EFFECT OF INTEGRATED FERTILIZER MANAGEMENT AND SOWING DATE ON GROWTH AND YIELD OF CHICKPEA

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CERTIFICATE

This is to certify that the thesis entitled, "**Effect of integrated fertilizer management and sowing date on growth and yield of chickpea**" submitted to the Department of Agronomy, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** (MS) in **AGRONOMY** embodies the results of a piece of bona fide research work carried out by **Nazia Tasnim, Registration No.12-05040** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation, has been duly acknowledged by her.

Dated:

Dhaka, Bangladesh

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EFFECT OF INTEGRATED FERTILIZER MANAGEMENT AND SOWING DATE ON GROWTH AND YIELD OF CHICKPEA

ABSTRACT

A field experiment was conducted at the Sher-e-Bangla Agricultural University farm Dhaka, Bangladesh during November, 2017 to March, 2018 in rabi season with a view to study the growth and yield variations in chickpea as influenced by fertilization and sowing date. The experiment was carried out in split plot design with three replication. The treatments consists of four fertilization levels as F_0=Control (No fertilizer) , F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) R , F_2= R + cow dung (3 ton ha^{-1}) , F_3= R + vermicompost (2.5 ton ha^{-1}) and three sowing date as S_1=07 November , S_2=19 November ,S_3= 02 December. Data on different parameters yield and yield contributing characters were recorded and variation was observed. Results indicated that the maximum height of plant (30.30, 48.14 at 60 and 90 days after sowing (DAS) respectively , maximum number of branches (5.97, 27.32, 39.87 at 30, 60, 90 DAS respectively) , maximum pod $plant^{-1}$ (70.00) , maximum seed yield (1.71 t/ha) , HI% (53.51) were obtained from treatment F_3 fertilization . On the other hand maximum values for plant height (15.18, 31.27, 50.52 at 30, 60,90 DAS respectively) were found from treatment S_1 sowing and for branches (30.88, 39.58 at 60 and 90 DAS respectively) from S_1 sowing but pod $plant^{-1}$ (86.03) , seed yield (1.32) and HI%(49.34) was obtained from treatment S_2 sowing . The highest value of plant height were observed (15.93 at 30 DAS) from treatment combination F_2S_1 and (41.13, 53.30 at 60, 90 DAS respectively) from treatment combination F_3S_1. Highest value for branches (6.55 at 30 DAS) from treatment combination F_2S_1 and (50.72, 54.00 at 60 .90 DAS respectively) from treatment combination F_3S_1. Maximum number of leaves (34.46 at 30 DAS) from F_2S_1 and (152.85, 326.11 at 60, 90 DAS respectively) from F_3S_1. Maximum number of pod $plant^{-1}$(114.60) and seed yield (2.54 t/ha) from F_3S_2 and maximum HI% was obtained 65.14 from F_2S_1. From the results of present study it can be concluded that manure like cowdung and vermicompost influenced crop production considerably whereas sowing date has less effect on crop production.

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LIST OF ACRONYMS

AEZ = Agro-Ecological Zone

BARI = Bangladesh Agricultural Research Institute

BINA = Bangladesh Institute of Nuclear Agriculture

SRI = System of Rice Intensification

SCI = System of Crop Intensification

SSI = System of Sugarcane Intensification

BBS = Bangladesh Bureau of Statistics

DAS = Days after sowing

et al. = And others

N = Nitrogen

TSP = Triple Super Phosphate

MoP = Muriate of Potash

Ca = Calcium

Mg = Magnesium

K = Potassium

P = Phosphorous

Fe = Iron

ha^{-1} = Per hectare

g = Gram

Kg = Kilogram

mm = Millimeter

SAU = Sher-e-Bangla Agricultural University

SRDI = Soil Resources Development Institute

HI = Harvest Index

No. = Number

Wt. = Weight

LSD = Least Significant Difference

^{0}C = Degree Celsius

NS = Non-significant

% = Percent

CV% = Percentage of coefficient of variance

T = Ton

Viz. = Videlicet (namely)

CHAPTER I

INTRODUCTION

Bangladesh is an agro-based nation where numerous harvests are developed. Among them, pulses constitute the main sources of vegetable protein for people, especially the poor people of Bangladesh, particularly the destitute individuals of Bangladesh. They are likewise the best wellsprings of protein for local creatures. They likewise help to beat the ailing health, which is a genuine medical issue in Bangladesh that has been compromising to the entire country. Chickpea (*Cicer arietinum* L.) has a place with the family Fabaceae. It is one of the essential grain vegetable developed on the planet. It is a standout amongst the most critical heartbeat crops in Bangladesh after grass pea and lentil positioned third position (BBS, 2012).
In Bangladesh the majority of the trimming region is involved by rice. Where pulse crop spread just 2.8% of the all-out trimming territory (BBS, 2010). Chickpea is developed just 16800 ha of land and creating 15600 metric ton (MoA, 2006). Presently the all-out development of chickpea in Bangladesh is around 17468 grounds of land and all out generation 6672 metric ton.

The normal yield of chickpea in Bangladesh is exceptionally poor, which is principally because of substandard method of cultivation, imbalance nutrition, lack of high yielding varieties and poor harvest stand. The low yield of chickpea other than different variables may incompletely because of absence of learning about nourishment and current generation innovation.

An improved variety is required for initiation and accelerated of production program of any crop. Variety plays an important role in producing high yield of chickpea because different varieties respond differently for their genotypic characters. Very recently with the introduction of some high yielding varieties like BARI Chola-5 increasing attention is being paid to the cultivation of this crop in order to mitigate the alarmingly protein shortage in the diet of our people. A balanced supply of essential nutrients is indispensable for optimum plant growth. Appropriate sowing date is must for higher yield and development.

Cow dung is an age old source of fertilizer. It provides all the necessary macro nutrients and many micro nutrients with increasing organic matter. Cow dung has relatively less nitrogen than some other manure, so it can be added directly to the soil without damaging plants. Fresh cow dung contains about the same ratio of N, P, and K as a balanced commercial fertilizer but in much smaller quantities.

Vermicompost is the product or process of composting using various worms usually it is a heterogeneous mixture of decomposing vegetable or food waste, bedding materials etc. During this process elements like N, P, K, and Ca present in the waste are released and converted through microbial activity into forms more soluble and available to plant than those present in the organic waste. Application of vermicompost might increase the availability of N, P, and K to plant.

Increase in yield was reported with nitrogen application as basal dose and at post flowering stage.

Nitrogen application during the post flowering stage enhance nitrate reduction activity and yield (Sekhon *et al*.1988). Phosphorous plays a significant role in plant physiological processes. The respose to the phosphate application depends on the availability of soil phosphorous and other edaphic factors (Saxena and Yadav, 1975). Phosphorous is very important element of enzymes which have remarkable role in the transformation of energy in carbohydrate metabolism in different types of plant and related to cell division and also in seed development . Phosphorous is main constituent of ATP and it plays a significant role in the energy transformation in plants and also in various physiological processes (Sivasankar *et al*.,1982) . It is also essential for enegy storage and release in living cell . Phosphorous shortage restricted the plant growth and remains immature (Hossain,1990) . It influences nutrient uptake by promoting root growth and nodulation . Phosphorous enhances the uptake of N in the crop , which increases protein content .
Information on response of chickpea to potassium application is limited. There is no response or a negative response due to the high levels of available potassium in chickpea growing soil (Saxena and Yadav, 1975).
Taking everything above into account , the present experiment has been done with the following objective :

1. To observe the influence of recommended inorganic fertilizer on growth and yield of chickpea .
2. To study the effectiveness of cow dung and vermicompost separately on the growth and yield of chickpea .
3. To know the combined effect of manure and inorganic fertilizer on growth and yield of chickpea.
4. To find out the effect of sowing date on growth and yield of chickpea .
5. To study the combined effect of manure , inorganic fertilizer and sowing date on growth and yield of chickpea.

CHAPTER II
REVIEW OF LITERATURE

Many experiments have been conducted on chickpea for its improvement of quality and yield. In Bangladesh several experiments are done for better yield and cultural management . There are many research institutes in our country like Bangladesh Agricultural Research Institute (BARI). They started work on chickpea to find out way for improving yield. Research work done with the effect of integrated fertilizer management and sowing date on different character of chickpea that is found in home and abroad have been reviewed and discuss in this section .

2.1 Effect of fertilization

2.1.1 Effect of manure

Compost produced by traditional processes is generally low in plant nutrient content and the process itself is also slow and time consuming. On the other hand, certain special type of earthworm (*Eisenia foitida)* has the capacity to convert the biodegradable organic waste into higher quality compost at comparatively faster rate (Bhattarai, 2003) than that of the traditional method. Such a compost usually known as "vermicompost" is rich in plant nutrients and contains higher number of microorganisms, which are responsible for decomposition process (Yami *et al* , 2003).
A field experiment was conducted by Sanu and Suresh (2009) and they found that the effect of vermicompost in combination with other mineral fertilizer and/or soil is quite encouraging for better crop growth and yield of chickpea. Even at the lower dose than that of the recommended dose of the mineral fertilizers, vermicompost has shown better results for nodulation and crop yield, which is not only economical but also beneficial with soil improvement point of view.

