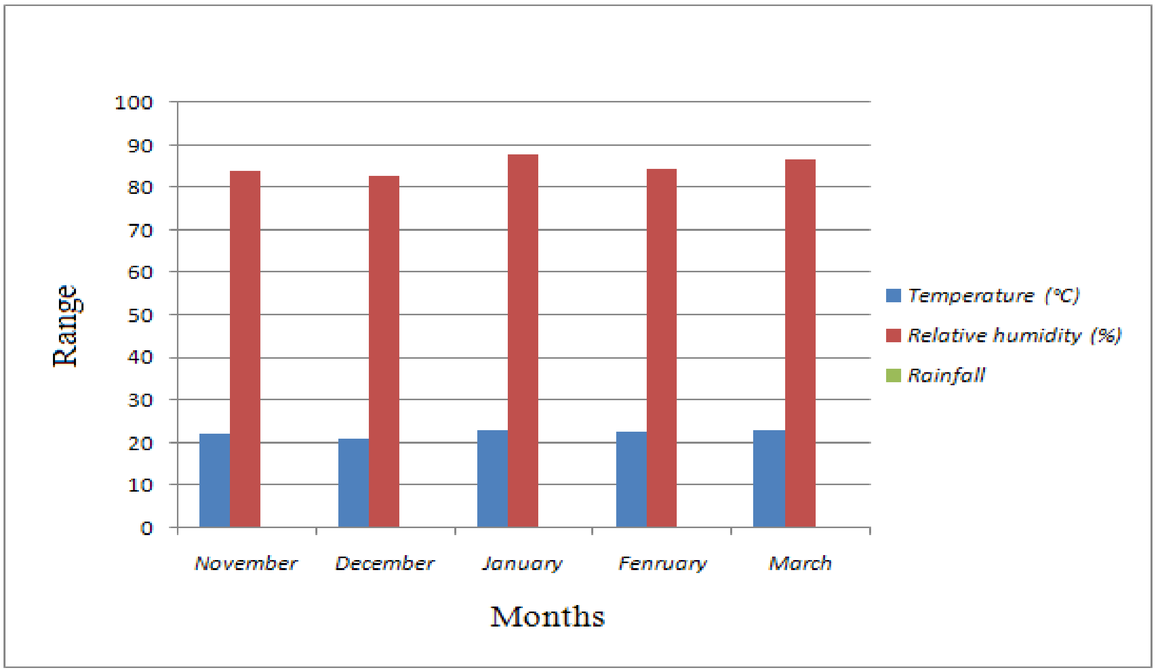

Figure 7. Recorded temperature, relative humidity and rainfall during the duration of the study

RESULTS AND DISCUSSION

Days from Planting to 50% Flowering

Effect of variety. There were significant differences noted in the number of days from planting to 50% flowering of chickpea as affected by the different varieties of chickpea. ICCV 2 (Kabuli type) was the earliest to reach 50% flowering after 47.31 days from planting while ICCV 93952 (Desi type) was the latest after 72.31 days from planting.

Findings showed that kabuli type chickpeas produce flowers earlier than the desi type.

Effect of organic fertilizers. There were no significant differences noted on the days from planting to 50% flowering of chickpea as affected by different organic fertilizers applied. The number of days from planting to 50% flowering ranged from 58.19 to 59.52 days. Result showed that the different organic fertilizers did not affect the number of days from planting to flowering of chickpea.

As stated by Summerfield and Roberts (1988), flowering time of chickpea is variable depending on the effect of the season, sowing date, latitude and altitude.

Interaction effect. Analysis revealed significant differences between the interaction of different organic fertilizers and varieties used on the days from planting to 50% flowering of chickpea. Results revealed that ICCV 2 (Kabuli type) applied with sagana 100 had produced flowers the earliest; while ICCV 93952 (Desi type) applied with unprocessed chicken manure was the latest to produce flower (Figure 8).

Table 1. Days from planting to 50% flowering

TREATMENT	MEAN (Days)
<u>Variety</u>	
ICCV 93952	72.31[a]
ICCV 93954	67.30[c]
ICCV 06102	70.53[b]
ICCV 2	47.31[d]
ICCV 95334	48.08[d]
ICCV 07307	47.56[d]
<u>Organic Fertilizers</u>	
Unprocessed chicken manure	59.52[a]
BSU compost	58.83[a]
Processed chicken manure	58.85[a]
Sagana 100	58.19[a]
CV (%)	3.43

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

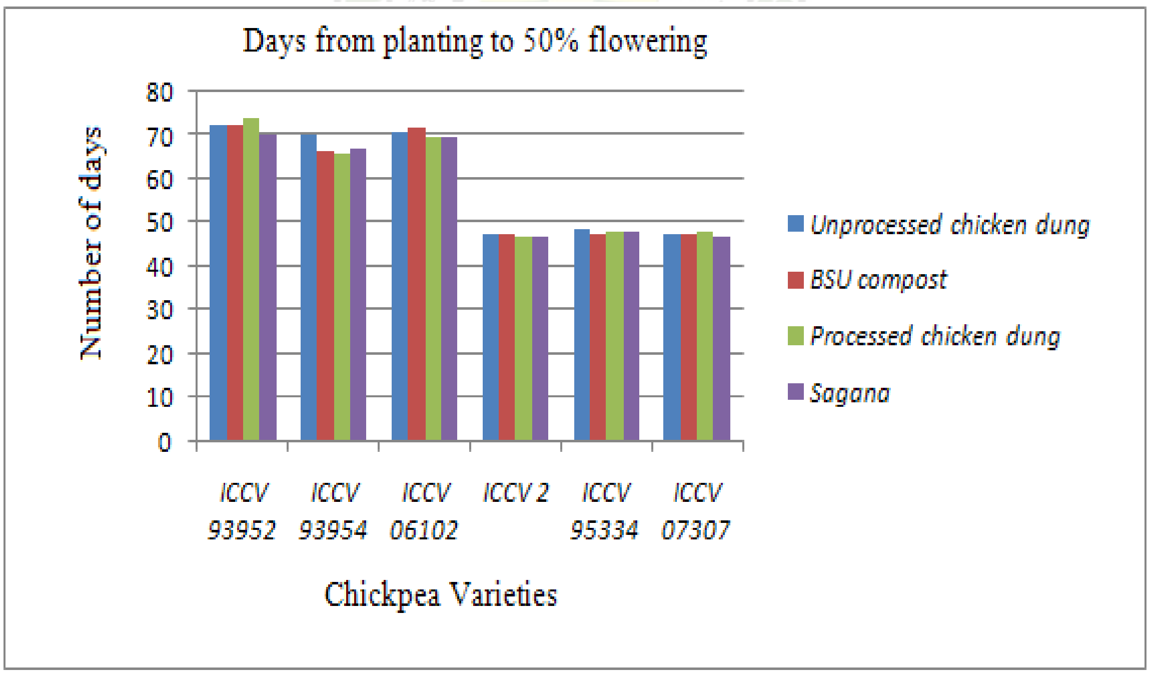

Figure 8. Days from planting to 50% flowering

Average Plant Height at Flowering (cm)

Effect of variety. Table 2 shows that there were significant differences noted in the average plant height at flowering of chickpea as affected by the different varieties of chickpea used. Results show that ICCV 93952 (Desi type) had the tallest plants at flowering with 53.05 cm; while ICCV 07307 (Kabuli type) had the shortest plants at flowering with 33.10 cm. Findings showed that desi type produces taller plant at flowering than kabuli type chickpea.

Effect of organic fertilizers. There were no significant differences noted on the average plant height at flowering of chickpea as affected by different organic fertilizers applied. The average plant height ranged from 43.99 to 46.64 cm. Result showed that the different organic fertilizers did not affect the average plant height at flowering of chickpea.

Interaction effect. Analysis revealed significant differences on the average plant height at flowering of chickpea as affected by the interaction between the different organic fertilizers applied and different varieties used. Results revealed that ICCV 93952 (Desi type) applied with processed chicken manure produced the tallest plant while ICCV 07307 (Kabuli type) applied with unprocessed chicken manure produced the shortest plants at flowering (Figure 9).

