BIBLIOGRAPHY

MAGCIANO, DAISY B. MAY 2009. Response of Chickpea (*Cicer arietinum L.*) Varieties to Organic Fertilizer Application. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study aimed to determine the response of chickpea as affected by the different organic fertilizers and to identify the chickpea accessions that would perform productively with the application of the different organic fertilizer. The study was conducted from October 2008 to February 2009.

The responses of the different chickpea accessions to the organic fertilizer were studied under open field condition. The four accessions used were ICCV 93952 and ICCV 93954 (Desi type) and, ICCV 95332 and ICCV V_2 (Kabuli type) while the five organic fertilizers used were control (farmers practice), chicken dung, BSU compost, processed chicken dung and Sagana 100.

The computed yield per hectare of the different chickpea accessions showed highly significant differences. ICCV 95332 (Kabuli type) produced the highest yield per hectare with 953.96 kg/ha; followed by ICCV 93954 (Desi type) with 773.48 kg/ha; ICCV 93952 (Desi type) with 412.14 kg/ha; lastly, ICCV 2 (Kabuli type) produced the lowest yield per hectare with 258.87 kg/ha.

Analysis also reveals highly significant differences on the yield per hectare of chickpea as affected by the different organic fertilizers. Chickpea applied with control

(farmers practice) produced the highest yield per hectare with 733.71 kg/ha; followed by Sagana100 with 683.16 kg/ha; chicken dung and processed chicken dung with 544.71 kg/ha and 545.76 kg/ha, respectively; lastly, chickpea applied with BSU compost produced the lowest yield per hectare of 490.73 kg/ha.

Highly significant differences were noted on the yield per hectare of chickpea as affected by the interaction of the accessions and organic fertilizer. Results revealed that ICCV 95332 (Kabuli type) applied with chicken dung produced the highest yield with 1066.90 kg/ha while ICCV 93952 (Desi type) applied with processed chicken dung produced the lowest yield per hectare with 162.995 kg/ha.

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INTRODUCTION

Nature of the Study

Organic matter is unifying elements in the soil, having a prominent influence on soil organisms, plant growth and on physical properties of the soil. We might regard the soil as the furnace of life, wherein organic matter is the fuel, soil organisms are the fire consuming the fuel, and the plant nutrient are the ashes of combustion. The fire needs no matches, only fuel on a modest amount of air and water; it is vigorous at the first addition of residues but slows to a smoldering oxidation the last for centuries.

According to Parnes (1986), fresh organic residues are a good source of all nutrients, but after decomposition, the resulting humus is rich in Nitrogen, Phosphorous, and Sulfur but low in Calcium, Magnesium and Potassium.

Organic matter added to garden soil improves the soil structure and feeds the microorganisms and insects. The more beneficial microorganisms the soil can support, the less bad organisms will survive.

Organic matter also contains acids that can make plant roots more permeable, improving their uptake of water and nutrients, and can dissolve minerals within the soil, leaving them available for plant roots.

Furthermore, organic fertilizers also feed the diverse food web of bacteria, fungi, earthworms and other beneficial soil life. These organisms convert soil minerals into available nutrients that can be absorbed by plant roots. These organisms also improve the texture of the soil; creating passage ways for air and water and aggregating soil particles into "crumbs". Beneficial bacteria and fungi also release many disease inhibiting substances.

The chickpea (*Cicer arietinum L.*) also called garbanzo bean, Indian bean, Bengal grain, a *chana, kadale, sanagapappil, shimbra*, is an edible legume of the family *Febaceae*, sub-family *Faboideae*. Chickpea are high in protein and one of the earliest cultured vegetable, 7,500 old remains have been found in the Middle East.

Chickpea is a plant grown for its nutritious edible seeds. The chickpea plant is cultured in India, the Middle East, Northern Africa, and Southern Europe, Central America and the United States. The chickpea plant grows approximately 30-60 cm high. The plant bears rectangular pods that contain one or two seeds. Chickpea maybe white, creamy yellow, red, brown, and nearly black.

Chickpeas are high in carbohydrates and are good source of protein. In India, people eat roasted chickpeas as a snack; they also use chickpeas to make a split pea soup called dhal. People in Middle East and Southern Europe make hummus by mashing cooked chickpeas and assign lemon juice, olive oil, garlic and crushed sesame seeds. It is used as a spread, dip or sauce. Chickpeas also are used to make small cakes called folafel which are deep fried in oil.

Importance of the Study

Renewed concern about the environment has stipulated interest in the use of organic fertilizers. Organic farming is a farming system that promotes, among other practices, the use of organic fertilizer. Organic matter is an essential component of healthy soils, and all sound farming practices integrates and allocates available organic materials to maintain and improve soil fertility. Regular additions of organic matter are important as food for microorganisms; insects, worms and other organisms degrade potential pollutants, help control disease and bind soil particles into larger aggregates.

Well aggregated crumbly coil allows good root penetration, improves water infiltration, makes tillage easier and reduce erosion.

Chickpea are helpful source of zinc foliate and protein. They are also very high in dietary fiber and hence a healthy source of a carbohydrates for persons with insulin sensitivity or diabetes. Chickpea are low in fat and most of this is poly saturated.

One hundred grams of mature bale chickpea contains 164 calories, 2.6 grams of fat (of which only .27 grams is sotured) 7.6 grams of dietary fiber and 8.9 grams of protein. Chickpea also provide dietary calcium (49-53 mg/ .100g) with some source citing the garbanzo's calcium content as about the same as yogurt and close milk. According to the International Crops Research Institute for Semi Arid Tropics, chickpea seeds contain an average: 23% protein, 64% total carbohydrates (47% starch, 6% soluble sugar) 5% fat, 6% crude fiber and 3% ash. There is also a high reported mineral content of phosphorus (340mg/100g), magnesium (140mg/100g), iron (7mg/100g) and zinc (3mg/100mg).

Objectives of the Study

The study aimed to:

1. Determine the response of chickpea as affected by the different organic fertilizers.

2. Identify the chickpea accessions that would perform productively with the application of different organic fertilizers.

Time and Place of the Study

This study was conducted at BSU Experimental Station, Benguet State University, La Trinidad, Benguet from October 2008 to January 2009.

REVIEW OF LITERATURE

Botany of Chickpea

The chickpea plant grows to between 20 and 60 cm high and has small feathery leaves on either side of the stem. One seedpod contains two or three peas. The flowers are white or sometimes reddish blue. Chickpeas need subtropical or tropical climate more than 4100 mm of annual rain. They can be grown in temperature climate but yields will be much lower.

The "Desi," has small, darker seeds and rough coat, cultivated mostly in the Indian subcontinent, Ethiopia, Mexico and Iran. The "Kabuli," has a lighter colored, 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, moaning country or local in Hindi is also known as Bengal grain 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 or archaeological sites and the wild plant ancestor or domesticated chickpeas (*Cicer arietinum L.*) 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 then suitable for people with blood sugar problems.

Fertilizer

Fertilizer is a substance that is added to soil to help plants grow. Farmers use various kinds of fertilizers to produce abundant crops. Home gardeners use fertilizers to raise larger, healthy flowers and vegetables. Landscapes spread fertilizers on lawns and golf course to thicken green grass.

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.

Kinds of Fertilizer

Fertilization is an important factor that affects production. The right method of fertilizer application influenced the production of better quality product.

Fertilizers are of two types: organic and inorganic or chemical fertilizers. Organic fertilizers are derived from organic wastes such as plant residues and animal wastes while inorganic chemical fertilizers consist of chemically prepared substance containing varying amount of nitrogen, phosphoric acid and potash. Organic fertilizers have an advantage over chemical because they are renewable, and soil fertility gradually declines as a result of their continued application (Balco, 1986).

Inorganic fertilizers are available for the plants as it is dissolve, unlike organic materials that must rot and decay before they become beneficial to the plants. Bautista *et al.* (1983) stated that inorganic fertilizers release great quantities of nutrients elements that can be easily absorbed by the roots. The results of application can be seen within a few days.

Fertilizer Value of Organic Matter

Parnes (1986) mentioned that organic matter is principally a source of nitrogen, phosphorus and sulfur nutrients which soil organisms require and retain. These nutrients slowly become available as the organic matter continues to decompose. Most of the calcium, magnesium and potassium in the decaying organic residues are discarded by the soil organisms during the first stage of decomposition, and these nutrients are quickly available to plants. Owing to the energy which it contains, organic matter serves many purposes, its own as well as indirectly through the soil organisms which it nourishes. Tangible value is set on this energy by relating it to energy in fuel.

Nutrient elements from organic fertilizers are released slowly which is particularly important in avoiding salt injury, ensuring a continuous supply of nutrients throughout the growing season and in producing of better quality.

Effect of Organic Fertilizer

Knott (1976) mentioned that the application of organic fertilizer in soil prior to planting or sowing time results high yield. Manure does not only provide nutrients but also humus, which improves physical condition of the soil. The author also said that well decomposed manure should be applied at a rate of 10-20 tons/ha after the first plowing. This amount will slowly provide nitrogen during vegetative growth of the crop. However, full benefits of such practice would be realized over a period of 2 years.

Similarly, Rodriguez (1981) reported that organic fertilizer such as compost and green manuring are very important needs in the vegetable production. The fertility also makes production continuous. As explained by Tisdale and Nelson (1975), organic fertilization releases the nutrient element slowly especially nitrogen for efficient utilization of plants. Once available nutrients are translocated to plant parts, growth and yield tend to increase. Chicken manure was found to contain about 1% nitrogen, 0.8% phosphorus, 0.40% potassium (Brady and Buckham, 1960).

On the other hand, Akiew (1978) reported that chicken dung contains 11% nitrogen which is the highest among organic fertilizers. But lower in phosphorus and potassium. However, chicken dung promotes faster and better vegetative growth.

Under La Trinidad, Deanon (1976) discovered that it is customary to mix a truck load of compost chicken dung with the soil of a hectare before planting. The author also wrote that most short season vegetable crops need various amounts of nutrients in readily available form for growth and development. As explained by Capiz and Aycado (1977) there is a need for sustained application of compost to provide the food supply needs of crops as well as to feed the beneficial flora and fauna especially the microbes that make the tied nutrients available.