A field trial was conducted by Reddy *et al*. (1998) during Kharif season of 1997-1998 showed that application of 60 kg P2O5 ha-1 through phosphor vermicompost significantly increased the growth , dry matter and yield of pea.
Karmegam and Daniel (2000) reported that application of vermicompost resulted in significant increase in growth and yield of cowpea.
However vermicompost at $2tha^{-1}$ seemed to be the optimum Other researchers Devi and Singh (2005) also reported benificial effect of vermicompost on the growth and yield of chickpea.

An experiment was done by Sanu *et al.* (2009) during the year 2003-2004 in a randomized complete block design with six treatments and three replications, each treatment conducted on an earthen pot of 12 kg capacity filled with

vermicompost alone and/or mixed with soil and/or mineral fertilizers up to 10 kg capacity depending upon the type of treatment. The experiment was laid out in the screen house of Soil Science Division, Khumaltar, Lalitpur during year 2003 and 2004. The vermicompost with 1.4% N, 0.8% P and 4.38% K content was used in the experiment, which was prepared from the farm waste. The nutrient content of the soil used in the pot were N% 0.156, P2O5 155 kg ha-1, K2O 874 kg ha-1 and OM% 2.01 with soil pH of 5.6. In each of the pot, seven seeds of local chickpea cultivar were sown. The objective of the experiment was to find out the effect of vermicompost in combination with or without soil and mineral fertilizers on the yield and other attributes of chickpea. The results showed an encouraging effect of vermicompost application on the plant height, root length and biomass dry weight of chickpea when vermicompost was applied in equal ratio with soil. Vermicompost with equal ratio of soil (5 kg each/pot) also produced the highest mean grain yield of 10.6 gm per pot. However, no significant treatments effects were observed for root length and straw weights of the chickpea. Vermicompost also produced the highest number of nodules per plant.

Another experiment was performed at Khatam-Alanbia University of Behbahan in Iran by Hosseinzadeh *et al*. The aim of the study was to characterize effects of vermicompost fertilizer on photosynthetic activity of chickpea (*Cicer arietinum* L. cv. Karaj) under drought conditions at three different growth stages. Tests were carried out with four volumetric ratios of vermicompost to soil, i.e., 0:100, 10:90, 20:80, and 30:70, and three levels of drought stress, i.e., no stress (NS), moderate drought (MS), and severe drought (SS) (100, 75, and 25% of field capacity, respectively). Evaluations were performed at the seedling, flowering, and podding stage. We found that the vermicompost treatment under NS conditions significantly increased total chlorophyll content [Chl (a+b)], intercellular CO2 concentration (Ci), net photosynthetic rate (PN), transpiration rate (E), and maximal quantum yield of PSII photochemistry (Fv/Fm) at all three stages. The VC addition of 10 and 20% significantly enhanced the Chl content and Fv/Fm under MS and Fv/Fm, Ci, and PN under SS at the flowering stage. In conclusion, our results proved a positive effect of the VC fertilizer on photosynthesis of chickpea under NS conditions, but it was not found under MS and SS.

A field experiment was conducted on clay textured soil at Agricultural Research Station, Annigeri, UAS, Dharwad during rabi season of 2009-10 and 2010-11 by Patil *et al.* (2012) to study the effect of organics on growth and yield of chickpea (*Cicer arietinum* L.) in vertisols of northern dry zone of Karnataka. The soil application of organic manures and foliar spray of liquid organic manures at flower initiation and 15 days after flowering (DAF) significantly enhanced the growth and yield parameters of chickpea viz., plant

height, number of branches, Leaf Area Index, Total Dry Matter, number of root nodule and dry weight of nodules, number of pods per plant, 100-seed weight, grain yield and haulm yield. Among treatment combinations, application of enriched compost 1/3 + vermicompost 1/3 + glyricidia leaf manure 1/3 equivalent to 100% RDN and foliar spray of panchagavya @ 3% at flower initiation and 15 DAF has recorded significantly higher grain yield (2400 kg/ha), haulm yield (3423 kg/ha), number of pods per plant (66.38) and 100-seed weight (20.91 g) compared to other treatment combinations.

2.1.2 Effect of Nitrogen

A field experiment was conducted by Uddin (2011) at Sher-e-Bangla Agricultural University . The experiment comprises 11 treatments T1= N0P0Rh, T2=N0P0R0, T3= N1P1Rh, T4=N1P2Rh, T5=N1P3Rh, T6=N2P1Rh, T7=N2P2Rh, T8=N2P3Rh, T9=N3P1Rh, T10=N3P2Rh, T11=N3P3Rh where Rh= Recommended dose of Rhizobium (6kg Rh ha-1), N_0= no application (0kg N ha-1) , N_1 = 50% less than recommended dose (10kg n ha-1) , N_2= Recommended dose (20kg N ha-1) , N_3= 50% higher than recommended dose (30 kg N ha-1) , P0= no application (0kg P_2O_5 ha^{-1}) , P_1= 50% less than recommended dose (20kg P2O5 ha-1) , P_2= recommended dose (40kg P2O5 ha-1) and P_3= 50 % higher than recommended dose (60 kg P2O5 ha-1) . The experiment was set up in randomized complete block design with three replications. The result found that treatment N_2P_2Rh obtained the highest value in all the growth , yield and yield contributing parameter except plant height , the highest value wich was obtained by the treatment N3P2Rh .

An application of 15 – 25 kg N ha^{-1} has been found to be optimum for stimulating growth and yield of chickpea in sandy and loam soils (Saxena and Yadev, 1975). However , when an active symbiotic nitrogen fixing system was present , there was no response to N application up to 100 kg N/ha^{-1} (Saxena and Sheldrake , 1980).

petal and Patel,(1991) reported that 20kg N ha^{-1} increased chickpea yield in sandy soils and a high yield was the result by applying 20 kg N ha^{-1} and Rhizobium inoculation in Gujrat , India.

Sekhon *et al* .(,1988) reported that With the application of N as basal dose and at post flowering stage showed increased yield. During post flowering stage N application enhanced Nitrate reductase activities and yield .

Saxena and Yadav (1975) indicated that N uptaken by chickpea may range from 60 to 200 kg N ha-1 . Foliar application of 2% urea increased yield at some locations of India (Ali, 1989).

An experiment was conducted by Rumana (2014) during the period from November 2012 to March, 2013 to study the performance of prilled urea and urea super granules in chickpea cultivation at Sher-e-Bangla Agricultural

University. The variety BARI Chola 9 was used as test crop. The experiment consists of the following treatments: T1= Prilled urea (PU) broadcasted; T2 = PU given between two rows; T3 = Urea Super granules (USG) placed at 10 cm distance (avoid one row); T4 = USG placed at 10 cm distance (avoid two rows); T5 = USG placed at 10 cm distance (avoid three rows); T6 = USG placed at 20 cm distance (avoid one row); T7 = USG placed at 20 cm distance (avoid two rows); T8 = USG placed at 20 cm distance (avoid three rows): T9= USG placed at 30 cm distance (avoid one row); T10= USG placed at 30 cm distance (avoid two rows); T11= USG placed at 30 cm distance (avoid three rows): T12 = USG placed at 40 cm distance (avoid one row); T13 = USG placed at 40 cm distance (avoid two rows) and T14 = USC placed at 40 cm distance (avoid three rows). USG was placed at 10 cm depth at each case. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. From this experiment the tallest plant was observed in T7 treatment and The highest pods plant-1 (68.60), seeds pod-1 (2.87), weight of 1000 seeds (221.81 g), seed yield (1.98 t had) and stover yield (2.87 t hi') was recorded from T7 treatment. This type of USG application showed bener performance than prilled urea given in two rows but not with broadcasted prilled urea.

An experiment was conducted by Abbasi *et al.* (2013) with nitrogen rates at four levels (0. 25, 50 and 75 kg urea hi1) the result reveal that plant height were significantly affected by urea nitrogen rates and seed inoculation.

Effect of *Rhizobium* and inorganic nitrogen fertilization on some physiological and agronomical traits of chickpea (*Cicer arietinum* L.) cv. ILC 482, was investigated by Namvar *et al*. (2013) with mineral nitrogen fertilizer at four levels (0, 50, 75 and 100 kg urea ha^{-1}) in the main plots, and two levels of inoculation with *Rhizobium* bacteria as sub plots and found that plant height were obtained from the highest level of nitrogen fertilizer (100 kg urea ha^{-1}).
Aliloo *et al*. (2012) studied the effects of foliar spraying of aqueous solutions 2 and 4% urea at two stages(before and after flowering) and 20 kg ha^{-1} urea application in soil. Results showed that the effect of urea treatment on plant height was notable the highest plant height was obtained by application of 20 kg ha^{-1} urea in soil.