Table 2. Average plant height at flowering (cm)

TREATMENT	MEAN (cm)
Variety	
ICCV 93952	53.05[a]
ICCV 93954	48.12[bc]
ICCV 06102	49.08[b]
ICCV 2	40.10[d]
ICCV 95334	45.76[c]
ICCV 07307	33.10[e]
Organic Fertilizers	
Unprocessed chicken manure	43.99[a]
BSU compost	45.91[a]
Processed chicken manure	46.64[a]
Sagana 100	44.93[a]
CV (%)	7.70

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

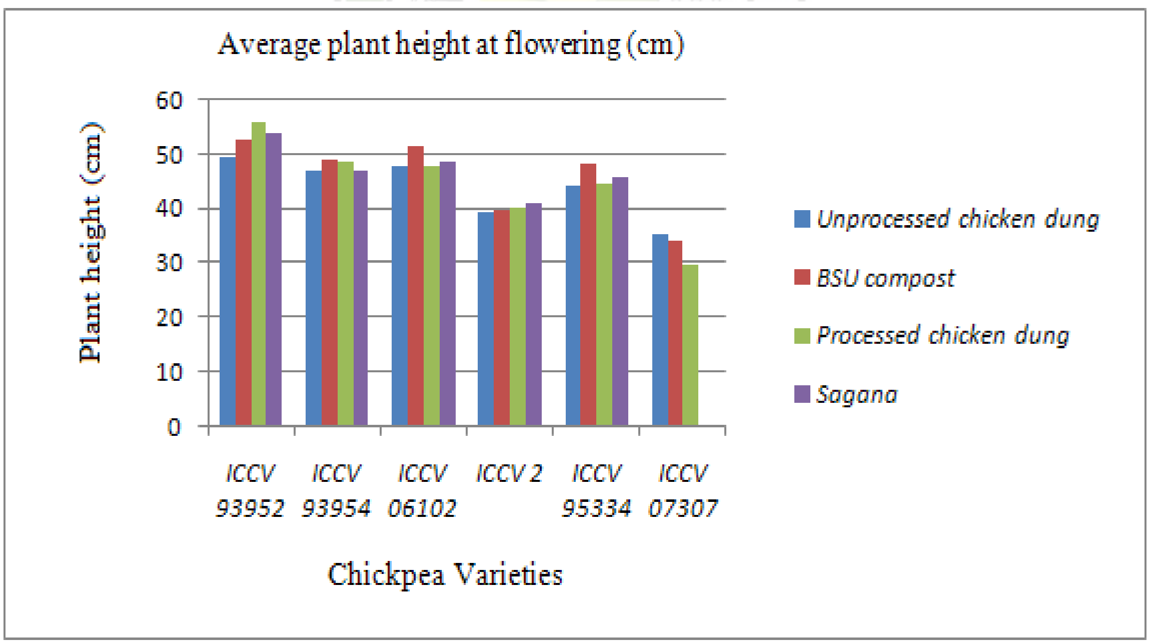

Figure 9. Average plant height at flowering (cm)

Number of Days from Planting to Harvesting

Effect of variety. There were significant differences noted on the days from planting to harvesting of chickpea as affected by the different varieties of chickpea used. Results show that ICCV 2 (Kabuli type) was the earliest to be harvested after 124 days from sowing the seeds; while ICCV 06102 (Desi type) was the latest to be harvested after 141 days from planting. Findings showed that kabuli type was harvested earlier than desi type chickpeas.

Effect of organic fertilizers. As shown in Table 3, there were no significant differences noted on the number of days from planting to harvesting of chickpea as affected by different organic fertilizers applied. Results showed that the different organic fertilizers applied have the same results of 132.8 days from planting to harvesting. It showed that the different organic fertilizers did not affect the duration from planting to harvesting of chickpea. According to McKay *et al.* (2001), chickpea matures later than dry pea or lentil and prefers a longer, warmer growing season.

Interaction effect. Analysis revealed that there were no significant differences on the number of days from planting to first harvest of chickpea as affected by the interaction between the different organic fertilizers applied and different varieties used.

Table 3. Number of days from planting to first harvest

TREATMENT	MEAN (Days)
Variety	
ICCV 93952	140.0[b]
ICCV 93954	140.0[b]
ICCV 06102	141.0[a]
ICCV 2	124.0[a]
ICCV 95334	126.0[c]
ICCV 07307	126.0[c]
Organic Fertilizers	
Unprocessed chicken manure	132.8[a]
BSU compost	132.8[a]
Processed chicken manure	132.8[a]
Sagana 100	132.8[a]
CV (%)	0

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

Number of Main Stems at Flowering

Effect of variety. There were significant differences noted in the number of main stems at flowering of chickpea as affected by the different varieties of chickpea used. Result showed that ICCV 2 (Kabuli type) had produced the most number of main stems at flowering with 4.31 lateral stems while ICCV 06102 (Desi type) produced the lowest number of main stems at flowering with 3.50 stems.

Effect of organic fertilizers. There were no significant differences noted on the number of main stems at flowering of chickpea as affected by different organic fertilizers applied. The number of main stems at flowering ranged from 3.67 to 4.07 main stems. Result showed that different organic fertilizers applied did not affect the production of the number of main stems of chickpea at flowering.

Interaction effect. Analysis revealed that there were no significant differences in the number of main stems at flowering of chickpea as affected by the interaction between the different organic fertilizers applied and different varieties used.

Table 4. Number of main stems at flowering

TREATMENT	MEAN
Variety	
ICCV 93952	3.75[b]
ICCV 93954	3.72[b]
ICCV 06102	3.50[b]
ICCV 2	4.31[a]
ICCV 95334	4.28[a]
ICCV 07307	3.58[b]
Organic Fertilizers	
Unprocessed chicken manure	3.98[a]
BSU compost	3.67[a]
Processed chicken manure	3.70[a]
Sagana 100	4.07[a]
CV (%)	16.06

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

Average Number of Pods per Plant

Effect of variety. There were significant differences noted in the average number of pods per plant of chickpea as affected by the different varieties of chickpea used. Results show that ICCV 93952 (Desi type) had the highest number of pods produced per plant with an average of 293.44 pods; while ICCV 95334 (Kabuli type) produced the least number of pods per plant with an average of 68.17 pods.

Findings showed that desi type produces higher number of pods per plant than desi type chickpea.

Effect of organic fertilizers. There were significant differences noted on the average number of pods per plant of chickpea as affected by different organic fertilizers applied. The application BSU compost had resulted on the most number of pods per plant with an average of 230.57 pods; while the application of unprocessed chicken manure resulted on the production of lowest number of pods per plant with an average of 199.24 pods.

Interaction effect. Analysis revealed significant differences in the average number of pods per plant of chickpea as affected by the interaction between the different organic fertilizers applied and different varieties used. Results showed that ICCV 93952 (Desi type) applied with BSU compost produced the highest number of pods per plant; while ICCV 95334 (Kabuli type) applied with unprocessed chicken manure produced the lowest number of pods produced per plant (Figure 10).

Table 5. Average number of pods per plant

TREATMENT	MEAN
<u>Variety</u>	
ICCV 93952	293.44[a]
ICCV 93954	267.28[a]
ICCV 06102	273.14[a]
ICCV 2	226.50[b]
ICCV 95334	68.17[d]
ICCV 07307	164.25[c]
<u>Organic Fertilizers</u>	
Unprocessed chicken manure	199.24[b]
BSU compost	230.57[a]
Processed chicken manure	209.61[ab]
Sagana 100	222.43[ab]
CV (%)	19.89

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

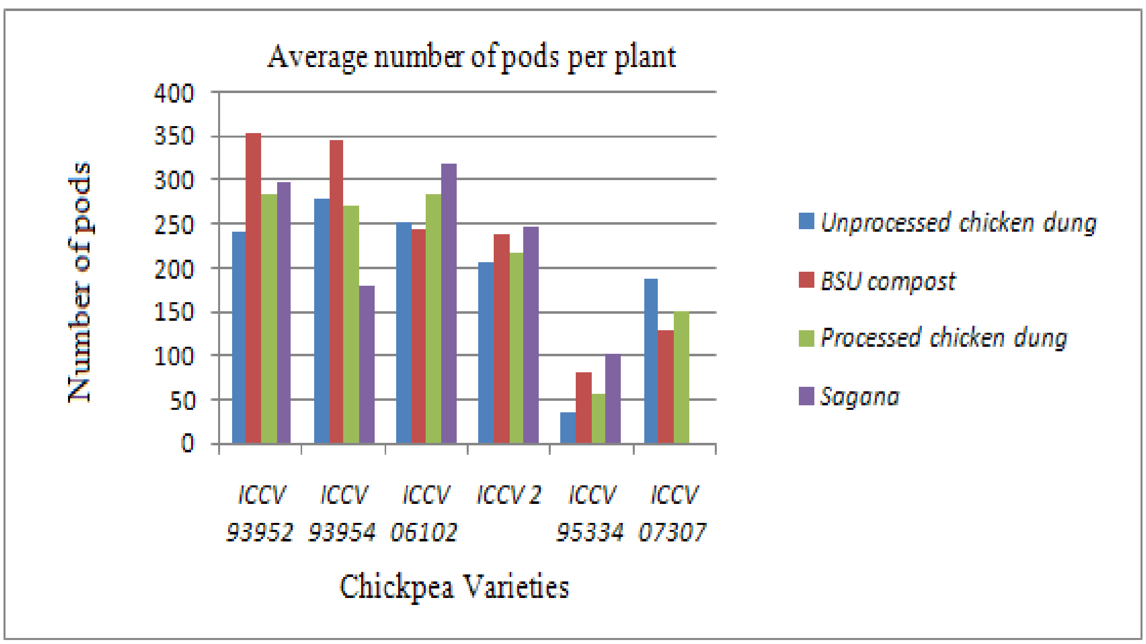

Figure 10. Average number of pods per plant

Average Number of Filled Pods

Effect of variety. There were significant differences noted in the average number of filled pods of chickpea as affected by the different varieties of chickpea used. Results show that ICCV 93952 (Desi type) produced the highest number of filled pods with a mean of 256.39 pods; while ICCV 95334 (Kabuli type) produced the lowest with a mean of 58.70 filled pods.