Crops fertilized with organic matter have greater resistance to pest and diseases. The writer explained that humid acids and growth substances are absorbed into the plant tissue through the roots and they favor the formation of proteins by influencing the synthesis of enzymes increasing the vigor and insect resistance of the plant. Soils high in organic matter allow little or no soil borne disease because of the oxygen ethylene cycle in the soil. It was also mentioned that the sap of the plants fertilized with organic matter is more bactericidal than plant not fertilized with organic matter. Not only does humus confer immunity to plant pest and disease. It also improves the quality of crops, characteristics that has very definite commercial value (Abadilla, 1982).

Importance of N-P-K

Nitrogen plays a vital role in plant growth and development. As Mendiola (1958) stated that nitrogen promotes the growth of sexual lands and flowers. He further added that most plants at certain period of their growth cease to produce new branches and leaves or to increase those already formed and commenced to produce flowers and fruits. If a plant is provided with mush available nitrogen that it can use at a time it begins to flower, the formation of flowers maybe checked and the growth activity is sent back to the stems which taken on new sugar and multiply profusely.

According to Mullins, the presence of phosphorus in the soil encourages plant growth because phosphorus is a major building block of DNA molecules. It is responsible for the storage of energy in the form of adenosine diphosphate (ADP) and adenosine triphosphate (ATP). The energy stored in this phosphate compounds allow for the transportation of nutrients across the cell wall and the synthesis of nucleic acid and proteins. The addition of phosphorus fertilizers ensures that the crops will reach their full potential by using additional phosphorus to encourage root growth and stalk strength while promoting resistance to root knot disease.

Potassium as an essential element is the backbone to a plant life and it plays many vital roles in its nutrition. It increases root growth, improves drought resistance, enhances several enzymes functions, builds cellulose, reduces lodging, controls plant turgidity, maintains the selectivity and integrity of cell membranes, helps in protein synthesis and uplifts the protein content of plants, produces grain rich in starch and controls pests and diseases.

MATERIALS AND METHODS

Materials

The materials used were seeds of chickpea, garden tools, unprocessed chicken dung, processed chicken dung, Sagana 100, BSU compost, 14-14-14, record book and identifying pegs.

Methods

Experimental Design and Treatments. This study was laid out in a Randomized Complete Block Design (RCBD) in factorial arrangement. Factor A was the lines of cultivar and Factor B was the source of organic matter. Hilling up operations was done one month from planting. The treatments were as follows:

Factor A (cultivar/line)

Desi Type	Kabuli Type
V_1 - ICCV 93952	V_3 - ICCV 95332
V_2 - ICCV 93954	V_4 - ICCV 2

Factor B (organic fertilizers)

S_1 – Farmers practice (control) 1 kerosene can chicken dung + 250g 14-14-14/5m²

S_2 – Chicken dung

S_3 – Compost (BSU compost)

S_4 – Processed chicken dung

S_5 – Sagana 100

Care and Maintenance

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

Data Gathered

There were five samples per replicate where the following parameters were gathered.

1. Vegetative growth

a. Days from planting to flowering. This was obtained by counting the number of days from planting to first flowering.

b. Average plant height at flowering (cm). This was taken at first flowering stage.

c. Days from planting to first harvest. This was noted on the first harvest of seeds.

d. Total number of harvest/picking. This was the total number of harvesting done for one cropping season.

e. Number of lateral stems at flowering. This was determined by counting the lateral stem of the plant at flowering.

2. Yield

a. Percentage pod setting. This was taken using the formula.

$$\text{Percentage Pod Setting} = \frac{\text{No. of Pods/Plant}}{\text{No. of Flowers Produced/Plant}} \times 100$$

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

Average Number of Pods = Total Number of Pods Produced by Sample Plants / No. of Sample Plants

c. Total yield per plot (kg). This was obtained by taking all the weight of the seeds per plot in the whole cropping season.

d. Computed yield/ha. This was computed using the formula:

Yield per ha = Total yield per plot 5m² (2000 m²)

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

3. Seed Quality

a. Weight of 100 seeds. This was taken by weighing 100 seeds (g).

Figure 1. Overview of the experimental area during the application of the different organic fertilizers

Figure 2. Overview of the experiment of chickpea accessions at transplanting

Figure 3. Overview of the experiment at flowering stage

Figure 4. Overview of the experiment at harvesting

RESULTS AND DISCUSSION

Days from Planting to Flowering

Effect of variety/accession. Highly significant differences were noted in the number of days from planting to flowering of the four accessions of chickpea used (Table 1). ICCV 2 (Kabuli type) produced flowers the earliest with 49 days after planting, followed by ICCV 95332 (Kabuli type) and ICCV 93954 (Desi type) within 51days and 60 days, respectively. ICCV 93952 (Desi type) were the latest to produce flowers after 68 days after planting. Results showed that Kabuli type chickpea produced flowers earlier than Desi type. Nevertheless, different accessions of chickpea differ in the number of days from planting to flowering.

Effect of organic fertilizers. Table 1 shows the number of days from planting to flowering as affected by the different organic fertilizers. Analysis reveals significant differences on the number of days from planting to flowering of chickpea as affected by the organic fertilizers. It was noted that chickpea applied with the control (farmers practice) produced flowers the earliest after 54 days from planting.

According to Abadilla (1982), crops fertilized with organic matter have greater resistance to pest and diseases. Not only does humus confer immunity to plant pest and diseases. It also improves the quality of crops, characteristics that has very definite commercial value.

Interaction effect. No significant differences were noted on the interaction effect of the accession and the organic fertilizers on the number of days from planting to flowering of the chickpea.

Table 1. Number of days from planting to flowering

TREATMENT	WEIGHTED MEAN
<u>Variety/Accession</u>	
ICCV 93952 (Desi type)	68[a]
ICCV 93954 (Desi type)	60[b]
ICCV 95332 (Kabuli type)	51[c]
ICCV 2 (Kabuli type)	49[d]
<u>Organic Fertilizers</u>	
Control	54[d]
Chicken Dung	56[c]
BSU Compost	60[a]
Processed Chicken Dung	58[b]
Sagana 100	57[b]
CV (%)	8.53

Means with common letters are not significantly different from each other at 5% level of significance using DMRT.

<u>Average Plant Height at Flowering</u>

<u>Effect of variety/accession.</u> Table 2 shows highly significant differences on the average plant height at flowering as affected by the accessions used. Results showed that ICCV 93952 (Desi type) had the tallest plant height at flowering with 34.40 cm; followed by ICCV 93954 (Desi type) with 31.47 cm; ICCV 2 (Kabuli type) with 25.29 cm; lastly, ICCV 95332 (Kabuli type) produced the shortest plant height at flowering with 22.13 cm.

Further, it was shown that Desi type produced taller plants at flowering as compared to Kabuli type.

Environmental factors like temperature certainly contributed to the duration of flowering in 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 attitude. Roberts *et al.* (1994) also said that the time to flowering was function of temperature and photoperiod.

Table 2. Average plant height (cm) at flowering

TREATMENT	WEIGHTED MEAN
Variety/Accessions	
ICCV 93952 (Desi type)	34.40[a]
ICCV 93954 (Desi type)	31.47[b]
ICCV 95332 (Kabuli type)	22.13[d]
ICCV 2 (Kabuli type)	25.29[c]
Organic Fertilizers	
Control	29.06[a]
Chicken Dung	28.18[a]
BSU Compost	28.18[a]
Processed Chicken Dung	27.54[a]
Sagana 100	28.66[a]
CV (%)	3.09

Means with common letters are not significantly different from each other at 5% level of significance using DMRT.

Effect of organic fertilizers. No significant differences were noted on the average plant height of chickpea as affected by the different organic fertilizers. Plant height of flowering ranged from 27.54 cm. to 29.06 cm. This result showed that the different organic fertilizers did not affect the average plant height of chickpea at flowering.