Chaudhari *et al*. (1998) found a positive effect of nitrogen on chickpea plant height when applied N 20 and 40 kg ha^{-1} respectively.
Dahiya et al. (1993) reported increased in plant height of chickpea applying N and P at the rate of 18-27 and 46-69 kg ha-1, respectively.
Rathore and Patel (1991) noticed that application of N along with P @ 18 and 46 kg ha-1 respectively increased plant height of chickpea over no N application. Vadavia *et al*. (1991) noticed that application of N and P @ 20

and 40 kg ha-1 increased plant height of chickpea significantly over no N and P application.
Patra and Padhi (1989) noticed increased plant height of chickpea over control with N along with P @ 20 and 40 kg ha-1respectively.
Chaudhari *et al*. (1998) found a positive effect of nitrogen at the rate of 20 and 40 kg ha^{-1} on increased in relation to the chickpea number of primary and secondary branches $plant^{-1}$.

An experiment was conducted by Dahiya *et al*. (1993) and reported that application of 18-27 kg N and 46-69 kg P ha-1 increased number of branches $plant^{-1}$ in chickpea.

Rathore and Patel (1991) found that the combination of of 18 kg N and 46 kg P ha^{-1} was the most effective in increasing the number of branches $plant^{-1}$ of chickpea. Vadavia *et al.* (1991) reported that application of 20 kg N ha^{-1} and P ha^{-1} increased number of branches $plant^{-1}$ of chickpea.
Mukesh (2006) conducted a field experimcnt to study the impact of starter doses of nitrogen (0, 15 and 30 kg ha^{-1}) on nodulation and yield of different cultivars (Radhey. Avarodhi and K-850) of chickpea under irrigated condition and reported that dry matter content $plant^{-1}$ was the highest in the crop when N was applied in the crop @ 30 kg N ha-1.

Chaudhari *et al.* (1998) found a positive effect of nitrogen at the rate of 20 and 40 kg ha^{-1} on increased in chickpea dry matter content $plant^{-1}$.
A field experiment was conducted by Mukesh (2006) to study the impact of starter doses of nitrogen (0, 15 and 30 kg ha-1) on nodulation and yield of different cultivars (Radhey, Avarodhi and K-850) of chickpea under irrigated condition and reported that number of pods $plant^{-1}$ was the highest in the crop applying 30 kg N ha^{-1}.

Karadavut and Ozdemir (2001) conducted a field trial on *Rhozobium* sp. Along with nitrogen on chickpea cultivars. They found that *Rhizobium* inoculation along with 30 kg N ha^{-1} significantly increased pods $plant^{-1}$.Khan *et at* .(1992) reported that the application of 20 kg N + 50 kg P_2O_5 ha^{-1} in chickpea produced significantly higher number of pods $plant^{-1}$.
Vadavia et al (1991) found that number of pods $plant^{-1}$ of chickpea increased following application of 20 kg N and 40 kg P ha-1.Rathore and Patel (1991) observed the maximum number of pods $plant^{-1}$ when chickpea was provided with 18kg N along with 46kg P ha^{-1}.

An experiment was carried out by Mukesh (2006) to study the impact of starter doses of nitrogen (0. 15 and 30 kg hi') on nodulation and yield of different cultivars (Radhey, Avarodhi and K-850) of chickpea under irrigated condition and reported that number of seeds $plant^{-1}$ was the highest in the crop

treated with 30 kg N ha^{-1}.Patra and Padhi (1989) noticed increased number of seeds pod^{-1} in chickpea over control with 20 kg N along with 40 kg P ha^{-1}.

An experiment was conducted by Humayun *et al.*(2011) to evaluate the effect of foliar and soil application of nitrogen, phosphorus and potassium (NPK) on yield component of lentil (*Lens culinaris* Medic). In general, best results were recorded from the plants applied with NPK through both soil and foliage. Optimal concentration of NPK for the various yield parameters was found to be 0.17% N, 0.21% P and 0.33% K for foliar and 0.35% N, 0.32% P and 0.50% K for soil application at pH 7.0. Timing of fertilizer application also affected different yield components. Multiple application of both soil and foliar application of NPK gave better results as compared to single application of NPK. Soil application produce slightly improved results compared to foliar application when applied unaided. The foliar application of nitrogen alone was more effective than NPK in producing higher number of seeds per pod.

2.1.3 Effect of Phosphorous

Application of phosphorus to the legumes improves the seed yield considerably (Hussain, 1983).

Raut and Kohire (1991) reported that seed yield of chickpea was increased significantly with *Rhizobium* and phosphorus application.

Patel and Patel (1991) also observed that nitrogen application as a starter dose along with phosphorus and seed inoculation has beneficial effect on yield of chickpea crop.

Takankhar *et al*. (1998) reported similar findings that application of 75 kg P_2O_5 ha^{-1} produced the highest seed yield of 1.25 tons ha^{-1}.

A low level of soil phosphorus is a great obstruction to the growth and development of leguminous crops (Walley *et al*. 2005).

In leguminous crops, phosphorus promotes root nodulation, nitrogen fixation, nutrient-use efficiency, efficient partitioning of photosynthates between source and sink, and biomass production (Gitari and Mureithi 2003).

The number of nodules, number of pods, weight of pods, green pod yield and protein content markedly increased with increasing P levels up to 90 kg ha-1 over control in cowpea (Baboo and Mishra, 2001).

Ram and Dixit (2001) also found that the application of P at 60 kg P_2O_5 ha^{-1} significantly increased the plant height, branches per plant, leaves per plant and dry matter accumulation as compared to control and 20 kg P_2O_5 ha^{-1} in green gram.

The growth characters of chickpea as plant height, number of nodules per plant and dry matter accumulation were significantly increased up to 30 kg P_2O_5 ha^{-1} (Meena *et al*. 2004).

Khoja *et al.* (2002) conducted a field experiment at Jobner with chickpea crop fertilizing with (20 kg N + 20 kg P_2O_5 ha^{-1}) and reported that the fertility levels significantly increased the plant height over control and 10 kg N + 20 kg P_2O_5 ha^{-1}. Whereas, number of branches per plant and dry matter accumulation per plant was significantly increased due to 10 kg N + 20 kg P_2O_5 ha^{-1} over control.

A field experiment was conducted at IARI, New Delhi by Shivkumar *et al*. (2004) and they reported that the growth attributes viz., plant height, branches per plant and dry matter accumulation were increased with increasing level of P2O5 up to 80 kg ha-1 over control in chickpea.
Tripathy *et al.* (2004) reported that the application of nitrogen at 20 kg ha-1 and P at 25 kg P_2O_5 ha^{-1} significantly increased primary, secondary and tertiary branches of chickpea at successive growth stage of 40 and 85 days after sowing and harvest over control.

The application of 60 kg P_2O_5 ha^{-1} significantly increased the growth attributes in chickpea like plant height, dry matter accumulation, and pods per plant over the control (Choudhary and Goswami, 2005).
The increasing levels of P up to 60 kg P_2O_5 ha^{-1} resulted in a significant increase in dry matter accumulation in chickpea over 0 and 30 kg P2O5 ha (Meena *et al.*, 2005).
Jarande et al. (2006) reported that the application of P at 37.5 kg P_2O_5 ha^{-1} + vermicompost + phosphate solubilizing bacteria (PSB) + Rhizobium recorded higher value of growth as well as yield contributing parameters in chickpea.

Kushwaha (2007) conducted a field experiment on sandy loam soil at Chitrakoot and observed that application of nitrogen at 15 kg ha^{-1} + P at 30 kg P_2O_5 ha^{-1} significantly increased the growth parameters viz., plant height, dry matter accumulation, branches per plant and seeds per pod over control in chickpea.

From the results of a field experiment, Ahmed and Badr (2009) concluded that the application of mineral P fertilizer at 46.5 kg P_2O_5 ha^{-1} resulted in a significant increase in growth characters in chickpea over control.
Kumar et al. (2009) reported that application of P at 50 kg P2O5 ha-1 significantly increased the branches per plant, number of pods per plant, number of grains per pod, test weight, grain and straw yield in chickpea over control.

Singh *et al*. (2010) observed that the application of 20 and 40 kg P_2O_5 ha^{-1} enhanced dry weight of root and shoot over no application of P in chickpea.

Thenua *et al*. (2010) reported that application of P as single super phosphate (SSP) recorded significantly higher plant height, branches per plant and dry matter accumulation in chickpea.

On loamy sand soils of Jobner, Meena *et al*. (2001) reported that the application of 40 kg P_2O_5 ha^{-1} significantly increased pods per plant, seeds per pod, test weight, seed and straw yield of chickpea over control. They reported that application of 40 kg P_2O_5 ha^{-1} significantly increased number of pods per plant, number of seeds per pod, test weight, grain and straw yield over control and 20 kg P_2O_5 ha^{-1}.

Application of 60 kg P_2O_5 ha^{-1} remained at par with 40 kg P_2O_5 ha^{-1}. Singh and Vaishya (2001) reported that the grain yield increased significantly with increasing P dose and was recorded maximum at 60 kg P_2O_5 ha^{-1} over control in chickpea.