Effect of organic fertilizers. Likewise, there were significant differences noted on the average number of filled pods of chickpea as affected by different organic fertilizers applied. The application of BSU compost produced the highest number of filled pods with an average of 210.20 pods; while the application of unprocessed chicken manure produced the lowest number of filled pods with an average of 173.33 pods.

Interaction effect. Analysis revealed significant differences in the average number of filled pods of chickpea as affected by the interaction between the different organic fertilizers applied and different varieties used. Results showed that ICCV 93952 (Desi type) applied with BSU compost produced the highest number of filled pods while ICCV 95334 (kabuli type) applied with unprocessed chicken manure produced the lowest number of filled pods (Figure 11).

Table 6. Average number of filled pods

TREATMENT	MEAN
Variety	
ICCV 93952	256.39[a]
ICCV 93954	243.70[a]
ICCV 06102	249.31[a]
ICCV 2	205.89[b]
ICCV 95334	58.70[d]
ICCV 07307	136.36[c]
Organic Fertilizers	
Unprocessed chicken manure	173.33[b]
BSU compost	210.20[a]
Processed chicken manure	187.70[ab]
Sagana 100	195.65[ab]
CV (%)	22.39

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

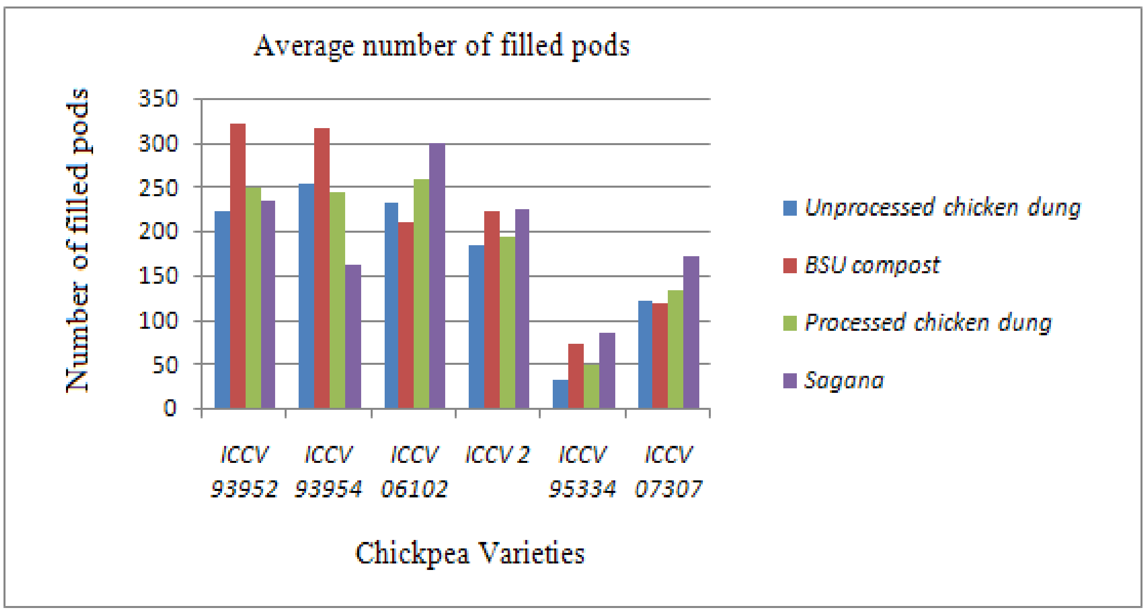

Figure 11. Average number of filled pods

Average Number of Unfilled Pods

Effect of variety. There were significant differences noted in the average number of unfilled pods of chickpea as affected by the different varieties of chickpea used. Results show that ICCV 93952 (Desi type) produced the highest number of unfilled pods with a mean of 37.06 pods; while ICCV 95334 (Kabuli type) produced the lowest number of unfilled pods with an average of 10.36 pods.

Effect of organic fertilizers. There were significant differences noted on the average number of unfilled pods of chickpea as affected by different organic fertilizers applied. Results showed that the application of sagana 100 produced the highest number of unfilled pods with a mean of 26.78 pods; while the application of unprocessed chicken manure produced the lowest with a mean of 17.57 unfilled pods.

Interaction effect. Analysis revealed significant differences in the average number of unfilled pods of chickpea as affected by the interaction between the different organic fertilizers applied and different varieties used. Results showed that ICCV 93952 (Desi type) applied with sagana 100 produced the highest number of unfilled pods while ICCV 95334 (Kabuli type) applied with unprocessed chicken manure produced the lowest number of unfilled pods (Figure 12).

Table 7. Average number of unfilled pods

TREATMENT	MEAN
Variety	
ICCV 93952	37.06[a]
ICCV 93954	23.58[b]
ICCV 06102	19.67[c]
ICCV 2	18.41[cd]
ICCV 95334	10.36[e]
ICCV 07307	15.41[d]
Organic Fertilizers	
Unprocessed chicken manure	17.57[b]
BSU compost	18.18[b]
Processed chicken manure	20.46[b]
Sagana 100	26.78[a]
CV (%)	22.12

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

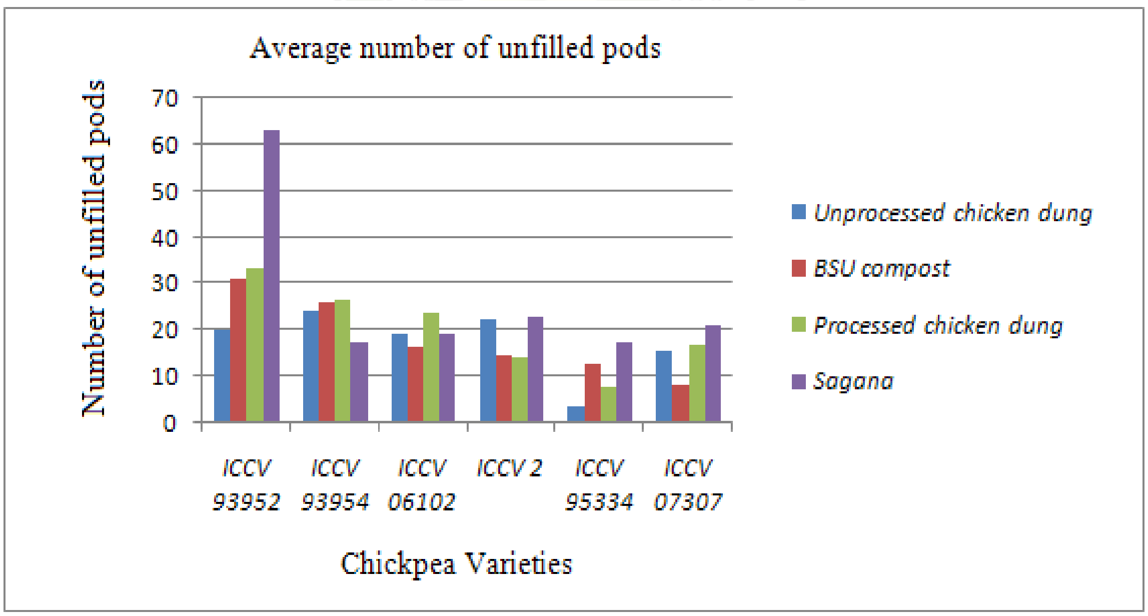

Figure 12. Average number of unfilled pods

Yield per Plot (g)

Effect of variety. There were significant differences noted in the yield per plot of chickpea as affected by the different varieties of chickpea used. Results show that ICCV 93952 (Desi type) produced the highest yield per plot with 619.33g; while ICCV 95334(Kabuli type) produced the lowest with 205.61g per plot. McKay *et al.* (2001) stated that optimum yield potential and success in chickpea production is obtained by giving complete attention to field selection, seeding, inoculation, disease control, weed management, insects, harvesting and crop rotation.

Effect of organic fertilizers. There were significant differences noted in the yield per plot of chickpea as affected by different organic fertilizers applied. Results showed that the application of sagana 100 produced the highest yield per plot with 530.92g while the application of processed chicken manure produced the lowest yield per plot with 447.42g.

Interaction effect. Analysis revealed significant differences in the yield per plot of chickpea as affected by the interaction between the different organic fertilizers applied and different varieties used. Results showed that ICCV 93952 (Desi type) applied with sagana 100 produced the highest yield per plot while ICCV 95334 (Kabuli type) applied with processed chicken manure produced the lowest total yield per plot (Figure 13).