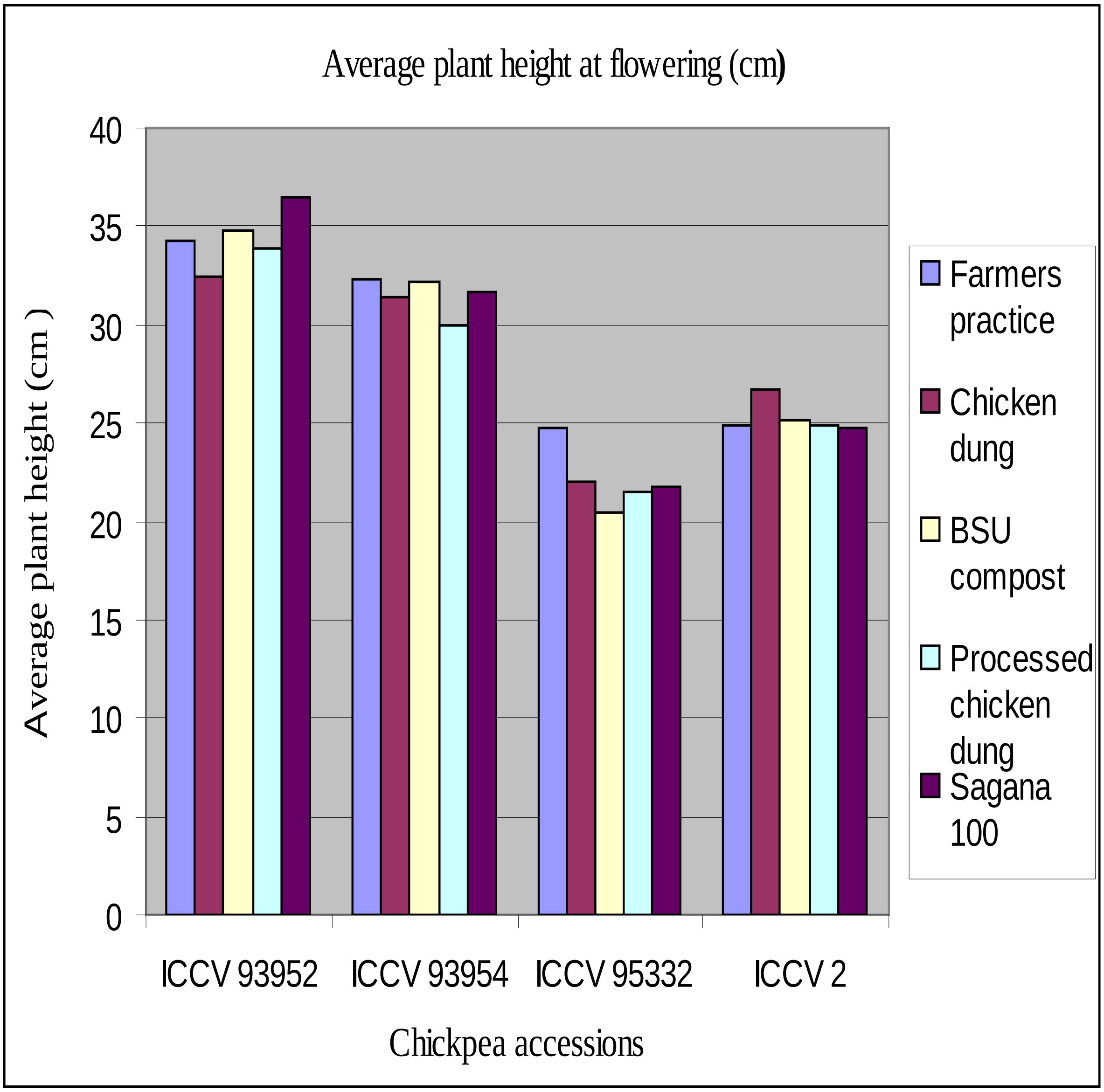

Figure 5. Average plant height at flowering

Interaction effect. Highly significant differences were noted on the average plant height at flowering of the chickpea as affected by the accession and the different organic fertilizers used. It was noted that ICCV 93952 (Desi type) applied with Sagana 100 produced the tallest plant height at flowering with 36.53 cm. while ICCV 95332 (Kabuli type) applied with BSU compost produced the shortest plant at flowering with 20.5 cm. Further, results revealed that Desi type chickpea applied with organic fertilizers produced taller plants compared to Kabuli type chickpeas applied with the same organic fertilizers.

Days from Planting to First Harvest

Effect of variety/accessions. Highly significant difference was noted on the days from planting to first harvest as affected by the different accessions of chickpea used (Table 3). Results showed that ICCV 2 (Kabuli type) were the earliest to be harvested after 86 days from planting; followed by ICCV 95332 (Kabuli type) that was harvested within 122 days; ICCV 93952 (Desi type) and ICCV 93954 (Desi type) were the latest to be harvested after 127 days from planting.

Effect of organic fertilizers. Highly significant differences were noted on the days from planting to first harvest of chickpea as affected by the different organic fertilizers. Results showed that chickpea applied with Sagana 100 were the earliest to be harvested after 114 days from planting; followed by chickpea applied with BSU compost and processed chicken dung with 115 days; chickpea applied with control (farmers practice) and chicken dung were the latest to be harvested after 117 days from planting.

Rodriguez (1981) said that Sagana 100 as an organic fertilizer contains some major trace elements essential for plant growth.

Interaction effect. No significant differences were noted on the days from planting to first harvest of the chickpea as affected by the interaction of the accession and thedifferent organic fertilizers.

Table 3. Days from planting to first harvest

TREATMENT	WEIGHTED MEAN
Variety/Accession	
ICCV 93952 (Desi type)	127[a]
ICCV 93954 (Desi type)	127[a]
ICCV 95332 (Kabuli type)	122[b]
ICCV 2 (Kabuli type)	86[c]
Organic Fertilizers	
Control	117[a]
Chicken Dung	117[a]
BSU Compost	115[b]
Processed Chicken Dung	115[b]
Sagana 100	114[c]
CV (%)	6.68

Means with common letters are not significantly different from each other at 5% level of significance using DMRT.

Total Number of Harvest or Picking

Effect of variety/accession. Significant differences were noted on the total number of harvest as affected by the different accessions of chickpea used (Table 4). It was noted that ICCV 95332 and ICCV 2 both Kabuli type had higher number of harvest/picking with 2.25 and 2.30, respectively. On the other hand, ICCV 93952 and ICCV 93954 both Desi type had the lower number of harvest/picking with 1.80 and 1.85, respectively. This result showed that pods of Desi type chickpea matures faster than Kabuli type.

Effect of organic fertilizers. No significant differences were noted on the total number of harvest/picking of chickpea as affected by the different organic fertilizers.

Interaction effect. No significant interaction effect existed between the accession of chickpea and the different organic fertilizer on the total number of harvest of chickpea.

Number of Lateral Stems at Flowering

Effect of variety/accession. Table 5 shows highly significant differences on the number of lateral stems at flowering as affected by the different accessions of chickpea. ICCV 93952 and ICCV 93954 both Desi type produced higher number of lateral stems at flowering among the accessions while ICCV 95332 and ICCV 2 both Kabuli type produced lower number of lateral stems at flowering. Each plant produces three lateral branches and a maximum of five branches were observed during the conduct of the study.

Effect of organic fertilizers. No significant differences were noted on the number of lateral stems at flowering of chickpea as affected by the different accessions and different organic fertilizers. It ranged from 1.68 to 1.86 lateral stems.

Table 4. Total number of harvest

TREATMENT	WEIGHTED MEAN
Variety/Accession	
ICCV 93952 (Desi type)	1.80[b]
ICCV 93954 (Desi type)	1.85[b]
ICCV 95332 (Kabuli type)	2.25[a]
ICCV 2 (Kabuli type)	2.30[a]
Organic Fertilizers	
Control	2.00[a]
Chicken Dung	2.06[a]
BSU Compost	2.13[a]
Processed Chicken Dung	2.00[a]
Sagana 100	2.06[a]
CV (%)	28.86

Means with common letters are not significantly different from each other at 5% level of significance using DMRT.

Interaction effect. No significant interaction existed between the accession of chickpea and organic fertilizers in terms of the number of lateral stems at flowering.

Percentage Pod Setting

Effect of variety/accession. Results showed that ICCV 93954 (Desi type) had the highest percentage pod setting of 97.60% while ICCV 2 (Kabuli type) had the lowest percentage pod setting of 92.06%. Desi type had relatively higher percentage pod setting as compared to Kabuli type. However, analysis revealed no significant differences on the percentage pod setting of the different accessions of chickpea (Table 6).

Effect of organic fertilizers. No significant differences were noted on the percentage pod setting of chickpea as affected by the different organic fertilizers. The percentage pod setting ranged from 95.47% to 98.21%.

Results showed that control (farmers practice) had the highest percentage pod setting of 98.21 while processed chicken dung had the lowest percentage pod setting of 95.16.

Table 5. Number of lateral stems at flowering

TREATMENT	WEIGHTED MEAN
Variety/Accession	
ICCV 93952 (Desi type)	2.04[a]
ICCV 93954 (Desi type)	2.11[a]
ICCV 95332 (Kabuli type)	1.17[b]
ICCV 2 (Kabuli type)	1.87[b]
Organic Fertilizers	
Control	1.86[a]
Chicken Dung	1.83[a]
BSU Compost	1.83[a]
Processed Chicken Dung	1.80[a]
Sagana 100	1.68[a]
CV (%)	32.83

Means with common letters are not significantly different from each other at 5% level of significance using DMRT.

Table 6. Percentage pod setting

TREATMENT	PERCENTAGE (%)
Variety/Accession	
ICCV 93952 (Desi type)	96.55[a]
ICCV 93954 (Desi type)	97.60[a]
ICCV 95332 (Kabuli type)	94.84[a]
ICCV 2 (Kabuli type)	92.06[a]
Organic Fertilizers	
Control	98.21[a]
Chicken Dung	97.91[a]
BSU Compost	95.47[a]
Processed Chicken Dung	95.16[a]
Sagana 100	97.06[a]
CV (%)	4.66

Means with common letters are not significantly different from each other at 5% level of significance using DMRT.

Interaction effect. No significant differences were noted on the percentage pod setting as affected by the interaction of accession and organic fertilizers.

Average Number of Pods per Plant

Effect of variety/accession. Table 7 shows highly significant differences on the number of pods per plant as affected by the different accessions of chickpea. ICCV 95332 (Kabuli type) produced the highest average number of pods per plant with 256.73; followed by ICCV 93954 (Desi type) with 132.72; lastly, ICCV 93952 (Desi type) and

ICCV 2 (Kabuli type) produced the lowest number of pods per plant with 103.88 and 103.51, respectively.

Effect of organic fertilizers. Highly significant differences were noted on the average number of pods per plant of chickpea as affected by the different organic fertilizers. Chickpea applied with control (farmers practice) produced the most number of pods per plant while those applied with BSU compost had the least number of pods per plant. The average number of pods per plant of chickpea as affected by the different organic fertilizers ranged from 111.56 to 189.66.

Rodriguez (1981) reported that organic fertilizer such as compost and green manuring are very important needs in the vegetable production.

Table 7. Average number of pods per plant

TREATMENT	WEIGHTED MEAN
Variety/Accession	
ICCV 93952 (Desi type)	103.88[c]
ICCV 93954 (Desi type)	132.72[b]
ICCV 95332 (Kabuli type)	256.73[a]
ICCV 2 (Kabuli type)	103.51[c]
Organic Fertilizers	
Control	189.66[a]
Chicken Dung	146.18[c]
BSU Compost	111.56[d]
Processed Chicken Dung	151.05[b]
Sagana 100	147.60[c]
CV (%)	13.62

Means with common letters are not significantly different from each other at 5% level of significance using DMRT.

Interaction effect. Analysis revealed highly significant interaction effect between accession and organic fertilizers on the average number of pods per plant of chickpea. Results revealed that ICCV 95332 (Kabuli type) applied with control (farmers practice) produced the highest average number of pods per plant with 334.80 pods per plant while ICCV 2 (Kabuli type) applied with compost produced the lowest average number of pods per plant with 73.25 pods per plant.