Arya *et al*. (2002) in a field experiment on chickpea reported that the application of 60 kg P_2O_5 ha^{-1} significantly increased number of pods per plant, number of seeds per pod, test weight, grain and straw yield over control and 30 kg P_2O_5 ha^{-1}.

A field experiment conducted by Meena *et al.* (2002) during the winter season of 1997-1998 and 1998-1999 at IARI, New Delhi reported that the application of P at 60 kg P_2O_5 ha^{-1} significantly increased yield attributes viz., number of nodules per plant and dry weight of nodules in chickpea over control.

Pramanik and Singh (2003) reported that the application of P_2O_5 at 60 kg ha^{-1} significantly increased yield attributes and yield over control in chickpea.

phosphorus plays a vital role in the formation and translocation of carbohydrates, root development, crop maturation and resistance to disease pathogens. Thus increase the mung bean yield and improves its quality (Arya and Kalara, 1988).

Application of nitrogen in combination with phosphorus to mung bean also increases its yield and yield components (Hussain, 1994) while nitrogen uptake and protein content of mungbean increase with increasing rate of applied phosphorus (Dewangan, 1992).

A Field experiments were conducted by Ali *et al* (2010) under Adaptive Research Station, to evaluate the influence of three levels of phosphatic fertilizer on mung at Mianwali for two consecutive kharif seasons i.e. 2007 and 2008. The experiment comprised of four treatments viz, control, Phosphatic fertilizer @ 30 kg ha^{-1} with started dose of nitrogen, Phosphatic fertilizer @ 57 Kg ha-1and Phosphatic fertilizer @ 84 Kg $ha^{-1.}$ Experiments were laid in randomized complete block design with three replications. The results revealed that all the levels of phosphatic fertilizer showed significant impact on mung compared to that of control plots, However, treatment of Phosphatic fertilizer @ 84 kg ha^{-1} out yielded rest of the treatments giving the maximum yield components and grain yield during both years.

The application of phosphorus to mungbean has been reported to increase dry matter at harvest, number of pods per plant, seed per pod, 1000 grain weight, seed yield and total biomass (Mitra *et al*., 1999).
Akhtar *et al.,* (1984) found increased number of branches, yield components and yield of green gram compared with treatments given no phosphorus.

On sandy soils, El-Awady *et al*., (1993) revealed that phosphorus addition at 0, 30, 45 and 60 kg significantly increased seed and straw yields / ha as well as seed protein content.

2.1.4 Effect of potassium

A field experiment was conducted by Zahan *et al*.(2009) at the Agronomy Field Laboratory, University of Rajshahi to study the effects of potassium levels on the growth, yield and yield contributing characters of lentil. The experiment comprised of three varieties viz. BARImasur-4, BARImasur-5 and BARImasur-6 and five potassium levels viz. 0, 15, 25, 35 and 45 kg K ha^{-1}. The results revealed that grain and stover yield of all varieties were increased with the increase of potassium application up to 35 kg ha-1. The highest grain yield (2.16 t ha^{-1}) was found at 35 kg K ha-1 and the lowest grain yield (1.61 t ha^{-1}) was exhibited from control potassium level and the highest stover yield (3.89 t ha^{-1}) was also found in 35 kg K ha^{-1} and the lowest (3.32 t ha^{-1}) was found in control potassium level.
An experiment was done by Hussain *et al* (2011) at experimental area of Department of Agronomy, University of Agriculture, Faisalabad during summer 2005. The objective was to find out the best level of potash fertilizer on growth and yield response of two mungbean (*Vigna radiata* L.) cultivars (Niab Mung-92 and Chakwal Mung-06) to different levels of potassium. The experiment was laid out in Randomized Complete Block Design with factorial arrangements and replicated thrice. Treatments were comprised of five levels of potash fertilizer (0, 30, 60, 90,120 kg ha^{-1}). Different potassium levels significantly affected the seed yield and yield contributing parameters except number of plants per plot. Maximum seed yield (753 kg ha^{-1}) was obtained with the application of 90 kg potash per hectare. The interactive effect of Mungbean varieties and Potassium level was found significant in parameter of protein contents (%). Maximum protein contents was observed in case of mung-06 with application of 90 Kg potash per hectare. It is concluded that the application of Potash fertilizer gave higher yield of mungbean cultivars under agro-climatic conditions of Faisalabad.

It is evident from the literature that application of major nutrients, i.e. NPK improved mungbean yield (Ali *et al.*, 1996; Ali *et al*., 2010).

Among other macro nutrients potash (K) plays a vital role in photosynthesis, enzyme activation, protein synthesis and resistance against the pest attack and diseases (Arif *et al*., 2008).

Ali *et al*. (1996) reported that number of pods per plant, seeds per pod, seed yield and seed protein contents were increased significantly with potassium application and maximum seed yield was obtained with 90 kg potash per hectare. They observed significant difference of protein contents in different mungbean cultivars due to application of potassium.

The supply of phosphorus and potassium to leguminous crops is necessary especially at the flowering and pod setting stages (Zahran *et al*., 1998).

Okaz *et al*.,(1994) showed that phosphorous application induced significant increases in seed and straw yields, yield components they also found that seed contents of K were significantly increased by K application.

Improved potassium supply also enhances biological nitrogen fixation and protein content of pulse grains (Srinivasarao *et al*., 2003).

The supply of phosphorus and potassium to leguminous crops is necessary especially at the flowering and pod setting stages (Zahran *et al*., 1998).

2.1.5 Effect of Boron

Boron ranks third place among micronutrients in its concentration in seed and stem as well as its total amount after zinc (Robinson 1973).

Effects of molybdenum and boron on different grain legumes have been reported by many scientists (Bhuiyan *et al*. 1998; Verma *et al*. 1988; Tiwari *et al*. 1989; Zaman *et al*. 1996).

Field experiments on chickpea (cv. BARI Chola-5) were carried out in Calcareous Dark Grey Floodplain Soil under AEZ 11 at Jessore and Non Calcareous Grey Floodplain Soil under AEZ 13 at Rahmatpur during the rabi season of 2001-2002 and 2002-2003 by Shil *et al* (2007). The objective was to find out the optimum dose of boron and molybdenum for yield maximization. Four levels each of boron (0, 1, 2 and 2.5 kg/ha) and molybdenum (0, 1, 1.5 and 2 kg/ha) along with a blanket dose of N_2O, P_2O_5 kg ha^{-1} & cowdung 5 t ha^{-1} were applied in this study. The combination of B2.5 Mo1.5 kg ha^{-1} and B2.5 Mo1 kg/ha produced significantly higher yield in both the years of study at Jessore and Rahmatpur, respectively. The said treatments produced the highest mean yields of 2.10 and 1.49 t/ha for Jessore and Rahmatpur, respectively, which was around 53% higher over control (B0 M0). The combined application of both boron and molybdenum were found superior to their single application even though boron played major role in augmenting the yield.

The seed yield of green gram was highest with a combination of 5 kg borax/ha in combination with 2 kg ha^{-1} sodium molybdate (Saha *et al*. 1996).
Bharti *et al*. (2002) reported that mean seed yield of chickpea increased with the application of boron @ 2.5 kg ha^{-1}.
Islam (2005) observed that seed yield of chickpea (cv.BARI chola 5) increased significantly due to application of 1 to 1.5 kg B ha.

2.1.6 Combined effect of manure and inorganic fertilizers

Rajkhowa *et al*. (2002) reported that the application of 100% RDF + vermicompost @ 2.5 t per ha resulted significantly higher plant height (57.7 cm) . number of pod per plant (12.67) , seed per pod (12.00), 100 seed weight (4.6g) , seed yield (5.35 q per ha) over control in mungbean.
Two field experiments were carried out by Zeidan (2007) during the two winter seasons of 2003/ 2004 and2004/2005 at the Experimental Farm of the National Research Centre at Nubariato study the effect of organic manure at 0,10 and 20 m3/ fed. And four phosphorus levels of 0,30,45 and 60 Kg P 2O5/ fed. on growth, yield and quality of lentil grown in sandy soil. Results indicated that plant height, number of branches/ plant, number of pods/plant,1000 seed weight, seed yield/plant, seed yield/fed and straw yield ton/fed. were significantly affected by organic manure application. Increasing rates of applied organic manure from 0 to 20 m3 /fed markedly increased all studded characters. Results also show that plots received 20m3 /fed gave the highest values of protein, P,K,% and Fe, Mn and Zn in(ppm) respectively compared to the control. Increasing phosphorus levels from0 to 60 kg/fed increased plant height, number of branches/ plant number of pods /plant,1000 seed Weight, seed yield/plant, seed yield/fed and straw yield/fed of lentil plant. Phosphorus levels caused increased in protein, P, K,(%) andFe, Mnand Zn in (ppm)contents in seeds of lentil plant. 60 kg P2 O5 /fed gave the highest levels of protein, P, K, Fe, Mn and Zn contents in seeds compared with O,30 and 45 kg /fed.