Table 8. Yield per plot (g)

TREATMENT	MEAN (g)
Variety	
ICCV 93952	619.33[a]
ICCV 93954	498.37[c]
ICCV 06102	562.99[b]
ICCV 2	561.25[b]
ICCV 95334	205.61[e]
ICCV 07307	436.51[d]
Organic Fertilizers	
Unprocessed chicken manure	487.62[b]
BSU compost	456.74[c]
Processed chicken manure	447.42[c]
Sagana 100	530.92[a]
CV (%)	8.27

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

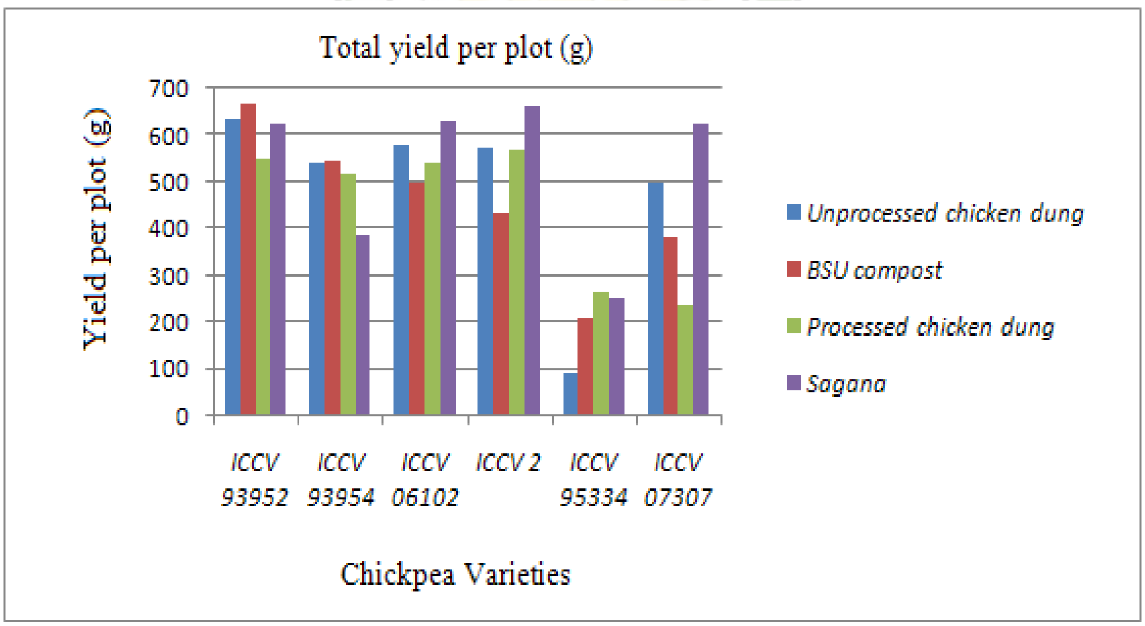

Figure 13. Yield per plot (g)

Computed Yield per Hectare

Effect of variety. There were significant differences noted in the Computed yield per hectare of chickpea as affected by the different varieties of chickpea used. Results show that ICCV 93952 (Desi type) produced the highest computed yield per hectare with a total of 2064.44kgs/ha while ICCV 95334 (Kabuli type) which had a computed yield of 685.33kgs/ha, had the lowest yield.

Effect of organic fertilizers. There were significant differences noted in the computed yield per hectare of chickpea as affected by different organic fertilizers applied. Results showed that the application of sagana 100 produced the highest Computed yield per hectare with a total of 1769.72kgs/ha while the application of processed chicken manure produced the lowest computed yield with a total of 447.42kgs/ha.

Interaction effect. Analysis revealed significant differences in the Computed yield per hectare of chickpea as affected by the interaction between the different organic fertilizers applied and different varieties used. Results showed that ICCV 93952 (Desi type) applied with sagana produced the highest computed yield while ICCV 95334 (Kabuli type) applied with processed chicken manure produced the lowest computed yield per hectare (Figure 14).

Table 9. Computed yield per hectare (kg)

TREATMENT	MEAN (kg)
Variety	
ICCV 93952	2064.44[a]
ICCV 93954	1661.22[c]
ICCV 06102	1876.64[b]
ICCV 2	1870.83[b]
ICCV 95334	685.33[e]
ICCV 07307	1455.03[d]
Sources of organic matter	
Unprocessed chicken manure	1625.39[b]
BSU compost	1522.48[c]
Processed chicken manure	1491.41[c]
Sagana 100	1769.72[a]
CV (%)	8.27

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

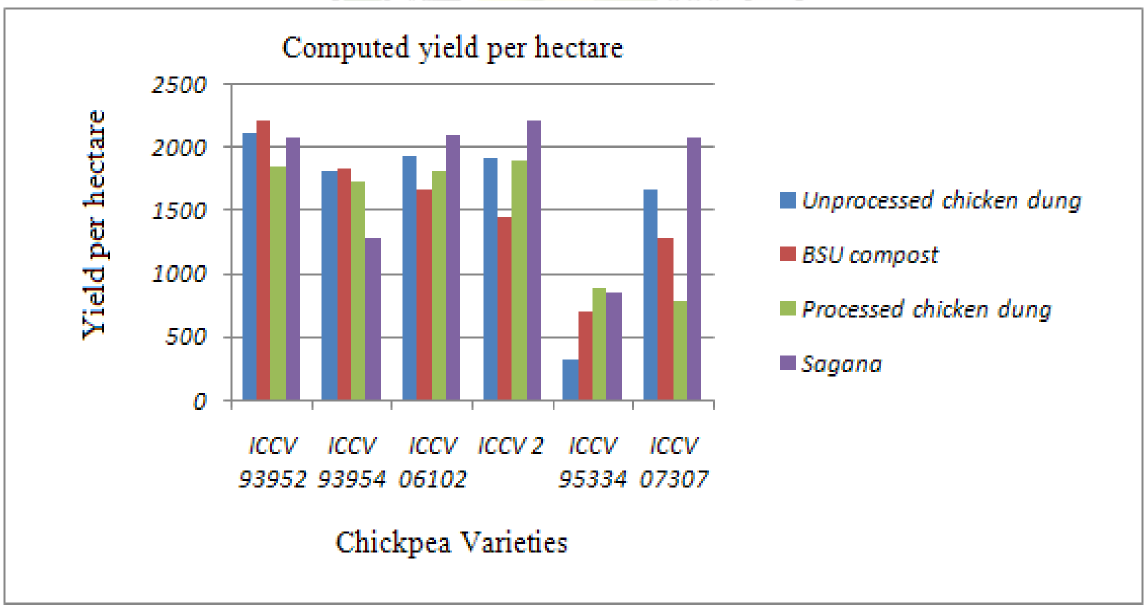

Figure 14. Computed yield per hectare (kg)

Yield per Sample Plant (g)

Effect of variety. There were significant differences noted in the yield per sample plant of chickpea as affected by the different varieties of chickpea used. Result showed that ICCV 93952 (Desi type) produced the highest yield per sample with a total of 66.47g while ICCV 95334 (Kabuli type) produced the lowest yield with a mean of 24.08g per sample.

Effect of organic fertilizers. There were significant differences noted in the yield per sample plant of chickpea as affected by different organic fertilizers applied. Results showed that the application of BSU compost produced the highest yield per sample with 57.01g; while the application of processed chicken manure produced the lowest yield of 51.40g per sample.

Interaction effect. Analysis revealed significant differences in the total yield per sample of chickpea as affected by the interaction between the different organic fertilizers applied and different varieties used. Results showed that ICCV 93952 (Desi type) applied with BSU compost produced the highest yield per sample plant; while ICCV 95334 (Kabuli type) applied with processed chicken manure produced the lowest yield per sample plant (Figure 15).

Table 10. Yield per sample (g)

TREATMENT	MEAN (g)
Variety	
ICCV 93952	66.47[a]
ICCV 93954	60.61[b]
ICCV 06102	61.97[b]
ICCV 2	52.16[c]
ICCV 95334	24.08[d]
ICCV 07307	59.33[b]
Organic Fertilizers	
Unprocessed chicken manure	52.19[b]
BSU compost	57.01[a]
Processed chicken manure	51.40[b]
Sagana 100	55.81[a]
CV (%)	8.74

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

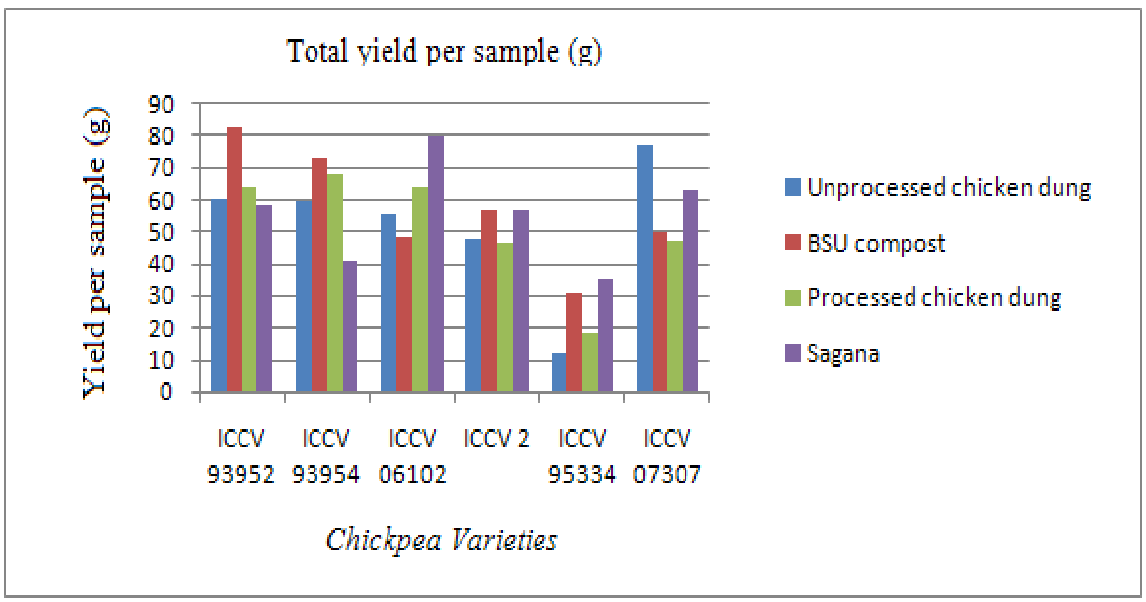

Figure 15. Yield per sample (g)

Weight of 100 Seeds (g)

Effect of variety. There were significant differences noted in the weight of 100 seeds of chickpea as affected by the different varieties of chickpea used. Result showed that ICCV 95334 (Kabuli type) produced the heaviest weight of 100 seeds with 43.68g while ICCV 2 (Desi type) had the lightest weight of 100 seeds with 24.22 grams. Kabuli type chickpea had generally bigger sized seeds that lead to heavier 100 seed weight.