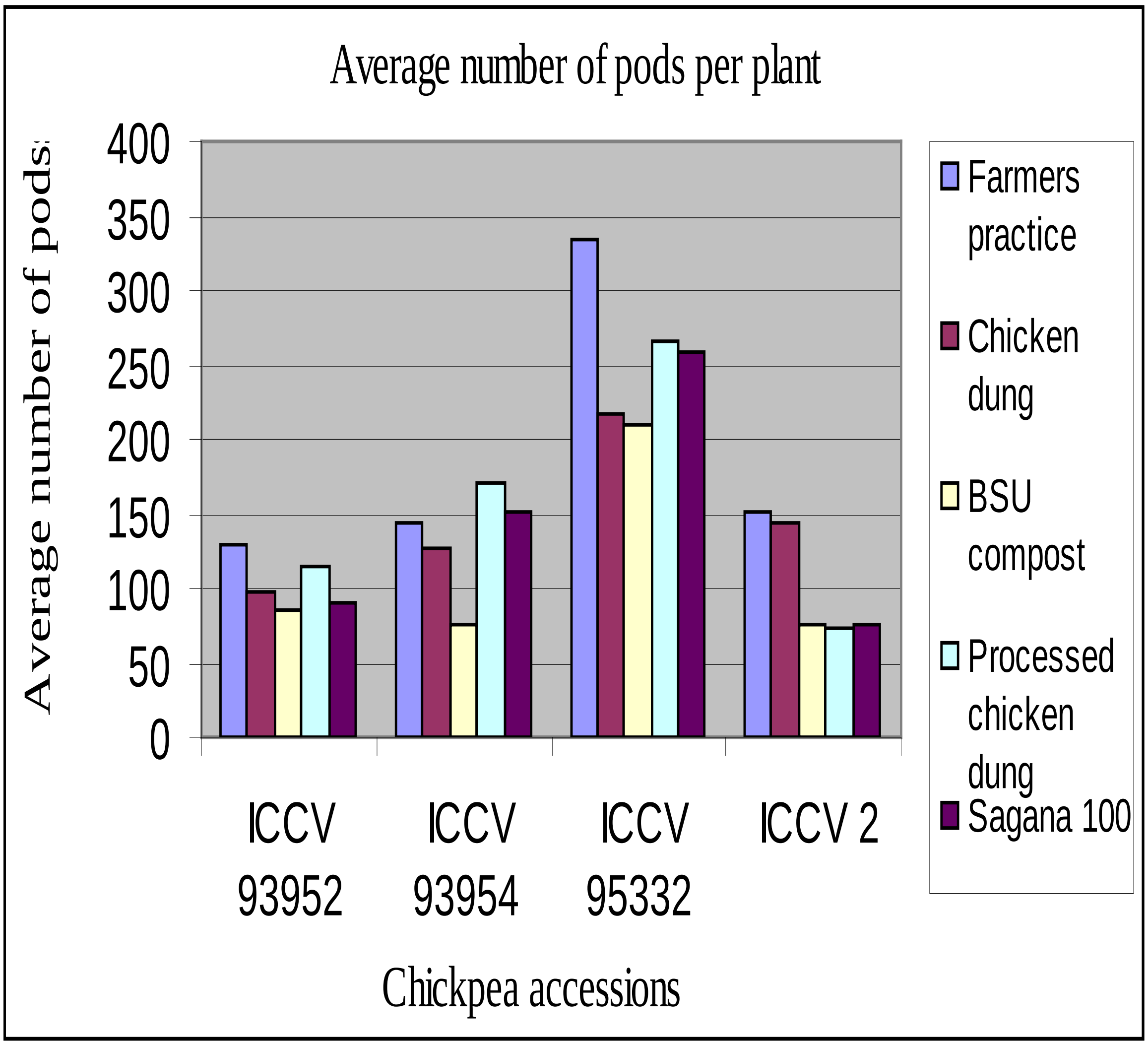

Figure 6. Average number of pods per plant

Total Yield per Plot

Effect of variety/accession. Highly significant differences were noted on the total yield per plot as affected by the different accessions of chickpea (Table 8). ICCV 95332 (Kabuli type) had the highest yield of 0.48 kg/5m^2; followed by ICCV 93954 (Desi type) with 0.39 kg/5m^2; ICCV 93952 (Desi type) with 0.24 kg/5m^2; lastly, ICCV 2 (Kabuli type) had the lowest total yield per plot of 0.13 kg/5m^2.

Effect of organic fertilizers. Significant differences were noted on the total yield per plot of chickpea as affected by the different organic fertilizers. Results showed that chickpea applied with the control (farmers practice) produced the highest total yield per plot among the different organic fertilizers. On the other hand, chickpea applied with processed chicken dung produced the lowest total yield per plot as compared to the other organic fertilizers.

Knott (1976) mentioned that the application of organic fertilizer in soil prior to planting or sowing time results high yield.

Interaction effect. No significant differences were noted on the total yield per plot of chickpea as affected by the interaction of accession and the different organic fertilizers.

Computed Yield per Hectare

Effect of variety/accession. The computed yield per hectare of the different varieties of chickpea showed highly significant differences (Table 9). ICCV 95332 (Kabuli type) produced the highest yield per hectare with 953.48 kg/ha; followed by ICCV 93954 (Desi type) with 773.48 kg/ha; ICCV 93952 (Desi type) with 412.12 kg; ha.

Result is due to the higher infestation rate of diseases to this particular variety. Poor germination of this variety in this location also contributes lower yield.

Effect of organic fertilizers. Highly significant differences were noted on the yield per hectare of chickpea as affected by the different organic fertilizers. Chickpea applied with control (farmers practice) produced the highest yield per hectare with 733.71 kg/ha; followed by Sagana 100 with 683.16 kg/ha; chicken dung and processed chicken dung with 544.71 kg/ha and 545.76 kg/ha, respectively; lastly, chickpea applied with BSU compost produced the lowest yield per hectare of 490.73 kg/ha.

Table 8. Total yield (kg/5m^2) per plot

TREATMENT	TOTAL YIELD PER PLOT (kg/5m^2)
Variety/Accession	
ICCV 93952 (Desi type)	0.24^c
ICCV 93954 (Desi type)	0.39^b
ICCV 95332 (Kabuli type)	0.48^a
ICCV 2 (Kabuli type)	0.13^d
Organic Fertilizers	
Control	0.37^a
Chicken Dung	0.27^c
BSU Compost	0.29^c
Processed Chicken Dung	0.26^c
Sagana 100	0.34^b
CV (%)	31.15

Means with common letters are not significantly different from each other at 5% level of significance using DMRT.

On the other hand, Akiew (1978) reported that chicken dung contains 11% nitrogen which is the highest among organic fertilizers. But lower in phosphorus and potassium. However, chicken dung promoted faster and better vegetative growth.

Interaction effect. Highly significant differences were noted on the yield per hectare of chickpea as affected by the interaction of the accession and organic fertilizers. Results revealed that ICCV 95332 (Kabuli type) applied with chicken dung produced the highest yield with 1066.90 kg/ha while ICCV 93952 (Desi type) applied with compost produced the lowest yield per hectare with 162.995 kg/ha.

Earlier findings of Mangosan (1996) on chickpea showed that application of chicken dung/manure significantly produced taller plants, promoted earlier development and produced more flower per plant.

Table 9. Computed yield per hectare (kg/ha)

TREATMENT	YIELD PER HECTARE (kg/ha)
Variety/Accession	
ICCV 93952 (Desi type)	412.14[c]
ICCV 93954 (Desi type)	773.48[b]
ICCV 95332 (Kabuli type)	953.96[a]
ICCV 2 (Kabuli type)	258.87[d]
Organic Fertilizers	
Control	733.71[a]
Chicken Dung	544.71[c]
BSU Compost	490.73[d]
Processed Chicken Dung	545.76[c]
Sagana 100	683.16[b]
CV (%)	10.96

Means with common letters are not significantly different from each other at 5% level of significance using DMRT.

Number of Filled Pods Produced per Plant

Effect of variety/accession. Table 10 shows highly significant differences on the number of filled pods produced per plant of the different accessions of chickpea. Results revealed that ICCV 2 (Kabuli type) produced the highest number of filled pods per plant with 188; followed by ICCV 93954 (Desi type) with 98.96; ICCV 95332 (Kabuli type) with 70.99; lastly, ICCV 93952 (Desi type) produced the lowest number of filled pods per plant with 65.19.