Channaveerswami (2005) found that application of combination of vermicompost @ 2.5 t per ha + (25:50:50 kg NPK per ha) + copper ore tailing recorded higher plant height (43.94 cm), number of branches (6.92) and minimum number of days to 50% flowering (35.15) , number of matured pod (17.06) , pod yield (3337 kh per ha) and kernel yield (2362 kg per ha) , 100 seed weight (35.26 g) . This seed obtained with this treatment also recorded higher seed quality parameters like , germination (94.31%) , seedling length (23.85 cm) , seedling dry weight (4.6 g) , seedling vigour index (2249) and lower electrical conductivity (0.186 dsm-1) in mungbean and groundnut .
A field experiment was done by Pawar *et al*. (1995). He applied vermicompost @ 2.50 t per ha along with 100% RDF recorded significantly higher seed yield

(74.80 q per ha). However in situ vermiculture and application of 50% RDF recorded a yield equivalent to that with 100% RDF.

Pot experiment was conducted by Sanu (2009) in a randomized complete block design with three replication and six treatments in the screenhouse of Soil Science Division, Khumaltar during the year 2003 and 2004. The objective of the experiment was to find out the effect of vermicompost in combination with or without soil and mineral fertilizers on the yield and other attributes of chickpea. The results showed an encouraging effect of vermicompost application on the plant height, root length and biomass dry weight of chickpea when vermicompost was applied in equal ratio with soil (5 kg each/pot) and 10:20:15 kg N: P_2O_5:K_2O kg ha^{-1}. Vermicompost with equal ratio of soil (5 kg each pot^{-1}) also produced the highest mean grain yield of 10.6 gm per pot. However, no significant treatments effects were observed for root length and straw weights of the chickpea.
In the tropics, where soil fertility is generally low, the decline in crop yields, even in conventional cropping systems due to excess soil mining calls for the inclusion of organic matter to maintain soil fertility (Eilitta *et al.* 2000).
In organic systems where inorganic fertilizers are not used, the replenishment of nutrients and soil quality maintenance is dependant on organic materials due to beneficial impacts in terms of soil physical, chemical and biological properties (Rawls *et al.* 2003)

2.1.7 Effect of sowing date

In order to investigate the impacts of sowing dateand row spacing on yield and yield components of Hashem chickpea variety, a field experiment was conducted in 2005 at farm of Dorood Faraman (Kermanshah-Iran) by Keyvan (2010). In this study, the sowing date in three level (6, 23 November and 6 December) and the row spacing in three level on rows (20, 30 and 40 cm) were evaluated with complete randomized block design in factorial arrangement. Results of experiment showed that there are significant differences for planting date and planting density effects of plant height, number of branch per plant, distance between 1st pod to soil, number of pod per plant, number of grain per plant, biological yield and grain yield. The maximum grain yield belongs to sowing date 6 November and row spacing 30 cm.. Also we found that planting at 6th December had higher distance of pod from soil surface and thus easier for mechanized harvesting.

Having tested Hashem variety of chickpea on 3 planting dates of December 6th, January 21st and March 6th with different planting densities (16, 32, 48 and 64 plants), Mohammadnejad and Soltani (2005) concluded that, the number of fertile pods on primary branch, grains per pod, the weight of 100 grains and grain yield per unit area were affected by planting date.

During a research under heading of "Assessing the possibility of fall or autumn planting of chickpea in Mashhad", Goldani, (1997) concluded that, among 4 planting dates of November 29th, March 14th, April 14th and May 22nd, the first planting date November 29th had high one plant yield due to the increase in duration of vegetative and germinative growing period increase in dry weight of organs, number of pods and number of grains .

The effect of advancing the sowing date from early February to November on the growth and seed and straw yields of three large seeded and three small seeded lines of lentil (*Lens culinaris*) was studied under rainfed conditions in northern Syria between 1982 and 1985 by Silim *et al* (1999). The average seed and straw yields from early winter sowing were 838 and 2476 kg ha"1 compared with 679 and 1470 kg ha"1, respectively, from a late sown crop. There were seasonal differences in the advantage in seed yield from early sowing, largely because infestation by Orobanche species limited the use of early sowing.

Early sowing of a Syrian land race before mid-December resulted in increased seed and biological yields over late winter sowing, mainly because of the extended period for vegetative growth (Saxena, 1981; Saxena et al., 1983).
Time of planting has been shown to be a major determinant of damage to southern peas in the field by the cowpea curculio, Chalcodermus aeneus Boheman (Sherman and Todd, 1938).
A split-plot design was used to investigate the vegetative and reproductive responses of two early maturing and two late-maturing Cajanus cajan accessions to eight sowing dates by Akinola and Whiteman (1975) . From this experiment they found that Optimum sowing times were as late November-mid January for dry seed production in the late maturing accessions, and not later than December for periodic green pod picking in the early maturing accessions.

CHAPTER III

MATERIALS AND METHODS

The trial materials and strategies in this investigation are displayed here. The trial time frame is November to Spring (Robi season) of 2017 and 2018 . The purpose for the analysis to discover the impact of manure, organic fertilizer and sowing date on development and yield of chickpea.

3.1 Experimental site

The experiment was done at Sher-e-Bangla Agricultural University (SAU) farm , Dhaka. The site is located at 23°77' North Latitude and 90°30' East Longitude. The elevation of the experimental site is 8.0 m above the sea level. The AEZ of this site is AEZ-28 (Madhupur Tract) The geological Location of the site is presented on the map in (Appendix I)

3.2 Climate of the Experimental site

Sub tropical , wet and humid climate is found in experimental site. The climate is characterized into 3 distinct seasons the winter season from November to February and the pre-monsoon or hot season from March to April and the monsoon period from May to October (Edris *et al.,* 1979).

3.3 Characteristic of Soil

The experiment was conducted on the soil that is shallow red brown terrace soil. The selected plot was medium high land and the soil series was 'Tejgaon'. The characteristics of the soil under the experimental plot were analyzed in the Soil Testing laboratory. SRI Khamarhari. Dhaka and details of the recorded of soil characteristics were presented in (Appendix II) .

3.4 Crop : Chickpea

In this experiment BARI Chola – 5 was used . The characteristics of this variety is given bellow:

BARI chlola-5 was developed by Bangladesh Agricultural Research Institute (BARI) Jovdebpur, Gazipur. It was released as a variety in 1996. This variety bears good phenotypic characters: such as light green leaf, bushy type plant,30-45 cm height. Whitish color flower, seed is smaller in size & deep brown in color, life cycle is 105-125 days and seed yield of 600-1800 kg/ha.

3.5 Treatments

In the experiment there are two factors :

Factor A

Manure and inorganic fertilizer (4 levels)

F_0 = to control (no fertilizer)
F_1 = Recommended dose of fertilizer (45 kg urea/ha + 85 kg TSP /ha + 35kg MOP/ha + 12 kg Boric acid/ha)
F_2 = Recommended dose of fertilizer + cow dung (3ton/ha)
F_3 = Recommended dose of fertilizer + Vermicompost (2.5 ton/ha)

Factor B

Sowing date (3 levels)

S_1= 07 November
S_2= 19 November
S_3=02 December

3.6 Experimental design and layout

Split plot design with three replications assigning fertilization in the main plot and sowing date in the subplot. Each plot was measured 2.4m ×1.25m .

3.7 Land preparation

The experimental plot was flooded to evacuate its hard dry ness before ploughing. Then it was first opened with tractor drawn harrow in the wake of having zoe'condition. Harrowed soil was then brought into attractive tilth by 4 tasks of furrowing. Harrowing and laddering. The stubble and weeds were evacuated. Atlast field was prepared on 5 November 2017. Test land was isolated into unit plots following the structure of trial. The plots were spaded one day before planting .

3.8 Fertilizer application

Manure (cowdung , vermicompost) were applied along with Urea, TSP , MOP , Boric acid as per requirement at the time of final land preparation .

3.9 Seed sowing

At first seed were sown after treating with Bavistin Fungicide on 7 November 40cm apart line continuously . After sowing seeds were covered with soil. Seeds were sown in similar manner incase of 2nd sowing (19 November 2017) and 3rd sowing (2 December 2017).

3.10 Intercultural operation

3.10.1 Weeding

Weeding was done thrice ,1st at 20 (DAS) , 2nd at 35(DAS) , 3rd at 50 (DAS) incase of each sowing .

3.10.2 Irrigation

Three irrigations were given as plants required. 1st irrigation was given after emergence of seedling (15 DAS) , 2nd irrigation was given at (50 DAS), and final irrigation at(70 DAS) incase of each sowing .

3.10.3 Crop protection

The crop plants were attacked by ants at vegetative stage . For controlling ants Autostin was applied to the field.

3.10.4 Corp sampling

From each plot 5 sample plants were randomly selected and marked with tag for recording data for different plant characters . The data on plant height, number of branches, fresh wt ,dry weight, 1000 seed weight, yield were recorded . The data was collected from the $1m^2$ area at the middle of the plot. The seed collected from all the pods were weighed and converted it into t ha^{-1} .