Effect of organic fertilizers. There were significant differences noted in the weight of 100 seeds of chickpea as affected by different organic fertilizers applied. Results showed that the application of Sagana 100 produced the heaviest weight of 100 seeds with 30.17 grams; while those applied with processed chicken manure produced the lightest weight of 100 seeds with 28.68 grams.

Interaction effect. Analysis revealed significant differences in the weight of 100 seeds of chickpea as affected by the interaction between the different organic fertilizers applied and different varieties used. Results showed that ICCV 95334 (Kabuli type) applied with sagana produced the heaviest weight while ICCV 2 (Desi type) applied with processed chicken manure produced the lightest (Figure 16).

Table 11. Weight of 100 seeds (g)

TREATMENT	MEAN (g)
Variety	
ICCV 93952	26.13^{c}
ICCV 93954	24.23^{d}
ICCV 06102	24.26^{d}
ICCV 2	24.22^{d}
ICCV 95334	43.68^{a}
ICCV 07307	34.50^{b}
Organic Fertilizers	
Unprocessed chicken manure	29.68^{ab}
BSU compost	29.48^{ab}
Processed chicken manure	28.68^{b}
Sagana 100	30.17^{a}
CV (%)	5.77

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

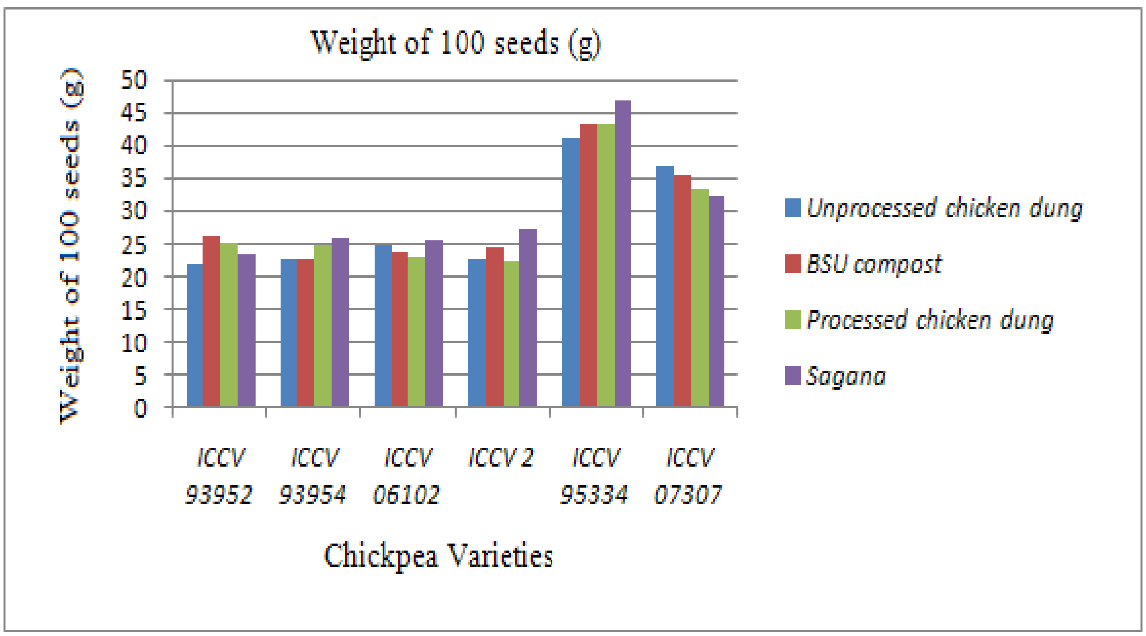

Figure 16. Weight of 100 seeds (g)

<u>Cost and Return Analysis</u>

Based on the cost and return analysis of the study, results show that the return on investment of the different varieties of chickpea applied with the different organic fertilizers revealed varying results. ICCV 93952 of the Desi type applied with unprocessed chicken manure have the highest return on investment with 69.96%; while ICCV 95334 a Kabuli type applied with unprocessed chicken manure produced the lowest return on investment with -102.29%. It was observed on Table 12 that the variety ICCV 93952 had high yield potential even when applied with different organic fertilizers as compared to the other varieties used. In addition, the application of unprocessed chicken manure compared to other organic fertilizers used, had the highest return on investment regardless of variety used. However, for ICCV 95334 the variety's low yielding potential affected the computed yield per hectare as shown in table 12.

Table 12. Cost and return analysis for a hectare basis

	COST OF FERTILIZER (Php)	PESTICIDE (Php)	LABOR (Php)	YIELD (Kg)	GROSS SALES (Php)	NET PROFIT (Php)	ROI (%)
ICCV 93952							
Unprocessed chicken manure	9,999.99	49,999.95	41,666.63	2115.89	338,542.4	236,857.83	69.96
BSU compost	99,999.9	49,999.95	41,666.63	2217.89	354,862.4	163,195.92	49.99
Processed chicken manure	20,999.98	49,999.95	41,666.63	1841.78	294,684.8	182,018.24	61.77
Sagana 100	39,499.96	49,999.95	41,666.63	2082.22	333,155.2	201,988.66	60.63
ICCV 93954							
Unprocessed chicken manure	9,999.99	49,999.95	41,666.63	1810.11	289,617.6	187951.03	64.90
BSU compost	99,999.9	49,999.95	41,666.63	1825.55	292,088.0	100,421.52	34.38
Processed chicken manure	20,999.98	49,999.95	41,666.63	1725.89	276,142.4	163,475.84	59.20
Sagana 100	39,499.96	49,999.95	41,666.63	1283.33	205,332.8	74,166.26	36.12
ICCV 06102							
Unprocessed chicken manure	9,999.99	49,999.95	41,666.63	1926.22	308,195.2	206,528.63	67.02
BSU compost	99,999.9	49,999.95	41,666.63	1668.55	266,968.0	75,301.52	28.21
Processed chicken manure	20,999.98	49,999.95	41,666.63	1809.11	289,457.6	176,791.04	61.08
Sagana 100	39,499.96	49,999.95	41,666.63	2102.66	336,425.6	205,259.06	61.01

Table 12 continued…

	COST OF FERTILIZER (Php)	PESTICIDE (Php)	LABOR (Php)	YIELD (Kg)	GROSS SALES (Php)	NET PROFIT (Php)	ROI (%)
ICCV 2							
Unprocessed chicken manure	9,999.99	49,999.95	41,666.63	1921	307,360.0	205,693.43	66.92
BSU compost	99,999.9	49,999.95	41,666.63	1442.89	230,862.4	39,195.92	16.98
Processed chicken manure	20,999.98	49,999.95	41,666.63	1903.11	304,497.6	191,831.04	63
Sagana 100	39,499.96	49,999.95	41,666.63	2216.33	354,612.8	223,446.26	63.01
ICCV 95334							
Unprocessed chicken manure	9,999.99	49,999.95	41,666.63	314.11	50,257.6	-51,408.97	-102.29
BSU compost	99,999.9	49,999.95	41,666.63	700.78	112,124.8	-79,541.68	-70.94
Processed chicken manure	20,999.98	49,999.95	41,666.63	880.89	140,942.4	28,275.84	20.06
Sagana 100	39,499.96	49,999.95	41,666.63	845.67	135,307.2	4,140.66	3.06
ICCV 07307							
Unprocessed chicken manure	9,999.99	49,999.95	41,666.63	1665.11	266,417.6	164,757.03	61.84
BSU compost	99,999.9	49,999.95	41,666.63	1279.22	204,675.2	13,008.72	6.36
Processed chicken manure	20,999.98	49,999.95	41,666.63	787.67	126,027.2	13,360.64	10.60
Sagana 100	39,499.96	49,999.95	41,666.63	2088.11	334,097.6	202,931.06	60.74