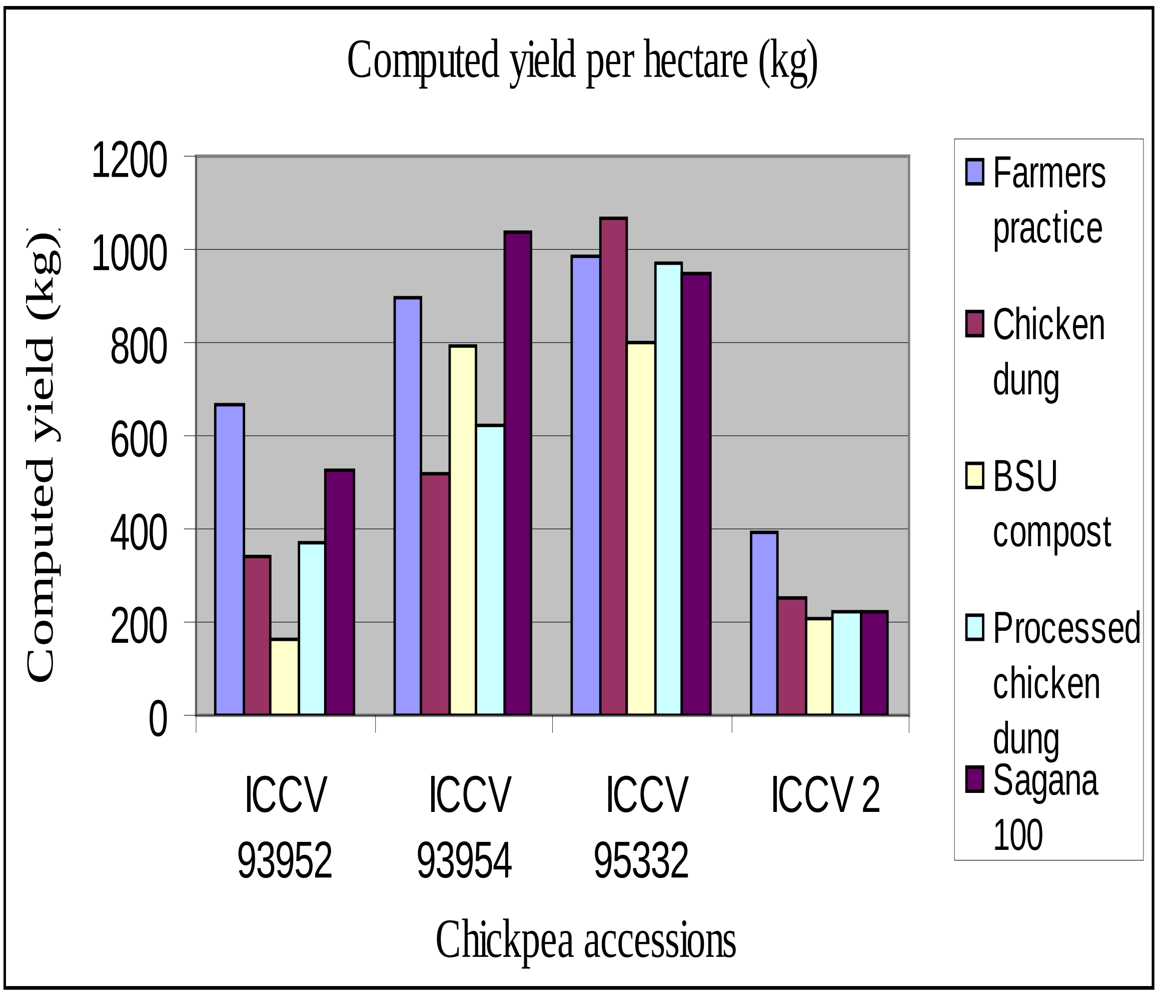

Figure 7. Computed yield per hectare

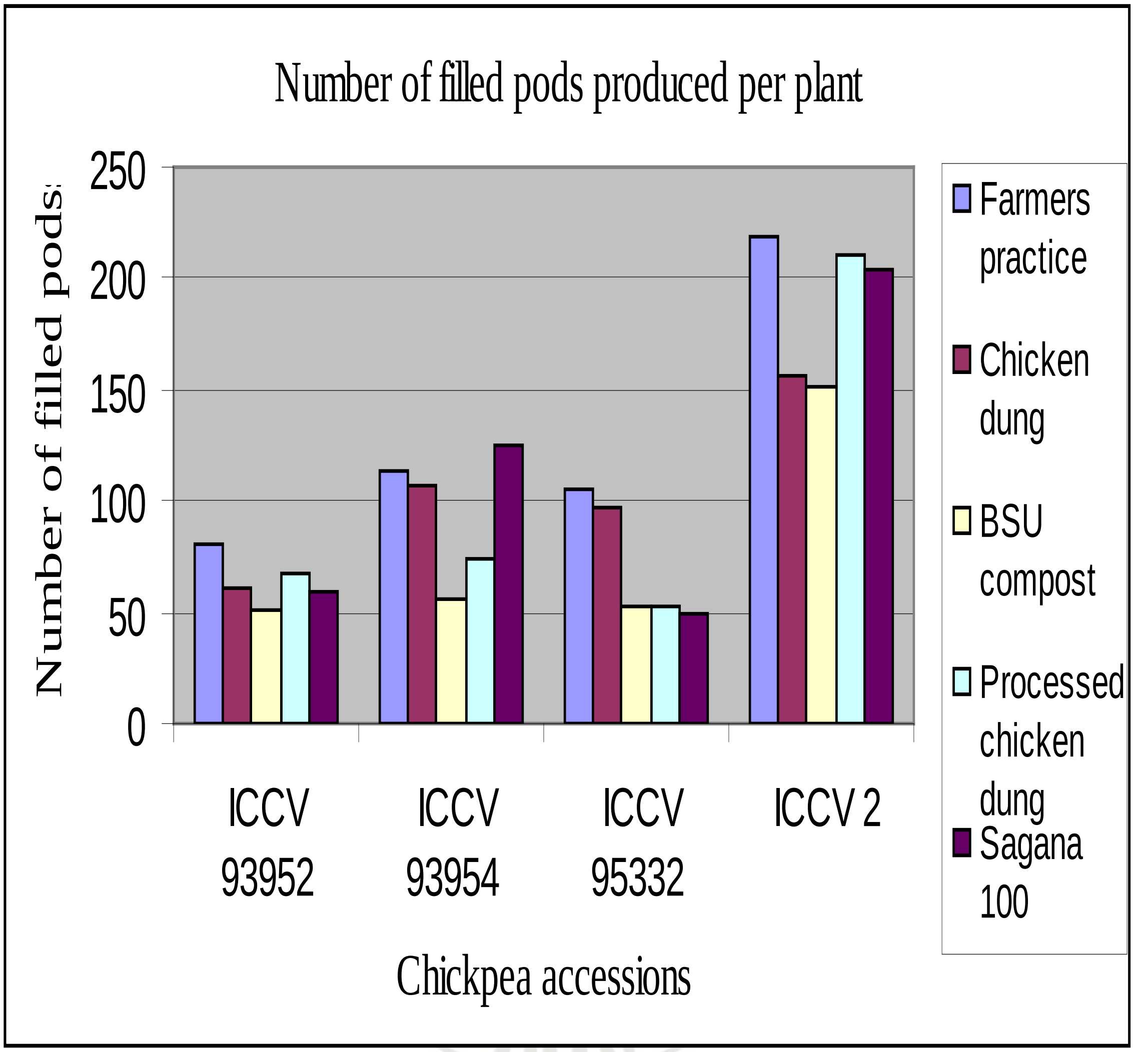

Figure 8. Number of filled pods produced per plant

Table 10. Number of filled pods produced per plant

TREATMENT	WEIGHTED MEAN
Variety/Accession	
ICCV 93952 (Desi type)	65.19[d]
ICCV 93954 (Desi type)	98.96[b]
ICCV 95332 (Kabuli type)	70.99[c]
ICCV 2 (Kabuli type)	188.00[a]
Organic Fertilizers	
Control	129.53[a]
Chicken Dung	105.08[c]
BSU Compost	77.76[d]
Processed Chicken Dung	107.35[c]
Sagana 100	109.21[b]
CV (%)	14.42

Means with common letters are not significantly different from each other at 5% level of significance using DMRT.

Effect of organic fertilizers. Analysis revealed highly significant differences on the number of filled pods per plant. Chickpea applied with control (farmers practice) produced the highest number of pods per plant with 129.53 while those applied with BSU compost produced the lowest number of pods per plant with 77.76.

Interaction effect. Highly significant differences were noted on the number of filled pods produced per plant of chickpea as affected by the interaction of the accession and organic fertilizers. ICCV 2 (Kabuli type) applied with control (farmers practice) produced the highest number of filled pods per plant with 219.3 while ICCV 95332 (Kabuli type) applied with Sagana 100 produced the lowest filled pods per plant with 49.15.

Table 11. Number of unfilled pods produced per plant

TREATMENT	WEIGHTED MEAN
Variety/Accession	
ICCV 93952 (Desi type)	40.19[b]
ICCV 93954 (Desi type)	30.33[d]
ICCV 95332 (Kabuli type)	32.82[c]
ICCV 2 (Kabuli type)	68.83[a]
Organic Fertilizers	
Control	60.14[a]
Chicken Dung	41.10[b]
BSU Compost	33.93[c]
Processed Chicken Dung	40.58[b]
Sagana 100	39.48[b]
CV (%)	19.09

Means with common letters are not significantly different from each other at 5% level of significance using DMRT.

Number of Unfilled Pods Produced per Plant

Effect of variety/accession. As shown in Table 11, the numbers of unfilled pods produced per plant significantly differ from each other as affected by the different accessions of chickpea. ICCV 2 (Kabuli type) produced the highest number of unfilled pods per plant with 68.83 while ICCV 93954 (Desi type) produced the lowest number of unfilled pods per plant with 30.33.

Effect of organic fertilizers. Analysis revealed that highly significant differences existed on the number of unfilled pods per plant of chickpea cultivated with different organic fertilizers. Chickpea applied with control produced the highest number of unfilled pods per plant; followed by chicken dung, processed chicken dung and Sagana 100; lastly, BSU compost produced the lowest number of unfilled pods per plant.

Interaction effect. Highly significant differences were noted on the number of unfilled pods per plant of chickpea as affected by the interaction of accession and organic fertilizers. Results revealed that ICCV 2 (Kabuli type) applied with control produced the highest number of unfilled pods per plant with 115.5 while ICCV 93954 (Desi type) applied with BSU compost produced the lowest number of unfilled pods per plant with 19.65.

Weight of 100 Seeds

Effect of variety/accession. Table 12 shows highly significant differences on the weight of 100 seeds as affected by the different accessions of chickpea. ICCV 95332 (Kabuli type) produced the heaviest weight of 100 seeds with 24.49 g; followed by ICCV 2 (Kabuli type) with 21.49 g; lastly, ICCV 93952 (Desi type) and ICCV 93954 (Desi type) produced the lowest weight of 100 seeds with 18.42 g and 18.78 g, respectively. This finding signifies that Kabuli type produced heavier seeds than Desi type. Thus, the result indicates that seed weight depends on the seed size. The bigger the seed, the heavier the weight and the smaller it is, the lightest weight.

In Poland, minimum Kabuli type seed weight (1000) is about 495g especially to the larger seeded Kabuli chickpea. Desi type, a small seeded one has a minimum weight of 245g per 1000 seeds.