3.10.5 Harvesting

Chickpea pods were harvested on 06 March , 13 March , & 2 March , 2018 respectively from the plots sowing on 07 November, 19 November and 02 December 2017.

3.11 Data collection

3.11.1 Plant height

Plant height of the 5 randomly selected plants were measured from base of the plant over soil to the tips with the help of a meter scale at 30, 60 ,90 (DAS). Average of the height of 5 plants was calculated and expressed in cm.

3.11.2 Number of branches $plant^{-1}$

The total number of branches was counted from the same 5 tagged plants at 30,60,90 (DAS) for each sowing date. Average of them was calculated and expressed as number of branches of $plant^{-1}$.

3.11.3 Number of leaves $plant^{-1}$

Number of leaves were counted from previous 5 tagged plants at 30, 60, 90 DAS for each sowing , then average of them was calculated to express number of leaves $plant^{-1}$.

3.11.4 Fresh weight

5 randomly selected plants from each plot were uprooted at 30 , 60 , 90 DAS . The plants were washed , root were cut and thereafter fresh weight were taken . Finally then average were made to calculate fresh weight $plant^{-1}$.

3.11.5 Dry weight

Dry weight was calculated of that 5 plants from which fresh weight were taken . After oven drying for 72 hours weight was taken into gram . Then the average of them was written as dry weight .

3.11.6 Number of pod $plant^{-1}$

Total number of pods were collected from 5 randomly selected plants after harvest and then averaged to express in number of pods $plant^{-1}$.

3.11.7 Number of seed pod^{-1}

Total number of seed were collected from 10 randomly selected pods from the 5 plants and total number of seeds was counted and then number of seeds pod^{-1} was measured by the following formula:

$$\text{Number of seed pod}^{-1} = \frac{\text{Total number of seed}}{\text{Total number of pod}}$$

3.11.8 pods length (cm)

Ten pods were at random selected from all pods from collected 5 tagged plants after harvesting .The length of each pod was measured and average were calculated and expressed as pod length.

3.11.9 100 seeds weight (g)

From each plot 100 seeds were separated and weight was taken .

3.11.10 yield m^{-2}

Seeds from the pods of plants within $1m^2$ area were collected and weight to calculate yield m^{-2}.

3.11.11 Days to 80% flowering

80% flowering means when in each plot 80% plant show flower . This date were counted after sowing date .

3.11.12 Days to 80% pod formation

80% pod formation means when in each plot 80% plant show pod . This dates were counted after sowing .

3.11.13 Stover yield (t ha^{-1})

After harvesting and threshing the plant , stover (above ground plant parts other than seeds) were separated in each plot , cleaned , dried in the sun ,then stover yield ton ha^{-1} was recorded .

3.11.14 Seed yield (t ha^{-1})

In each plot the seed harvested were cleaned and dried in sun for 5 days . Then they were weighted in gram . The seed weight were then computed as ton per ha.

3.11.15 Biological yield (t ha^{-1})

Biological yield was calculated by using the following formula :

Biological yield = Seed yield + Stover yield

3.11.16 Harvest index (%)

Harvest index was calculated with the help of following formula and it was calculated on dry weight basis .

$$\text{Harvest Index (\%)} = \frac{\text{Seed yield (t ha-1} \times 100}{\text{Biological yield (t ha-1)}}$$

3.12 Statistical analysis

The data obtained for different parameters were statistically analyzed to find out the significant difference between manure, inorganic fertilizer and sowing date on yield of chickpea. The mean estimations of' the considerable number of characters were calculated and examination of change was performed by the F'(variance ratio) test. The significance of the difference among the treatment combinations means was estimated by the Least significant Difference (LSD) test at 5% level of probability.

CHAPTER IV

RESULTS AND DISCUSSION

This experiment was done to find the effect of fertilization and sowing date on growth and yield of chickpea . For this the data of growth and yield parameter were recorded at different days after sowing. The analyses of variance (ANOVA) of these data are presented in the Appendix. Here result and discussion have been presented with necessary graphs and tables.

4.1 Plant height (cm)

At different levels of fertilizer plant height do not show different significance levels pair wise at 30, 60, and 90 (DAS). (Appendix III) . The tallest plant was recorded 13.70 cm from treatment F_2 (Recommended dose of fertilizer + cow dung) and 30.32cm ,48.14 cm from F_3 treatment (Recommended dose of fertilizer + vermicompost) at 30, 60,and 90 DAS respectively . shortest plant was recorded (13.16, 24.93 ,41.51 cm) at 30, 60, 90 DAS respectively from treatment F_0 (control) (Figure 1)

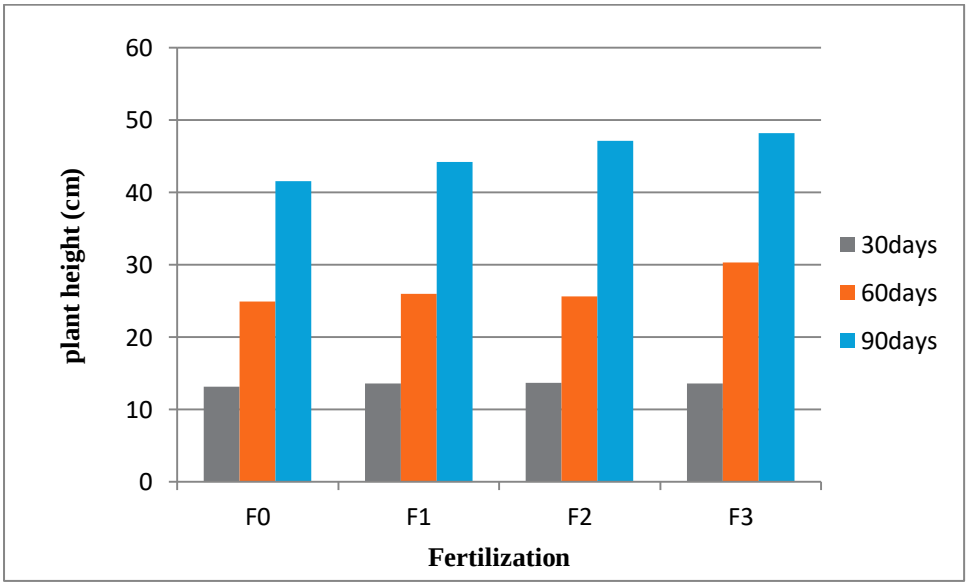


Figure 1: Effect of fertilization on plant height of chickpea at different days after sowing ($LSD_{0.05}$ = 0.32 , 1.34, 0.75 at 30, 60 and 90 DAS, respectively)

Here F_0= control (No fertilizer), F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) , F_2= Recommended dose of fertilizer + cow dung (3 ton ha^{-1}), F_3= Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1}).

Due to three different sowing date significant differences were also seen at 30. 60 90 DAS on plant height of chickpea (Appendix III) . The tallest plant was recorded

(15.18, 31.27, 50.52cm) respectively from S_1 sowing on 07 November . On the other hand shortest plant was found (12.16, 23.16, 40.40 cm) respectively from S_3 sowing 02 December . (Figure 2).

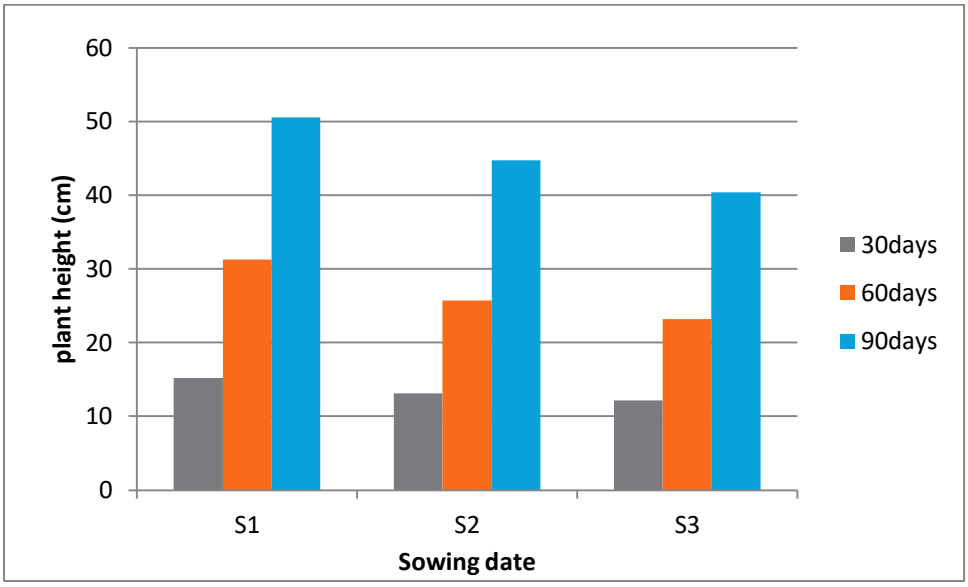


Figure 2: **Effect of sowing date on plant height of chickpea at different days after sowing ($LSD_{0.05}$ = 0.50, 1.26, 0.68 at 30, 60 and 90 DAS, respectively)**

Here , S_1= 07 November , S_2=19 November ,S_3=02 December

Combined effect of fertilization and sowing date also had significance differences on plant height of chickpea at 30, 60 ,90 DAS (Appendix III) . The tallest plant was recorded (15.93 cm) from F_2S_1 and 41.13cm from F_3S_1 and 56.30 cm from F_2S_1 at 30, 60, and 90 DAS, respectively. The experiment also represents significantly similar result from treatment F_0S_1 and F_2S_1 . The smallest plant height was found (10.85 , 21.30, 36.02 cm) at 30, 60 , 90 DAS respectively from treatment F_0S_3. (Table1).