Table 13. Cost of Production for a 1x3m area and per hectare basis

INPUT	QUANTITY	UNIT	UNIT PRICE	TOTAL/3m^2	TOTAL/ha
1. Fertilizer					
a.Unprocessed chicken manure	1.5	Kg	2.00	3.00	9,999.99
b.BSU compost	1.5	Kg	20.00	30.00	99,999.90
c. Processed chicken manure	1.5	Kg	4.20	6.30	20,999.98
d. Sagana 100	1.5	Kg	7.90	11.85	39,499.96
2. Pesticide					
a. Insecticide	1.0	Tbsp	10.00	10.00	33,333.30
b. Fungicide	1.0	Tbsp	5.00	5.00	16,666.65
3.Labor (Land preparation, planting, hilling-up, weeding, harvesting, dressing)	30 (min)	Min/plot	200/day(8hrs)	12.50	41,666.63
TOTAL (Php)				78.65	262,166.41

a. Unprocessed chicken manure = Php100.00/Sack

b. BSU compost = Php 20.00/Kg

c. Processed chicken dung = Php 210.00/Sack

d. Sagana 100 = Php 395.00/Sack

Retail price for chickpea seeds = Php 160.00/Kg

SUMMARY CONCLUSION AND RECOMMENDATION

Summary

The study was conducted to determine the growth and yield performance of chickpea as affected by different sources of organic fertilizers and to identify the chickpea variety that would respond favorably to the application of different organic fertilizers. Based on the proceeding results, there were no significant differences observed on the days from planting to 50% flowering, average plant height at flowering, days from planting to first harvest and in the number of lateral stems at flowering as affected by the different sources of organic fertilizers used. However, significant differences were observed on the following.

In the average number of pods per plant, BSU compost produced the highest number of pods produced while chicken manure had the lowest.

The average number of filled and unfilled pods significantly differs among the different organic fertilizers. Application of BSU compost produced the highest number of filled pods; while sagana 100 had the highest number of unfilled pods; unprocessed chicken manure applied produced the lowest number of both filled and unfilled pods.

The application of BSU compost produced the highest yield per sample while processed chicken manure applied produced the lowest. In the total yield per plot and computed yield per hectare, the application of sagana 100 produced the highest yield while processed chicken manure produced the lowest yield.

Chickpea applied with sagana 100 produced the heaviest weight of 100 seeds at 14% moisture content while the application of unprocessed chicken manure had the

lightest weight.

Results showed that ICCV 93952 (Desi type) was the latest to produce flower while ICCV 2 (kabuli type) produced the earliest flowers. Findings showed that kabuli type produces flower earlier than the desi type chickpea.

ICCV 94952(Desi type) produced the tallest plants at flowering; while ICCV 07307 (kabuli type) produced the shortest plants. Findings showed that Desi type produces taller plants at flowering compared to the kabuli type.

In the number of days from planting to harvesting, results show that ICCV 2 (kabuli type) was the earliest to be harvested while ICCV 06102 (Desi type) was the latest. Findings showed that kabuli type matures and harvested earlier than desi type.

As to the number of main stems at flowering, results show that ICCV 2 (kabuli type) produced the most number of main stems while ICCV 06102 (desi type) produced the least number of main stems.

ICCV 93952 (desi type) produced the highest number of pods per plant while ICCV 95334 (kabuli type) had the least number of pods. Findings showed that desi type produces more pods per plant than kabuli type.

In the average number of filled and unfilled pods, results showed that ICCV 93052 (desi type) produced the highest number of both filled and unfilled pods while ICCV 95334 (kabuli type) had produced the least nember of filled and unfilled pods.

ICCV 93952 (desi type) significantly produced the highest yield per sample while ICCV 95334 (kabuli) produced the lowest yield per sample, total yield per plot and computed yield per hectare.

In the weight of 100 seeds, results showed that ICCV 95334 (kabuli) had the heaviest weight of collected 100 seeds while ICCV 2 (kabuli) had the lightest weight.

As for the interaction, no significant differences were noted in the interaction of the sources of different organic matter and different varieties on the days from planting to first harvest and number of lateral stems at flowering of chickpea.

ICCV 93952 applied with unprocessed chicken manure were the latest to attain 50% flowering while ICCV 2 applied with sagana 100 were the earliest to bear flower.

In the average plant height at flowering, ICCV 93952 applied with processed chicken manure were the tallest at flowering while ICCV 07307 applied with unprocessed chicken manure produced the shortest plants at flowering.

ICCV 93952 applied with BSU compost produced the most number of pods per plant while ICCV 95334 applied with unprocessed chicken manure produced the least number of pods.

As for the average number of filled and unfilled pods, ICCV 93952 applied with BSU compost produced the most number of filled pods However, ICCV 93952 applied with sagana produced the most number of unfilled pods. On the Other hand, ICCV 95334 applied with unprocessed chicken manure produced the least number of both filled and unfilled pods.

The results show that for the total yield and computed yield per hectare, ICCV 93952 applied with sagana 100 produced the highest yield per plot and computed yield per hectare while ICCV 95334 applied with processed chicken manure produced the lowest yield.

In relation to the weight of 100 seeds, ICCV 95334 applied with sagana 100 produced the heaviest weight of 100 seeds while ICCV 2 applied with processed chicken manure had the lightest weight of 100 seeds.

The cost and return analysis show that ICCV 93952 of the Desi type applied with unprocessed chicken manure have the highest return on investment with 69.96% while ICCV 95334 applied with unprocessed chicken manure produced the lowest return on investment with a total of -102.29%.

Conclusion

Based on the results discussed, the best three varieties tested under La Trinidad, Benguet condition were ICCV 93952 (Desi type) followed by ICCV 06102 (Desi type) and lastly ICCV 2 (Kabuli type) since they had good growth and flowering and produced the highest return on investment among all the other varieties grown. The best organic fertilizer chosen for the selected varieties is the application of unprocessed chicken manure since it contributed to low cost of production yet gained a high return on investment.

Recommendation

Based on the findings and conclusion of the study, it is therefore recommended that ICCV 93952 (Desi type), ICCV 06102 (Desi type), and ICCV 2 (Kabuli type) can be productively grown and have a highest return on investment with the application of .5kg/sq.m (5tons/ha) of unprocessed chicken manure under La Trinidad, Benguet condition.

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APPENDICES

Appendix Table 1. Number of days from planting to 50% flowering

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	S_1	71.33	76.67	69.67	217.67	72.56
	S_2	72.00	74.33	70.67	217.00	72.33
	S_3	74.33	75.33	72.00	221.66	73.89
	S_4	70.33	67.33	73.67	211.33	70.44
V_2	S_1	70.33	70.67	69.33	210.33	70.11
	S_2	64.00	69.33	66.33	199.66	66.55
	S_3	64.33	64.00	69.00	197.33	65.78
	S_4	67.33	69.67	63.33	200.33	66.78
V_3	S_1	73.67	71.67	67.67	213.01	71.00
	S_2	71.33	73.33	70.33	214.99	71.66
	S_3	73.67	69.67	66.33	209.67	69.89
	S_4	73.33	67.67	67.67	208.67	69.56
V_4	S_1	47.00	47.00	48.00	142.00	47.33
	S_2	47.00	48.00	48.33	143.33	47.78
	S_3	47.33	47.00	47.00	141.33	47.11
	S_4	47.00	47.00	47.00	141.00	47.00
V_5	S_1	48.33	48.00	49.67	146.00	48.67
	S_2	47.00	47.00	47.67	141.67	47.22
	S_3	47.00	49.33	48.00	144.33	48.11
	S_4	47.00	49.33	48.67	145.00	48.33
V_6	S_1	47.33	47.00	48.00	142.33	47.44
	S_2	47.67	47.00	47.67	142.34	47.45
	S_3	48.00	47.67	49.33	145.00	48.33
	S_4	47.00	47.00	47.00	141.00	47.00

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	7.36	3.68	0.91		
Variety	5	9187.92	1837.58	452.26*	<.0001	
Organic fertilizers	3	16.02	5.34	1.31	.028	
A X B	15	51.12	3.41	0.84*	0.63	
Error	46	186.91	4.06			
TOTAL	71	9449.32				

* - Significant

Coefficient of variation = 3.43%

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

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	S_1	48.03	51.87	49.00	148.90	49.63
	S_2	53.7	53.43	50.57	157.70	52.57
	S_3	58.13	55.17	54.53	167.83	55.94
	S_4	53.67	51.87	56.57	162.11	54.04
V_2	S_1	46.07	46.07	49.63	141.77	47.26
	S_2	44.20	51.57	51.87	147.64	49.21
	S_3	42.77	49.07	54.90	146.74	48.91
	S_4	45.53	54.53	41.20	104.26	34.75
V_3	S_1	51.37	48.47	44.37	144.21	48.07
	S_2	49.57	53.13	51.83	154.53	51.51
	S_3	46.43	50.20	47.63	144.26	48.09
	S_4	50.43	49.50	46.03	145.96	48.65
V_4	S_1	36.23	47.13	40.50	118.03	39.34
	S_2	36.53	40.10	42.80	119.43	39.81
	S_3	38.43	42.27	40.13	120.83	40.28
	S_4	37.13	44.63	41.20	122.96	40.99
V_5	S_1	45.63	42.30	45.00	132.93	44.31
	S_2	50.80	45.37	48.83	145.00	48.33
	S_3	41.20	46.17	46.60	133.97	44.66
	S_4	42.47	44.07	50.70	137.24	45.75
V_6	S_1	30.10	34.03	41.93	106.06	35.35
	S_2	31.50	28.10	42.50	102.10	34.03
	S_3	27.90	29.57	32.43	89.90	29.97
	S_4	31.90	32.10	35.13	99.13	33.04