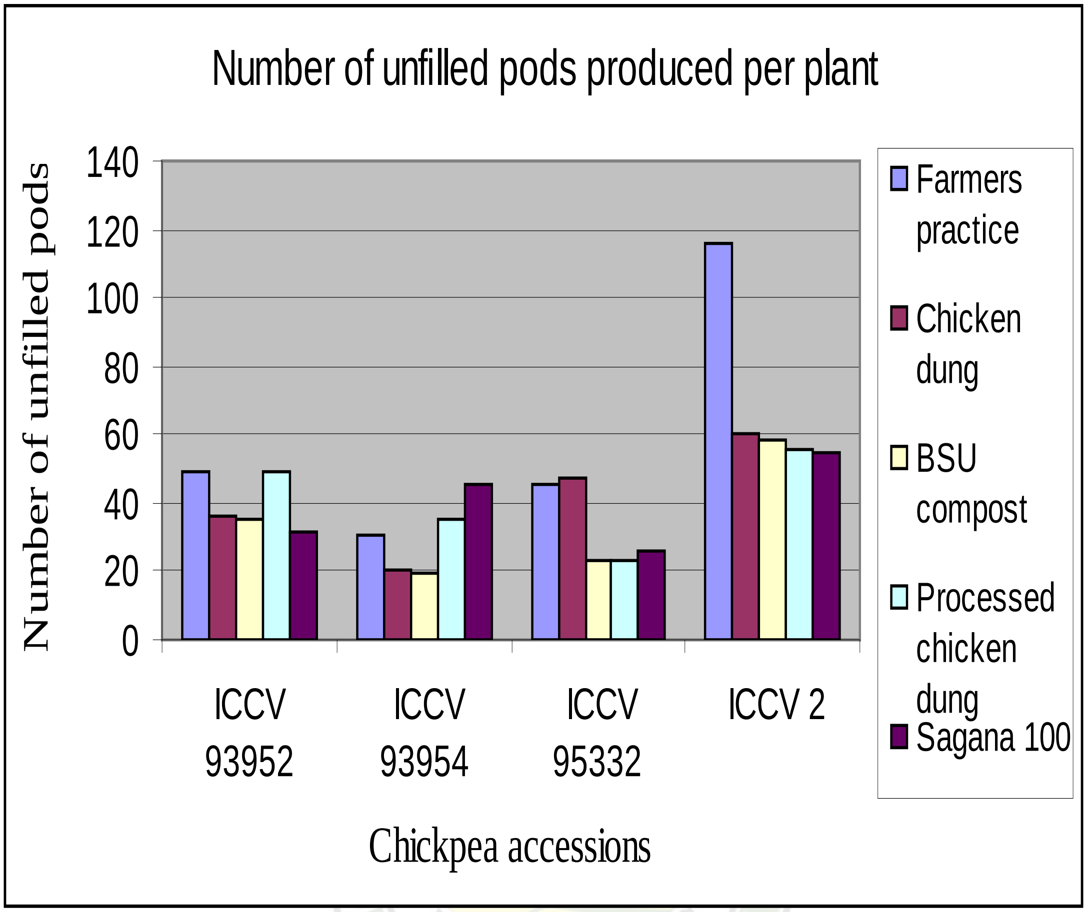

Figure 9. Number of unfilled pods produced per plant

Effect of organic fertilizers. No significant differences were noted on the weight of 100 seeds of chickpea as affected by the different organic fertilizers. Results revealed that the weight of 100 seeds as affected by the source of organic matter ranged from 20.16 g to 21.49 g.

Interaction effect. No significant interaction effect existed between the accession and organic fertilizers on the weight of 100 seeds of chickpea.

Table 12. Weight of 100 seeds (grains)

TREATMENT	WEIGHTED MEAN
<u>Variety/Accession</u>	
ICCV 93952 (Desi type)	18.42[c]
ICCV 93954 (Desi type)	18.78[c]
ICCV 95332 (Kabuli type)	24.49[a]
ICCV 2 (Kabuli type)	21.49[b]
<u>Organic Fertilizers</u>	
Control	21.49[a]
Chicken Dung	20.58[a]
BSU Compost	20.16[a]
Processed Chicken Dung	20.77[a]
Sagana 100	20.97[a]
CV (%)	13.17

Means with common letters are not significantly different from each other at 5% level of significance using DMRT.

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted to determine the response of chickpea as affected by the different organic fertilizers; and to identify the chickpea accessions that would perform productively with the application of the different organic matter.

The responses of the different accessions of chickpea to the organic fertilizers were studied under open field condition. The four accessions were ICCV 93952 and ICCV 93954 (Desi type), ICCV and ICCV 2 (Kabuli type) while the five organic fertilizers were Control (farmers practice), Chicken Dung, BSU Compost, Processed Chicken Dung and Sagana 100.

ICCV 2 (Kabuli type) produced flowers the earliest while ICCV 93952 (Desi type) were the latest to produced flowers. Findings showed that Kabuli type chickpeas produced flowers earlier than Desi type. ICCV 93952 (Desi type) were the tallest at flowering while ICCV 95332 (Kabuli type) produced the shortest plant at flowering.

Results showed that ICCV 2 (Kabuli type), an early maturing accession, were the earliest to be harvested while ICCV 93952 (Desi type) and ICCV 93954 (Desi type) were both harvested the latest. ICCV 95332 and ICCV 2 both Kabuli type produced higher total number of harvest as compared to ICCV 93952 and ICCV 93954 both Desi type which produced lower total number of harvest.

ICCV 93952 and ICCV 93954 both Desi type produced higher number of lateral stems at flowering while ICCV 95332 and ICCV 2 both Kabuli type produced lower number of lateral stems at flowering.

ICCV 95332 (Kabuli type) produced the highest average number of pods per plant while ICCV 93952 (Desi type) and ICCV 2 (Kabuli type) produced the lowest number of pods per plant. ICCV 95332 (Kabuli type) produced the highest yield per plot and highest yield per hectare while ICCV 2 (Kabuli type) produced the lowest total yield per plot as well as the yield per hectare.

ICCV 2 (Kabuli type) produced the highest number of filled and unfilled pods per plant while ICCV 93952 (Desi type) produced the lowest number of filled and unfilled pods per plant.

ICCV 95332 (Kabuli type) produced the heaviest weight of 100 seeds; followed by ICCV 2 (Kabuli type); lastly, ICCV 93952 (Desi type) and ICCV 93954 (Desi type) produced the lowest weight of 100. This finding signifies that Kabuli type produced heavier seeds than Desi type.

Chickpea applied with the control (farmers practice) produced flowers the earliest as compared to chickpea applied to the other organic fertilizers.

No significant differences were noted on the average plant height, total number of harvest, number of lateral stems at flowering and percentage pod setting of chickpea as affected by the different sources of organic matter.

Chickpea applied with Sagana 100 was harvested first while chickpea applied with control and chicken dung were harvested last.

Chickpea applied with control produced the most pods per plant while chickpea applied with BSU compost produced the least number of pods per plant.

Results showed that chickpea applied with the control produced the highest total yield per plot among the organic fertilizers. On the other hand, chickpea applied with processed chicken dung produced the lowest total yield per plot as compared to the other organic fertilizers. Chickpea applied with control produced the highest yield per hectare, highest number of pods per plant and highest number of unfilled pods per plant while chickpea applied with BSU compost produced the lowest yield per hectare, highest number of pods per plant as well as highest number of unfilled pods per plant.

No significant differences were noted on the weight of 100 seed of chickpea as affected by the different organic fertilizers.

As for the interaction, no significant differences were noted on the interaction effect of the accession and organic fertilizers on the number of days from planting to flowering, days from planting to first harvest, total number of harvest, of lateral stems at flowering, percentage setting, total yield per plot and weight of 100 seeds of the chickpea.

Highly significant differences were noted on the average plant height at flowering of the chickpea as affected by the interaction effect of accession and the organic fertilizers. It was noted that ICCV 93952 (Desi type) applied with Sagana 100 produced the tallest plant at flowering with 36.53 cm. while ICCV 95332 (Kabuli type) applied with BSU compost produced the shortest plant at flowering. Further, results revealed that Desi type applied with the different organic fertilizers produced taller plant as compared to Kabuli type applied with the same organic fertilizers.

ICCV 95332 (Kabuli type) applied with control produced the highest average number of pods per plant while ICCV 2 (Kabuli type) applied with processed chicken dung produced the lowest average number of pods per plant.

Results revealed that ICCV 95332 (Kabuli type) applied with chicken dung produced the highest yield per plot while ICCV 93952 (Desi type) applied with processed chicken dung produced the lowest yield per hectare.

ICCV 2 (Kabuli type) applied with control produced the highest number of filled pods per plant while ICCV 95332 (Kabuli type) applied with Sagana 100 produced the lowest filled pods per plant. Also, ICCV 2 (Kabuli type) applied with control produced the highest number of unfilled pods per plot while ICCV 93954 (Desi type) applied with BSU compost produced the lowest number of unfilled pods per plant.

Conclusion

Based on the results presented and discussed, the best accession tested was Kabuli type ICCV 95332 and Desi type ICCV 93954 since they produced higher yield potential among the cultivars evaluated. The best organic fertilizer for the selected accession is the application of the farmers practice (1 kerosene can chicken dung + 250g 14-14-14) and the Sagana 100.

Recommendation

Based on the findings and conclusion of the study, it is therefore recommended that Kabuli type ICCV 95332 and Desi type ICCV 93954 can be productively grown with the application of the farmers practice (1 kerosene can chicken dung+250g 14-14-14l) and Sagana 100.

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APPENDICES

Appendix Table 1. Number of days from planting to flowering

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
ICCV 93952 Control (Farmers practice)	66	60	69	62	257	64.25
Chicken dung	68	63	75	60	266	66.5
BSU compost	64	81	75	71	291	72.75
Processed chicken dung	67	69	73	62	271	67.75
Sagana 100	68	64	67	69	268	67
ICCV 93954 Control (Farmers practice)	55	56	52	64	227	56.75
Chicken dung	59	56	54	64	233	58.25
BSU compost	65	56	58	70	249	62.25
Processed chicken dung	62	58	61	65	246	61.5
Sagana 100	53	54	73	65	245	61.25
ICCV 95332 Control (Farmers practice)	55	55	44	49	203	50.75
Chicken dung	49	53	47	50	199	49.75
BSU compost	56	53	49	49	207	51.75
Processed chicken dung	53	54	50	49	206	51.5
Sagana 100	52	55	49	49	205	51.25
ICCV 2 Control (Farmers practice)	42	54	44	39	179	44.75
Chicken dung	44	55	47	49	195	48.75
BSU compost	55	52	49	50	206	51.5
Processed chicken dung	48	56	49	47	200	50
Sagana 100	49	51	48	50	198	49.5

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN OF SQUARES	FCOMP	FTAB	
					0.05	0.01
Variety	3	4479.638	1493.213	63.417 **	2.76	4.13
Sources	4	267.425	66.856	2.839*	2.52	3.65
Factor AB	12	92.175	7.681	0.326	1.92	2.50
Error	60	1412.750	23.546			
TOTAL	79	6251.987				

**highly significant

ns- not significant

Coefficient of variation (%) = 8.53

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

TREATMENT	BLOCK I	II	III	IV	TOTAL	MEAN
ICCV 93952 Control (Farmers practice)	43.14	32.34	28.58	33.2	137.26	34.315
Chicken dung	40.7	29.1	28.8	31.4	130	32.5
BSU compost	39.3	34.04	31.9	34.12	139.36	34.84
Processed chicken dung	37.2	33.3	29.4	35.38	135.28	33.82
Sagana 100	35.2	35.1	34.3	41.5	146.1	36.525
ICCV 93954 Control (Farmers practice)	28.92	33.48	34.2	32.48	129.08	32.27
Chicken dung	31.2	34.8	30.8	28.76	125.56	31.39
BSU compost	30.1	35.5	27.94	35.1	128.64	32.16
Processed chicken dung	27.04	33.14	29	30.56	119.74	29.935
Sagana 100	32.54	32.4	30.7	30.8	126.44	31.61
ICCV 95332 Control (Farmers practice)	24.2	21.74	29.24	24.1	99.28	24.82
Chicken dung	19.9	21	24.54	22.8	88.24	22.06
BSU compost	21.2	18.7	22.9	19.2	82	20.5
Processed chicken dung	20	22	24.2	19.7	85.9	21.475
Sagana 100	22.1	19.9	23.9	21.2	87.1	21.775
ICCV 2 Control (Farmers practice)	27.06	22.78	22.9	26.6	99.34	24.835
Chicken dung	27.24	26.66	23.58	29.54	107.02	26.755
BSU compost	25.9	23.2	24.6	27.1	100.8	25.2
Processed chicken dung	24.54	25.28	22.96	26.94	99.72	24.93
Sagana 100	21.4	24.48	21.42	31.6	98.9	24.725