Table 1: Interaction effect of fertilization and sowing date on plant height of chickpea at different days after sowing

Treatment Combination	Plant height (cm)		
	30 DAS	60 DAS	90 DAS
F_0S_1	14.92 ab	27.98 b	44.83 bcd
F_1S_1	14.90 ab	27.30 b	45.98 bc
F_2S_1	15.93 a	28.67 b	56.30 a
F_3S_1	14.97 ab	41.13 a	55.00 a
F_0S_2	13.72 bc	25.52 bc	43.66 cde
F_1S_2	13.30 bc	27.10 b	44.08 bcd
F_2S_2	12.29 cd	24.52 bc	44.15 bcd
F_3S_2	13.31 bc	25.56 bc	45.98 bc
F_0S_3	10.85 d	21.30 c	36.02 f
F_1S_3	12.57 cd	23.44 bc	42.40 de
F_2S_3	12.87 c	23.65 bc	40.82 e
F_3S_3	12.34 cd	24.26 bc	42.36 de
LSD $_{(0.05)}$	1.01	2.51	1.36
CV%	9.16	11.52	3.70

In a column means with same letter (s) are not significantly different by LSD at 5% level of significance

Here F_0= To control (No fertilizer) ,F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) , F_2=Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) F_3= Recommended dose of fertilizer + vermicompost (2.5 ton ha^{-1})
S_1= 07 November , S_2=19 November , S_3=02 December

From the experiment it can be noticed that both cowdung and vermicompost with inorganic fertilizer help to increase plant height. From different experiment it is found that due to application of organic fertilizer organic matter content of plant increase as a result plant height increase. Channaveerswami (2005) in groundnut and Rajkhowa *et al* (2002) in greengram noticed that combined application of organic and inorganic fertilizer is better than single application of inorganic fertilizer . Sowing date also has effect on plant growth .

4.2 Number of branches plant $^{-1}$

Distinctive significance levels at 30, 60, and 90 DAS was seen because of various levels of fertilization on number of branches plant^{-1} .(Appendix IV). The most elevated number of branches were discovered 5.9 ,27.32 and 39.87 from treatment F_3 treatment at 30, 60,and 90 DAS separately. The most reduced number of branches were watched 4.63 from treatment F_2 (Suggested portion of manure + dairy animals excrement) and 13.44, 20.94 from treatment F_0 (control) at 30, 60, 90 DAS separately

(Figure 3).

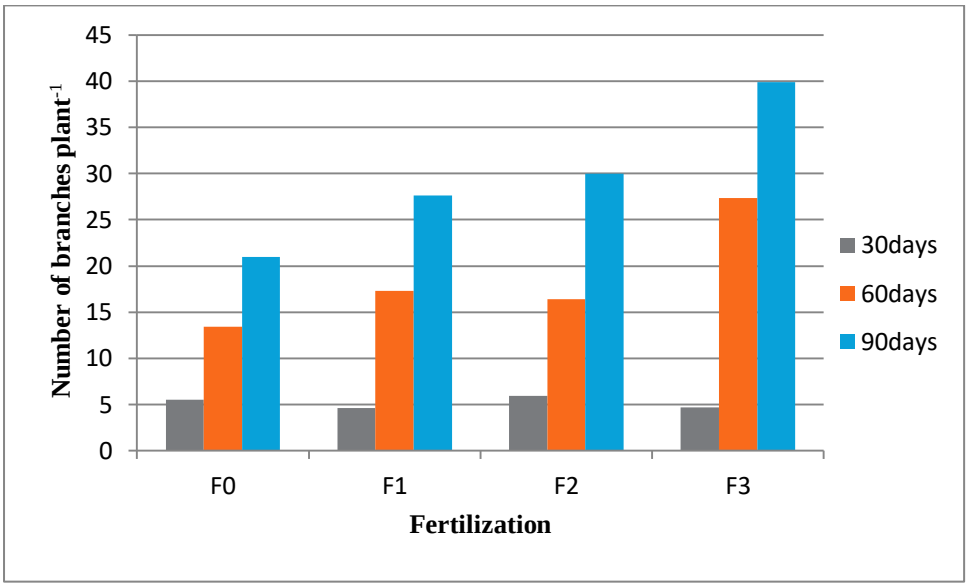


Figure 3: Effect of fertilization on number of branches plant^{-1} of chickpea at different days after sowing ($LSD_{0.05}$ = 0.29, 0.56, 2.41,at 30, 60 respectively)

Here F_0= To control (No fertilizer) ,F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) ,F_2= Recommended dose of fertilizer + cow dung (3 ton ha^{-1}), F_3= Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1})

At three different sowing date significant difference were also seen at 30,60, 90 DAS on number of branches of chickpea (Appendix IV) . the highest number of branches were found 5.55 at 30 DAS from treatment S_2 and 30.88 39.58 at 60 and 90 DAS respectively from S_1 sowing .The lowest number of branches were recorded 4.75 and 21.51 at 30, 90 DAS respectively from S_3 sowing date (2/12/2017) and 11.46 at 60 DAS from S_2 . (Figure 4)

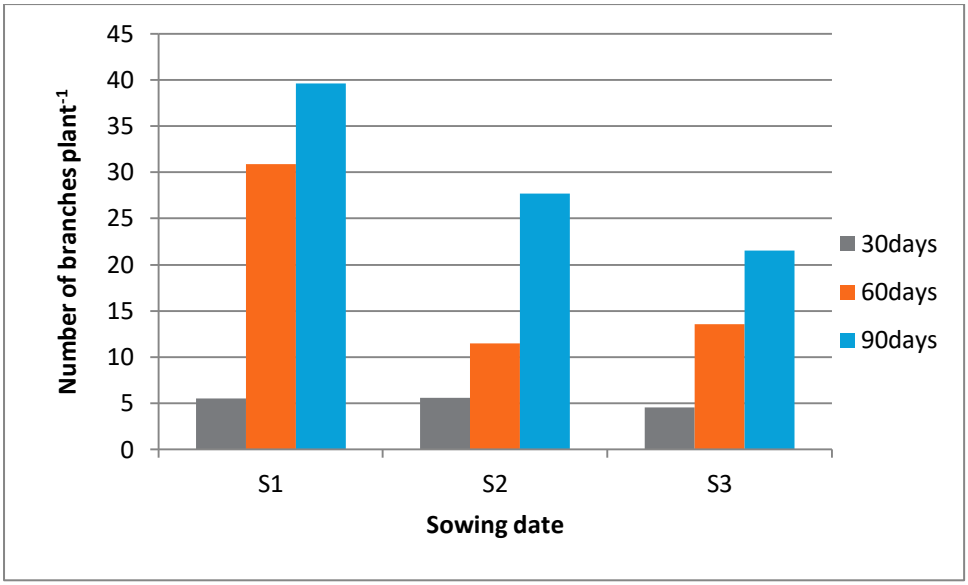


Figure 4: Effect of sowing date on number of branches plant^{-1} of chickpea at different days after sowing ($LSD_{0.05}$ = 0.34, 0.35, 2.11 at 30, 60 and 90 DAS, respectively)

Here , S_1= 07 November , S_2=19 November , S_3=02 December

Joined utilization of various dimensions of composts and sowing date additionally demonstrates essentialness contrasts on number of parts of chickpea at 30, 60 ,90 DAS. The most noteworthy number of branches were discovered 6.55 from treatment F_2S_1 at 30 DAS and altogether comparative outcome was seen from F_0S_1 .At 60 and 90 DAS the most highest number of branches were determined 50.72, 54.00 individually from treatment F_3S_1 . The most minimal number of branches was discovered 3.96 at 30 DAS from F_1S_3 treatment and at 60 , 90 DAS 6.67, 14.16 individually from F_0S_3 treatment . (Table 2)

Table 2: Interaction effect of fertilization and sowing date on number of branches plant^{-1} of chickpea at different days after sowing

Treatment Combination	Number of branches plant^{-1}		
	30 DAS	60 DAS	90 DAS
F_0S_1	6.11 ab	21.33 c	31.40 cde
F_1S_1	4.11 d	26.05 b	35.77 bcd
F_2S_1	6.55 a	25.41 b	37.16 bc
F_3S_1	5.17 abcd	50.72 a	54.00 a
F_0S_2	5.78 abc	12.33 ef	17.26 fg
F_1S_2	5.83 abc	8.71 g	25.52 ef
F_2S_2	6.01 abc	11.29 f	26.25 ef
F_3S_2	4.61 cd	13.51 e	41.84 b
F_0S_3	4.67 bcd	6.67 h	14.16 g
F_1S_3	3.96 d	17.11 d	21.53 fg
F_2S_3	5.33 abcd	12.59 ef	26.57 def
F_3S_3	4.32 d	17.74 d	23.78 ef
LSD $_{(0.05)}$	0.69	0.71	4.22
CV%	16.34	4.65	17.46

In a column means with same letter (s) are not significantly different by LSD at 5% level of significance

Here F_0= To control (No fertilizer) ,F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) , F_2=Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) F_3= Recommended dose of fertilizer + vermicompost (2.5 ton ha^{-1})

S_1= 07 November , S_2=19 November , S_3=02 December

Mix of vermicompost and inorganic manure fundamentally expanded the quantity of branches per plant than sole utilization of inorganic fertilizer. As natural compost help to improve the soil condition and inorganic manure guarantee brisk accessibility of basic supplement , the mix of two demonstrated superior to single utilization of the each. Channaveerswami (2005) revealed that joined utilization of vermicompost @ 2.5 t per ha+ RDF(25:50:50 kg NPK per ha) + copper metal following recorded higher number of branches (6.92) in mungbean.