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	95.25	47.62	3.99		
Variety	5	3085.94	617.19	51.65*	<.0001	
Organic fertilizers	3	34.31	11.44	0.96	0.42	
A X B	15	146.20	9.75	0.82*	0.66	
Error	46	549.71	11.95			
TOTAL	71	3911.41				

* - Significant

Coefficient of variation = 7.70%

Appendix Table 3. Number of days from planting to first harvest

TREATMENT		REPLICATION I	II	III	TOTAL	MEAN
V_1	S_1	140	140	140	420	140
	S_2	140	140	140	420	140
	S_3	140	140	140	420	140
	S_4	140	140	140	420	140
V_2	S_1	140	140	140	420	140
	S_2	140	140	140	420	140
	S_3	140	140	140	420	140
	S_4	140	140	140	420	140
V_3	S_1	141	141	141	423	141
	S_2	141	141	141	423	141
	S_3	141	141	141	423	141
	S_4	141	141	141	423	141
V_4	S_1	124	124	124	372	124
	S_2	124	124	124	372	124
	S_3	124	124	124	372	124
	S_4	124	124	124	372	124
V_5	S_1	126	126	126	378	126
	S_2	126	126	126	378	126
	S_3	126	126	126	378	126
	S_4	126	126	126	378	126
V_6	S_1	126	126	126	378	126
	S_2	126	126	126	378	126
	S_3	126	126	126	378	126
	S_4	126	126	126	378	126

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.00	0.00	0.00		
Variety	5	4090.00	818.00	-*	<.0001	
Organic fertilizers	3	0.00	0.00	.	.	
A X B	15	0.00	0.00	.	.	
Error	46	0.00	0.00			
TOTAL	71	4090.00				

* - Significant

Coefficient of variation = 0%

Appendix Table 4. Number of main stems at flowering

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	S_1	4.67	3.67	3.33	11.67	3.89
	S_2	3.67	3.33	3.67	10.67	3.56
	S_3	3.67	3.33	3.33	10.33	3.44
	S_4	5.00	4.33	3.00	12.33	4.11
V_2	S_1	2.67	2.67	4.00	9.34	3.11
	S_2	3.00	4.00	4.67	11.67	3.89
	S_3	4.00	3.67	4.00	11.67	3.89
	S_4	433	3.67	4.00	12.00	4.00
V_3	S_1	567	3.33	3.33	12.33	4.11
	S_2	3.00	3.67	2.33	9.00	3.00
	S_3	2.67	3.67	3.33	9.67	3.22
	S_4	3.33	3.67	4.00	11.00	3.67
V_4	S_1	4.00	4.33	4.00	12.33	4.11
	S_2	4.67	3.00	3.33	11.00	3.67
	S_3	4.67	5.00	4.00	13.67	4.56
	S_4	4.67	467	5.33	14.67	4.89
V_5	S_1	4.00	4.67	5.00	13.67	4.56
	S_2	4.33	4.00	5.33	13.66	4.55
	S_3	3.67	4.00	4.33	12.00	4.00
	S_4	3.67	3.67	4.67	12.01	4.00
V_6	S_1	4.00	3.67	4.67	12.34	4.11
	S_2	3.67	3.00	3.33	10.00	3.33
	S_3	2.33	3.33	3.67	9.33	3.11
	S_4	4.00	3.33	4.00	11.33	3.78

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Block	2	0.55	0.28	0.72		
Variety	5	7.33	1.47	3.82*	0.0056	
Organic fertilizers	3	2.21	0.74	1.92	0.1397	
A X B	15	7.61	0.51	1.32	0.23	
Error	46	17.64	0.38			
TOTAL	71	35.34				

* - Significant   Coefficient of variation = 16.06%

Appendix Table 5. Average number of pods per plant

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	S_1	203.33	298.33	222.33	723.99	241.33
	S_2	393.00	349.33	313.67	1056.00	352.00
	S_3	300.33	246.33	303.33	849.99	283.33
	S_4	309.00	288.00	294.33	891.33	297.11
V_2	S_1	344.33	202.00	286.00	832.33	277.44
	S_2	265.67	373.67	390.00	1029.34	343.11
	S_3	286.67	259.00	264.33	810.00	270.00
	S_4	127.67	183.33	224.67	535.67	178.56
V_3	S_1	294.33	189.33	266.00	704.66	234.89
	S_2	122.00	262.33	294.33	678.66	226.22
	S_3	295.67	261.33	287.67	844.67	281.56
	S_4	317.67	324.33	312.67	954.67	318.22
V_4	S_1	203.67	228.00	185.67	61734	205.78
	S_2	243.67	19033	277.33	711.33	237.11
	S_3	257.00	245.33	148.33	650.66	216.89
	S_4	235.33	246.67	256.67	738.67	246.22
V_5	S_1	36.00	33.33	34.00	103.33	34.44
	S_2	70.00	89.67	84.33	254.67	84.89
	S_3	53.00	58.33	56.00	167.33	55.78
	S_4	101.33	102.00	100.00	303.33	101.11
V_6	S_1	125.33	252.33	182.00	559.66	186.55
	S_2	75.67	181.00	124.33	381.00	127.00
	S_3	131.33	152.67	166.33	450.33	150.11
	S_4	174.33	132.33	273.33	579.99	193.33

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Block	2	2316.62	1158.31	0.63		
Variety	5	438399.46	87679.89	47.75*	<.0001	
Organic fertilizers	3	10337.00	3445.67	1.88*	0.15	
A X B	15	79831.77	5322.12	2.90*	0.0028	
Error	46	84470.96	1836.33			
TOTAL	71	615355.80				

* - Significant   Coefficient of variation = 19.89%

Appendix Table 6. Average number of filled pods

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	S_1	181.00	274.33	207.67	663.00	221.00
	S_2	366.00	312.00	284.67	962.67	320.89
	S_3	289.67	24433	215.33	74933	249.78
	S_4	274.67	215.67	211.33	701.67	233.89
V_2	S_1	208.33	287.67	263.67	759.67	253.22
	S_2	246.00	336.33	368.67	951.00	317.00
	S_3	265.67	136.33	228.00	730.00	243.33
	S_4	113.00	167.00	203.67	483.67	161.22
V_3	S_1	269.67	171.67	250.67	692.01	230.67
	S_2	114.00	242.00	273.67	629.67	209.89
	S_3	231.00	268.67	273.67	773.34	257.78
	S_4	307.00	200.67	389.00	896.67	298.89
V_4	S_1	17633	216.33	158.00	550.66	183.55
	S_2	226.33	173.33	268.00	667.66	222.55
	S_3	239.00	206.67	136.00	581.67	193.89
	S_4	219.00	217.33	234.33	67066	223.55
V_5	S_1	30.33	30.33	31.67	92.33	30.78
	S_2	76.00	64.33	75.67	216.00	72.00
	S_3	47.67	47.67	49.00	14434	48.11
	S_4	76.67	77.67	97.33	251.67	83.89
V_6	S_1	109.67	133.00	119.67	362.34	120.78
	S_2	129.67	110.00	117.00	356.67	118.89
	S_3	130.33	130.33	139.33	399.99	133.33
	S_4	153.67	125.00	23867	517.34	172.45

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Block	2	3404.49	1702.25	0.92		
Variety	5	373928.83	74785.77	40.57*	<.0001	
Organic fertilizers	3	12802.83	4267.61	2.32*	0.09	
A X B	15	69563.00	4637.53	2.52*	0.0084	
Error	46	84796.18	1843.40			
TOTAL	71	544495.34				

* - Significant

Coefficient of variation = 22.39%

Appendix Table 7. Average number of unfilled pods

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	S_1	22.33	24.00	14.67	61.00	20.33
	S_2	27.00	37.33	29.00	93.33	31.11
	S_3	39.67	23.00	38.00	100.67	33.56
	S_4	64.33	62.33	63.00	189.66	63.22
V_2	S_1	26.00	24.33	22.33	72.66	24.22
	S_2	29.67	27.33	21.33	78.33	26.11
	S_3	21.00	22.67	36.33	80.00	26.67
	S_4	14.67	16.33	21.00	52.00	17.33
V_3	S_1	24.67	1767	15.33	57.67	19.22
	S_2	18.00	15.33	15.67	49.00	16.33
	S_3	24.67	22.67	24.00	71.34	23.78
	S_4	10.67	23.67	23.67	58.01	19.34
V_4	S_1	27.33	11.67	27.67	66.67	22.22
	S_2	15.33	17.00	11.33	43.66	14.55
	S_3	18.00	12.33	12.33	42.66	14.22
	S_4	20.33	25.30	22.33	67.99	22.66
V_5	S_1	4.67	3.00	3.33	11.00	3.67
	S_2	12.67	15.33	10.67	38.67	12.89
	S_3	7.33	8.67	7.00	23.00	7.67
	S_4	14.67	19.33	17.67	51.67	17.22
V_6	S_1	15.67	19.33	12.33	47.33	15.78
	S_2	6.00	11.00	7.33	24.33	8.11
	S_3	17.00	14.33	19.00	50.33	16.78
	S_4	20.67	17.33	24.67	62.67	20.89