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN OF SQUARES	FCOMP	FTAB 0.05	FTAB 0.01
Variety	3	1889.208	629.736	99.341**	2.76	4.13
Sources	4	20.999	5.250	0.828	2.52	3.65
Factor AB	12	302.098	25.175	3.971**	1.92	2.50
Error	60	380.350	6.339			
TOTAL	79	2592.654				

**highly significant ns-not significant Coefficient of variation (%) = 3.09

Appendix Table 3. Days from planting to first harvest

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
ICCV 93952	127	128	117	134	506	126.5
Control (Farmers practice)						
Chicken dung	127	128	117	134	506	126.5
BSU compost	127	128	117	134	506	126.5
Processed chicken dung	127	128	117	134	506	126.5
Sagana 100	127	128	117	134	506	126.5
ICCV 93954	135	127	128	117	507	126.75
Control (Farmers practice)						
Chicken dung	135	127	128	117	507	126.75
BSU compost	135	127	128	117	507	126.75
Processed chicken dung	135	127	128	117	507	126.75
Sagana 100	135	127	128	117	507	126.75
ICCV 95332	130	116	120	126	492	123
Control (Farmers practice)						
Chicken dung	130	116	120	126	492	123
BSU compost	130	116	120	126	492	123
Processed chicken dung	130	116	120	126	492	123
Sagana 100	116	116	120	126	478	119.5
ICCV 2	83	87	113	81	364	91
Control (Farmers practice)						
Chicken dung	83	87	113	81	364	91
BSU compost	83	87	78	81	329	82.25
Processed chicken dung	83	87	78	81	329	82.25
Sagana 100	83	87	78	81	329	82.25

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN OF SQUARES	FCOMP	FTAB	
					0.05	0.01
Variety	3	131464.450	43821.483	739.395**	2.76	4.13
Sources	4	416474.575	104118.644	1756.783**	2.52	3.65
Factor AB	12	-107609.075	-8967.423	-151.306	1.92	2.50
Error	60	35556.000	59.267			
TOTAL	79	443885.950				

**highly significant ns- not significant Coefficient of variation (%) =6.68

Appendix Table 4. Total number of harvest/picking

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
ICCV 93952						
Control (Farmers practice)	1	2	2	2	7	1.4
Chicken dung	1	2	2	2	7	1.4
BSU compost	2	2	2	2	8	2
Processed chicken dung	1	2	2	2	7	1.4
Sagana 100	1	2	2	2	7	1.4
ICCV 93954						
Control (Farmers practice)	1	2	2	2	7	1.4
Chicken dung	2	2	2	2	8	2
BSU compost	1	2	2	2	7	1.4
Processed chicken dung	1	2	2	2	7	1.4
Sagana 100	2	2	2	2	8	2
ICCV 95332						
Control (Farmers practice)	3	2	2	2	9	2.25
Chicken dung	3	2	2	2	9	2.25
BSU compost	3	2	2	2	9	2.25
Processed chicken dung	3	2	2	2	9	2.25
Sagana 100	3	2	2	2	9	2.25
ICCV 2						
Control (Farmers practice)	2	3	1	3	9	2.25
Chicken dung	2	3	1	3	9	2.25
BSU compost	2	3	2	3	10	2.5
Processed chicken dung	2	3	1	3	9	2.25
Sagana 100	2	3	1	3	9	2.25

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN OF SQUARES	FCOMP	FTAB 0.05	FTAB 0.01
Variety	3	4.100	1.367	3.905*	2.76	4.13
Sources	4	0.175	0.044	0.125	2.52	3.65
Factor AB	12	0.525	0.044	0.125	1.92	2.50
Error	60	21.000	0.350			
TOTAL	79	25.800				

*significant ns- not significant Coefficient of variation (%) =28

Appendix Table 5. Number of lateral stems at flowering

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
ICCV 93952						
Control (Farmers practice)	2.4	2.4	1.6	2.4	8.8	2.2
Chicken dung	2.4	1.8	1.2	2.4	7.8	1.95
BSU compost	3.2	1.4	1.8	2	8.4	2.1
Processed chicken dung	2.6	1.6	1.8	2	8	2
Sagana 100	2.2	1.6	1.8	2.2	7.8	1.95
ICCV 93954						
Control (Farmers practice)	2.6	2.4	2.2	1	8.2	2.05
Chicken dung	2.4	3.2	2	1.6	9.2	2.3
BSU compost	1.6	3	1.8	1.2	7.6	1.9
Processed chicken dung	2.4	2.6	1.4	2	8.4	2.1
Sagana 100	2.2	2.8	2	1.8	8.8	2.2
ICCV 95332						
Control (Farmers practice)	1.2	1	1.6	1	4.8	1.2
Chicken dung	1	1	1.6	1	4.6	1.15
BSU compost	1	1	1.6	1.2	4.8	1.2
Processed chicken dung	1	1.2	1.4	1.4	5	1.25
Sagana 100	1	1	1	1.2	4.2	1.05
ICCV 2						
Control (Farmers practice)	2.8	1.2	1.2	2.8	8	2
Chicken dung	2.6	1.4	1.2	2.4	7.6	1.9
BSU compost	3.4	1	1.4	2.6	8.4	2.1
Processed chicken dung	2.6	1.4	1.4	2	7.4	1.85
Sagana 100	1.8	1	1	2.2	6	1.5

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN OF SQUARES	FCOMP	FTAB	
					0.05	0.01
Variety	3	11.110	3.703	10.636**	2.76	4.13
Sources	4	0.332	0.083	0.238	2.52	3.65
Factor AB	12	1.148	0.096	0.275	1.92	2.50
Error	60	20.890	0.348			
TOTAL	79	33.480				

**highly significant ns- not significant Coefficient of variation (%) =32.83

Appendix Table 6. Percentage pod setting

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
ICCV 93952 Control (Farmers practice)	96.5	99	95.3	97.4	388.2	97.05
Chicken dung	94.6	95.7	97.2	97.8	385.3	96.325
BSU compost	97.7	94.2	95.2	96.5	383.6	95.9
Processed chicken dung	97.9	97.6	97.6	98.1	391.2	97.8
Sagana 100	96.6	96.2	91.4	98.5	382.27	95.675
ICCV 93954 Control (Farmers practice)	99.4	98.7	97.4	98.5	394	78.8
Chicken dung	99.6	97.3	98.2	98.4	393.5	98.375
BSU compost	97.7	95.7	97.1	92.2	382.7	95.675
Processed chicken dung	98.4	97	97.7	98.3	391.4	97.85
Sagana 100	97.9	98	96.6	97.8	390.3	97.575
ICCV 95332 Control (Farmers practice)	98.4	98.3	98.9	98	393.6	98.4
Chicken dung	97.7	98.5	98.5	98.3	393	98.25
BSU compost	79.4	95.7	97	97.5	369.6	92.4
Processed chicken dung	63.2	97.6	95.3	97	353.1	88.275
Sagana 100	95.4	97.7	98	96.4	387.5	96.875
ICCV 2 Control (Farmers practice)	99	97.5	99.5	99.5	395.5	98.875
Chicken dung	98.5	99.3	98.5	98.5	394.7	98.675
BSU compost	97.7	96.8	98.5	98.6	391.6	97.9
Processed chicken dung	99.1	89.7	99.1	99	386.9	96.725
Sagana 100	97.5	97.5	98.8	98.6	392.4	98.1

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN OF SQUARES	FCOMP	FTAB 0.05	FTAB 0.01
Variety	3	122.095	40.698	2.002	2.76	4.13
Sources	4	123.402	30.851	1.518	2.52	3.65
Factor AB	12	230.910	19.242	0.947	1.92	2.50
Error	60	1219.665	20.328			
TOTAL	79	1696.072				

ns- not significant

Coefficient of variation (%) =4.66

Appendix Table 7. Average number of pods/plant

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
ICCV 93952 Control (Farmers practice)	116.8	145	105.2	148.4	515.4	128.85
Chicken dung	108.8	85.4	104.8	90.2	389.2	97.3
BSU compost	103	81.2	96	65.4	345.6	86.4
Processed chicken dung	113	136.6	104.4	114.2	468.2	114.05
Sagana 100	80.2	95	35.6	118.4	359.2	89.8
ICCV 93954 Control (Farmers practice)	133.4	135.4	149.8	160.4	579	144.75
Chicken dung	133.8	101	153.4	123.4	511.6	127.9
BSU compost	84.2	75.6	65.8	76	301.6	75.4
Processed chicken dung	125	114.8	176.2	178.8	684.8	171.2
Sagana 100	173	156.8	182	155.6	601	150.25
ICCV 95332 Control (Farmers practice)	321.8	328.8	299	389.6	1339.2	334.8
Chicken dung	194.6	202.6	211.8	255	864	216
BSU compost	202	196.2	195.2	242	835.4	208.85
Processed chicken dung	299.6	249.2	263.2	248.8	1060.8	265.2
Sagana 100	246.8	254.4	245	289	1035.2	258.8
ICCV 2 Control (Farmers practice)	124.6	138.8	182	155.6	601	150.25
Chicken dung	127	141.4	168.8	136.8	574	143.5
BSU compost	83.4	67	75.2	76.8	302.4	75.6
Processed chicken dung	72.6	80.4	69.2	70.8	293	73.25
Sagana 100	78.4	76.6	75.6	69.2	299.8	74.95

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN OF SQUARES	FCOMP	FTAB 0.05	FTAB 0.01
Variety	3	319515.388	106505.129	257.788**	2.76	4.13
Sources	4	49102.847	12275.715	29.712**	2.52	3.65
Factor AB	12	41434.397	3452.866	8.357**	1.92	2.50
Error	60	24789.040	413.151			
TOTAL	79	434841.672				