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Block	2	2.72	1.36	0.06		
Variety	5	5003.96	1000.79	47.53*	<.0001	
Organic fertilizers	3	955.27	318.42	15.12*	<.0001	
A X B	15	3099.37	206.62	9.81*	<.0001	
Error	46	968.64	21.06			
TOTAL	71	10029.95				

* - Significant Coefficient of variation = 22.12%

Appendix Table 8. Total yield per plot (g)

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	S_1	631.80	652.70	619.80	1904.30	634.77
	S_2	609.00	663.00	724.10	1997.00	665.67
	S_3	556.50	545.80	555.30	1657.60	552.53
	S_4	577.40	641.80	654.80	1874.00	624.67
V_2	S_1	588.00	519.60	52150	1629.10	543.03
	S_2	490.30	584.90	567.80	1643.00	547.67
	S_3	430.50	559.00	560.80	1553.30	517.77
	S_4	392.00	373.60	389.40	1155.00	385.00
V_3	S_1	579.10	529.00	625.50	1733.60	577.87
	S_2	466.90	475.70	559.10	1501.70	500.57
	S_3	582.60	509.90	535.70	1628.20	542.73
	S_4	640.90	590.50	661.00	1829.40	630.80
V_4	S_1	600.70	502.00	626.20	1728.90	576.30
	S_2	424.10	403.80	470.70	1298.60	432.87
	S_3	553.50	613.80	545.50	1702.80	567.60
	S_4	668.70	633.60	692.40	1994.70	664.90
V_5	S_1	96.70	99.10	869.00	282.70	94.23
	S_2	212.80	215.80	202.10	630.70	210.23
	S_3	257.60	215.40	319.80	729.80	264.27
	S_4	259.70	254.60	246.80	761.10	253.70
V_6	S_1	454.50	576.20	467.90	1498.60	499.53
	S_2	403.10	341.20	407.00	1151.30	388.77
	S_3	243.10	217.70	248.10	708.90	236.30
	S_4	608.10	583.90	687.30	1879.30	626.43

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	12238.01	6119.00	3.87		
Variety	5	1325038.30	265007.66	167.69*	<.0001	
Organic fertilizers	3	76516.34	25505.45	16.14*	<.0001	
A X B	15	410270.85	27351.39	17.31*	<.0001	
Error	46	72694.05	1580.31			
TOTAL	71	1896757.55				

* - Significant

Coefficient of variation = 8.27%

Appendix Table 9. Computed yield per hectare (kg)

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	S_1	2106.00	2175.66	2066.00	6347.66	2115.89
	S_2	2030.00	2210.00	2413.66	6653.66	2217.89
	S_3	1855.00	1819.33	1851.00	5525.33	1841.78
	S_4	1924.66	2139.33	2182.66	6246.65	2082.22
V_2	S_1	1960.00	1732.00	1738.33	5430.33	1810.11
	S_2	1634.33	1949.66	1892.66	5476.65	1825.55
	S_3	1435.00	1863.33	1879.33	5177.66	1725.89
	S_4	1306.67	1245.33	1298.00	3850.00	1283.33
V_3	S_1	1930.33	1763.33	2085.00	5778.66	1926.22
	S_2	1556.33	1585.67	1863.66	5005.66	1668.55
	S_3	1942.00	1699.66	1785.66	5427.32	1809.11
	S_4	2136.33	1968.33	2203.33	6307.99	2102.66
V_4	S_1	2002.33	1673.33	2087.33	5762.99	1921.00
	S_2	1413.67	1346.00	1569.00	4328.67	1442.89
	S_3	1845.00	2046.00	1818.33	5709.33	1903.11
	S_4	2229.00	2112.00	2308.00	6649.00	2216.33
V_5	S_1	322.33	330.33	289.67	942.33	314.11
	S_2	704.33	719.33	673.67	2102.33	700.78
	S_3	858.67	718.00	1066.00	2642.67	880.89
	S_4	865.67	848.67	822.67	2537.01	845.67
V_6	S_1	1515.00	1920.66	1559.67	4995.33	1665.11
	S_2	1343.67	1137.33	1356.67	3837.67	1279.22
	S_3	810.33	725.66	827.00	2363.00	878.67
	S_4	2027.00	1946.33	2291.00	6264.33	2088.11

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	136000.27	68000.14	3.87		
Variety	5	14723185.17	2944637.03	167.71*	<.0001	
Organic fertilizers	3	850169.66	283389.89	16.14*	<.0001	
A X B	15	4558821.54	303921.44	17.31*	<.0001	
Error	46	807672.81	17558.10			
TOTAL	71	21075849.46				

* - Significant

Coefficient of variation = 8.27%

Appendix Table 10. Yield per sample (g)

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	S_1	50.20	63.63	67.77	181.60	60.53
	S_2	85.37	81.23	82.03	248.63	82.88
	S_3	65.53	61.60	62.60	191.73	63.91
	S_4	63.67	52.13	59.90	175.70	58.57
V_2	S_1	68.07	53.37	57.53	178.97	59.66
	S_2	70.50	79.37	70.23	220.10	73.37
	S_3	71.76	65.50	68.17	205.34	68.45
	S_4	33.23	49.27	40.33	122.83	40.94
V_3	S_1	58.80	52.23	54.97	166.00	55.33
	S_2	47.23	52.5	46.30	146.03	48.68
	S_3	65.37	63.33	62.67	191.37	63.79
	S_4	74.90	85.70	79.63	240.23	80.08
V_4	S_1	49.83	44.83	48.73	143.39	47.80
	S_2	56.27	51.57	63.80	171.64	57.21
	S_3	50.83	48.73	40.57	140.13	46.71
	S_4	52.83	58.83	60.13	171.79	57.26
V_5	S_1	15.83	10.37	10.70	36.90	12.30
	S_2	32.93	29.63	29.23	91.79	30.60
	S_3	17.93	19.67	17.97	55.57	18.52
	S_4	28.93	36.77	38.97	104.67	34.89
V_6	S_1	77.70	75.93	79.00	232.63	77.54
	S_2	49.07	44.17	55.70	148.94	49.65
	S_3	43.57	47.63	49.77	140.97	46.99
	S_4	62.27	62.77	64.37	189.41	63.14

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	8.71	4.36	0.19		
Variety	5	14277.34	2855.47	127.78*	<.0001	
Organic fertilizers	3	402.34	134.11	6.00*	0.0015	
A X B	15	7265.39	484.36	21.68*	<.0001	
Error	46	1027.92	22.35			
TOTAL	71	22981.70				

* - Significant

Coefficient of variation = 8.74%

Appendix Table 11. Weight of 100 seeds (g)

TREATMENT		REPLICATION			TOTAL	MEAN
		I	II	III		
V_1	S_1	26.70	32.20	30.80	89.70	29.90
	S_2	25.90	24.70	28.20	78.80	26.27
	S_3	24.60	25.70	25.00	75.30	25.10
	S_4	22.50	22.70	24.50	69.70	23.23
V_2	S_1	23.90	22.70	21.10	67.70	22.57
	S_2	23.50	23.20	24.30	71.00	23.67
	S_3	24.20	25.10	25.00	74.30	24.77
	S_4	24.70	25.90	27.20	77.80	25.93
V_3	S_1	23.60	26.50	24.70	74.80	24.93
	S_2	23.60	24.10	23.30	71.00	23.67
	S_3	22.20	22.00	25.00	69.20	23.07
	S_4	24.10	27.00	25.00	76.10	25.37
V_4	S_1	23.40	24.40	20.10	67.90	22.63
	S_2	24.20	23.90	24.80	72.90	24.30
	S_3	22.80	22.00	22.60	67.40	22.47
	S_4	27.90	26.00	28.50	82.40	27.47
V_5	S_1	43.00	40.10	40.40	123.50	41.17
	S_2	44.50	41.20	44.60	130.30	43.43
	S_3	43.50	41.90	44.20	129.60	43.20
	S_4	48.10	45.20	47.40	140.70	46.90
V_6	S_1	36.10	37.00	37.50	110.60	36.87
	S_2	37.20	34.00	35.40	106.60	35.53
	S_3	35.70	28.00	36.80	100.50	33.50
	S_4	33.50	29.30	33.50	96.30	32.10

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Block	2	13.24	6.62	2.28		
Variety	5	3845.37	769.07	265.10*	<.0001	
Organic fertilizers	3	20.58	6.86	2.36*	0.83	
A X B	15	219.28	14.62	5.04*	<.0001	
Error	46	133.45	2.90			
TOTAL	71	4231.93				

* - Significant

Coefficient of variation = 5.77%