*highly significant Coefficient of variation (%) =13.62

Appendix Table 8. Total yield (kg/5m^2) per plot

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
ICCV 93952 Control (Farmers practice)	0.27377	0.3359	0.33	039	1.33	0.33
Chicken dung	0.1477	0.16983	0.16	0.20	0.68	0.17
BSU compost	0.0815	0.075	0.87	0.08	2.23	0.63
Processed chicken dung	0.16517	0.18	0.20	0.20	0.74	0.19
Sagana 100	0.2072	0.29957	0.26	0.28	1.05	0.26
ICCV 93954 Control (Farmers practice)	0.1446	0.45	0.45	0.48	1.80	0.45
Chicken dung	0.2622	0.23	0.26	0.29	1.04	0.26
BSU compost	0.4012	0.34	0.45	0.40	1.59	0.40
Processed chicken dung	0.32121	0.31	0.31	0.30	1.24	0.31
Sagana 100	0.51881	0.50	0.52	0.52	2.07	0.52
ICCV 95332 Control (Farmers practice)		0.40	0.49	0.56	1.97	0.49
Chicken dung		0.53	0.51	0.27	2.13	0.53
BSU compost		0.47	0.40	0.40	1.60	0.40
Processed chicken dung		0.52	0.48	0.48	1.94	0.49
Sagana 100		0.48	0.47	0.49	1.90	0.48
ICCV 2 Control (Farmers practice)		0.15	0.20	0.24	0.78	0.20
Chicken dung		0.10	0.13	0.16	1.37	0.34
BSU compost		0.08	0.10	0.13	1.12	0.28
Processed chicken dung		0.12	0.09	0.15	1.27	0.32
Sagana 100		0.11	0.14	0.11	0.45	0.11

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN OF SQUARES	FCOMP	FTAB 0.05	FTAB 0.01
Variety	3	1.435	0.478	52.140**	2.76	4.13
Sources	4	0.130	0.033	3.545*	2.52	3.65
Factor AB	12	0.200	0.017	1.817	1.92	2.50
Error	60	0.550	0.009			
TOTAL	79	2.315				

**highly significant ns- not significant Coefficient of variation (%) =31.15

Appendix Table 9. Computed yield per hectare (kg/ha)

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
ICCV 93952 Control (Farmers practice)	547.54	671.8	665.38	776.8	2664.52	665.38
Chicken dung	295.4	339.66	321.24	402.2	1358.5	339.635
BSU compost	163	150.94	173.4	164.64	651.98	162.995
Processed chicken dung	330.34	369.78	383.98	395.04	1479.14	369.785
Sagana 100	414.4	599.14	522.94	555.2	2091.68	522.92
ICCV 93954 Control (Farmers practice)	829.2	896.58	909.34	951.18	3586.3	896.575
Chicken dung	524.4	459.2	521.14	580.94	2085.68	521.42
BSU compost	802.4	675.4	901.46	793.08	3172.34	793.085
Processed chicken dung	642.42	614.66	620.54	604.56	2482.18	620.545
Sagana 100	1037.62	983.26	1080.8	1041.42	4143.1	1035.775
ICCV 95332 Control (Farmers practice)	1032.4	801	970.4	1127	3930.8	982.7
Chicken dung	1062.2	1060.4	1011.6	1133.4	4267.6	1066.9
BSU compost	655.8	940.6	799.26	801.4	3197.06	799.265
Processed chicken dung	914.74	1037.6	959.8	967.38	3879.52	969.88
Sagana 100	960	951.06	922	971.2	3804.26	951.065
ICCV 2 Control (Farmers practice)	382.42	299.86	390.16	488.22	1560.66	390.165
Chicken dung	249.78	193.54	250.9	309.38	1003.6	250.9
BSU compost	205.96	155.86	207.56	260.94	830.32	207.58
Processed chicken dung	179.66	234.96	182.32	294.34	891.28	222.82
Sagana 100	168.54	219.18	280.9	222.88	891.5	222.875

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN OF SQUARES	FCOMP	FTAB 0.05	FTAB 0.01
VARIETY	3	6140917.066	2046972.355	474.197**	2.76	4.13
SOURCES	4	683686.549	170921.637	39.595**	2.52	3.65
FACTOR AB	12	824668.148	68722.346	15.920**	1.92	2.50
ERROR	60	259003.052				
TOTAL	79					

**highly significant

Coefficient of variation (%) = 10.96

Appendix Table 10. Number of filled pods produced per plant

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
ICCV 93952 Control (Farmers practice)	73.6	90.6	64.2	91.4	319.8	79.95
Chicken dung	62.8	49.2	65.8	65.2	243	60.75
BSU compost	59.8	45.4	55	44	204.2	51.05
Processed chicken dung	71.4	76.2	88.2	67.2	273	68.25
Sagana 100	44.4	67.6	46.2	75.6	233.8	58.45
ICCV 93954 Control (Farmers practice)	98.4	103	117	138.8	457.2	114.3
Chicken dung	110	82	136.4	101	429.4	107.35
BSU compost	64.6	55	47.8	55.6	223	55.75
Processed chicken dung	88.4	71.6	115.6	92.6	298.2	74.55
Sagana 100	114.8	112	136.6	138	501.4	125.35
ICCV 95332 Control (Farmers practice)	86.8	94.6	129	107.8	418.2	104.55
Chicken dung	85	98.6	114.2	88.4	386.2	96.55
BSU compost	63.8	46.8	52.4	48.4	211.4	52.85
Processed chicken dung	57.4	57	47.6	45.4	207.4	51.85
Sagana 100	51.8	52.8	47.4	44.6	196.6	49.15
ICCV 2 Control (Farmers practice)	208.4	214.8	194.6	259.4	877.2	219.3
Chicken dung	137.8	149	159.8	176	622.6	155.65
BSU compost	149.6	134.8	153.8	167.4	605.6	151.4
Processed chicken dung	238.4	187.6	221.4	191.6	839	209.75
Sagana 100	192.4	204	196.8	222.4	815	203.9

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN OF SQUARES	FCOMP	FTAB	
					0.05	0.01
VARIETY	3	193290.658	64430.219	276.966**	2.76	4.13
SOURCES	4	21816.787	5454.197	23.446**	2.52	3.65
FACTOR AB	12	20403.457	1700.288	7.309**	1.92	2.50
ERROR	60	13957.720	232.629			
TOTAL	79	249468.622				

**highly significant

Coefficient of variation (%) =14.42

Appendix Table 11. Number of unfilled pods produced per plant

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
ICCV 93952 Control (Farmers practice)	43.2	54.4	41	57	195.6	48.9
Chicken dung	46	36.2	39	25	146.2	36.55
BSU compost	43.2	35.8	41	21.4	141.4	35.35
Processed chicken dung	41.6	60.4	46.2	47	195.2	48.8
Sagana 100	35.8	27.4	19.4	42.8	125.4	31.35
ICCV 93954 Control (Farmers practice)	35	32.4	32.8	21.6	121.8	30.45
Chicken dung	23.8	19	17	22.4	82.2	20.55
BSU compost	19.6	20.6	18	20.4	78.6	19.65
Processed chicken dung	36.6	43.2	22.6	38.2	140.6	35.15
Sagana 100	58.2	44.8	39.6	40.8	183.4	45.85
ICCV 95332 Control (Farmers practice)	37.8	44.2	53	47.8	182.8	45.7
Chicken dung	42	42.8	54.6	48.4	187.8	46.95
BSU compost	19.6	20.2	22.8	28.4	91	22.75
Processed chicken dung	21.2	23.4	21.6	25.4	91.6	22.9
Sagana 100	26.6	23.8	28.2	24.6	103.2	25.8
ICCV 2 Control (Farmers practice)	113.4	114	104.4	130.2	462	115.5
Chicken dung	56.8	53.6	52	79	241.4	60.35
BSU compost	52.4	61.4	41.4	76.6	231.8	57.95
Processed chicken dung	61.2	61.6	41.8	57.2	221.8	55.45
Sagana 100	54.4	50.4	48.2	66.6	219.6	54.9

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN OF SQUARES	FCOMP	FTAB	
					0.05	0.01
Variety	3	18784.782	6261.594	92.725**	2.76	4.13
Sources	4	6367.308	1591.827	23.573**	2.52	3.65
Factor AB	12	10011.616	834.301	12.355**	1.92	2.50
Error	60	4051.710	67.528			
TOTAL	79	39215.416				

**highly significant Coefficient of variation (%) =19.09

Appendix Table 12. Weight of 100 seeds (grains)

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
ICCV 93952						
Control (Farmers practice)	16	18.2	17	21.6	72.8	18.2
Chicken dung	15.3	17.9	22.9	20.9	77	19.25
BSU compost	16.3	15.2	19	18.9	69.4	17.35
Processed chicken dung	16.8	17.5	17.9	21.8	74	18.5
Sagana 100	16.6	19.4	22.6	16.5	75.1	18.775
ICCV 93954						
Control (Farmers practice)	22	21.5	18.9	16.4	78.8	19.7
Chicken dung	21.4	17.0	19.7	13.9	72	18
BSU compost	22.1	19	17.7	16.3	75.1	18.775
Processed chicken dung	21.7	18.5	18.2	15.9	74.3	18.575
Sagana 100	24.8	18.8	15.7	16.1	75.4	18.85
ICCV 95332						
Control (Farmers practice)	23.2	27.5	32.2	21.2	104.1	26.025
Chicken dung	22	23.7	27.6	19.8	93.1	23.275
BSU compost	23.7	24.3	23.4	25	97.3	24.325
Processed chicken dung	24	26	25	23.4	98.4	24.6
Sagana 100	25.5	22.2	30	20	97.7	24.425
ICCV 2						
Control (Farmers practice)	22	20.8	24.7	20.6	88.1	22.025
Chicken dung	21.9	23.5	20.7	21	87.1	21.775
BSU compost	19.7	21	19.1	21.9	81.7	20.425
Processed chicken dung	23.2	22.1	20.1	20.2	85.6	21.4
Sagana 100	18.9	23.8	22.8	21.8	87.3	21.825

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN OF SQUARES	FCOMP	FTAB 0.05	FTAB 0.01
Variety	3	476.474	158.825	21.190**	2.76	4.13
Sources	4	15.342	3.835	0.512	2.52	3.65
Factor AB	12	21.214	1.768	0.236	1.92	2.50
Error	60	449.725	7.495			
TOTAL	79	962.755				

**highly significant ns- not significant Coefficient of variation (%) =13.17