4.3 Number of leaves plant $^{-1}$

Significance differences were found on number of leaves plant^{-1} due to the application of different levels of manure and inorganic fertilizers at 30, 60 and 90 days (Appendix V). The maximum number of leaves plant^{-1} were recorded at 30, 60, 90 DAS (22.95, 99.21, 210.33) from treatment F_0 (To control) , F_3 (Recommended dose of fertilizer + vermicompost 2.5 ton ha^{-1}), F_3 (Recommended dose of fertilizer + vermicompost 2.5 ton ha^{-1}) respectively. And the lowest number of leaves plant^{-1} were recorded at 30,

60, 90 DAS (18.87, 63.13,172.73) from treatment F_3 (Recommended dose of fertilizer + vermicompost 2.5 ton ha^{-1}), F_1 (Recommended dose of fertilizer), F_0 (To control) respectively .(Figure 5)

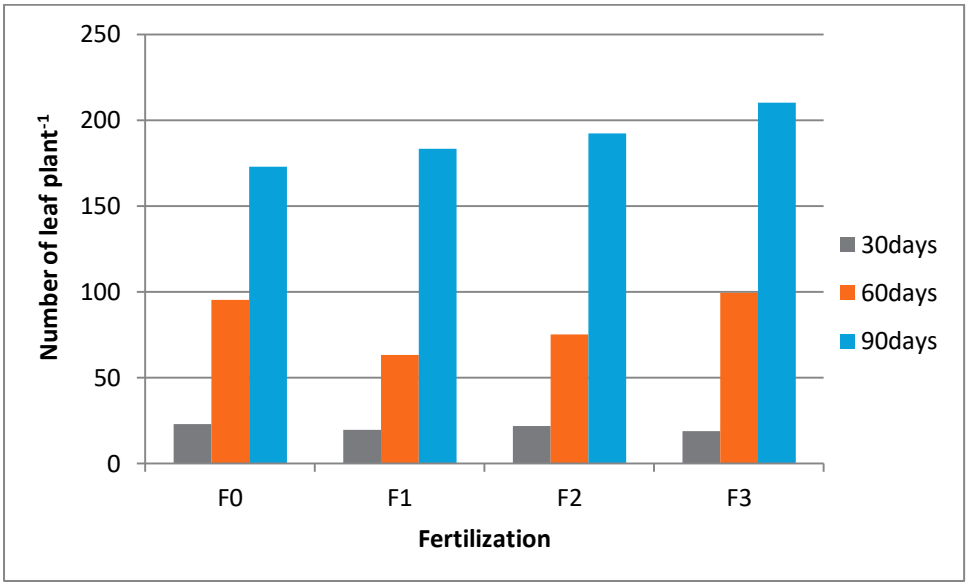


Figure 5: Effect of fertilization on number of leaves plant^{-1} of chickpea at different days after sowing ($LSD_{0.05}$ =0.53, 1.52, 1.19 at 30, 60 and 90 DAS, respectively)

Here F_0= To control (No fertilizer), F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) , F_2= Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) , F_3= Recommended dose of fertilizer + vermicompost (2.5 ton ha^{-1})

Significant differences were found due to the different levels of sowing date at 30, 60 and 90 days on number of leaves plant^{-1}(Appendix V). The maximum number of leaves plant^{-1} were recorded at 30, 60, 90 DAS (24.92, 113.21, 294.05) from S_1 sowing .And the lowest number of leaves plant^{-1} were recorded at 30, 60, 90 DAS (17.90, 48.94, 136.86) from S_3 sowing (Figure 6).

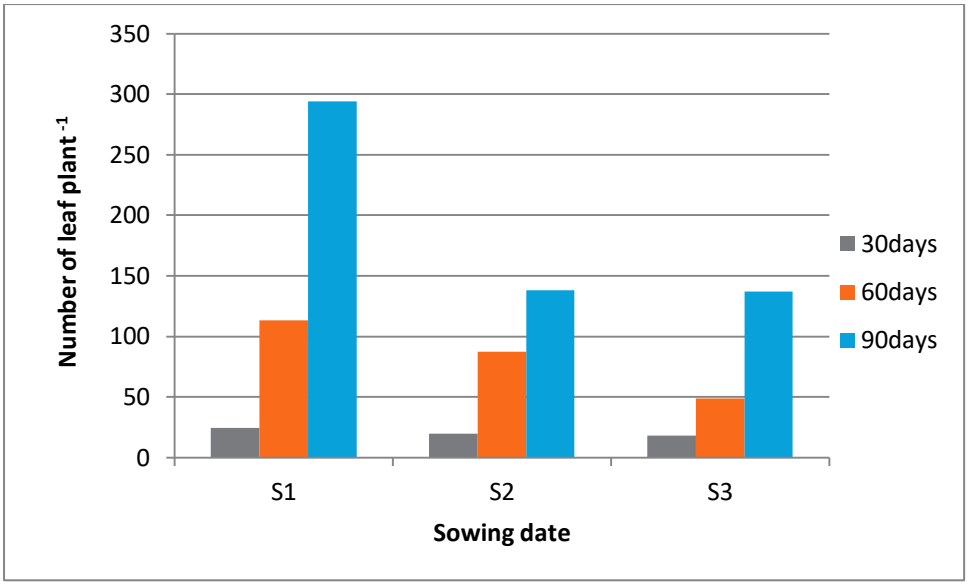


Figure 6: Effect of sowing date on number of leaf plant^{-1} of chickpea at different days after sowing ($LSD_{0.05}$ = 0.61, 1.86, 1.27 at 30, 60 and 90 DAS, respectively)

Here , S_1= 07 November , S_2=19 November , S_3=02 December

Combined utilization of various dimensions of composts and sowing date additionally demonstrates criticalness contrasts on number of leaves plant^{-1} of chickpea at 30, 60 ,90 DAS. The highest number of leaves was recorded (34.47, 152.85, 326.11) from the treatment combination F_2S_1, F_3S_1, F_3S_1 respectively . The minimum number of leaves were recorded (12.47, 44.60, 113.98) from the treatment combination F_2S_3, F_0S_3, F_0S_3 , respectively . (Table 3)

Table 3 : Interaction effect of fertilization and sowing date on number of leaf plant^{-1} of chickpea at different days after sowing

Treatment Combination	Number of leaves plant^{-1}		
	30 DAS	**60 DAS**	**90 DAS**
F_0S_1	16.23 d	126.37 b	281.40 b
F_1S_1	23.96 bc	95.28 d	282.25 b
F_2S_1	34.46 a	78.36 e	286.44 b
F_3S_1	23.30 c	152.85 a	326.11 a
F_0S_2	26.26 b	114.83 c	122.81 e
F_1S_2	17.13 d	95.28 d	124. 30 e
F_2S_2	18.01 d	94.20 d	143.10 d
F_3S_2	17.70 d	93.54 d	161.54 c
F_0S_3	26.37 b	44.60 g	113.98 f
F_1S_3	17.15 d	46.74 fg	143.27 d
F_2S_3	12.47 e	53.16 f	146.87 d
F_3S_3	15.63 d	51.24 fg	143.33 d
LSD $_{(0.05)}$	1.22	3.73	2.55
CV%	7.27	5.50	1.65

In a column means with same letter (s) are not significantly different by LSD at 5% level of significance

Here F_0= To control (No fertilizer) ,F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) , F_2=Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) F_3= Recommended dose of fertilizer + vermicompost (2.5 ton ha^{-1})
S_1= 07 November , S_2=19 November , S_3=02 December

Combination of vermicompost and inorganic fertilizer and cowdung on a very basic level extended the amount of leaves per plant than sole use of inorganic manure. As regular fertilizer help to improve the soil condition and inorganic compost ensure lively availability of essential enhancement , the blend of two showed better than single usage of the each. Patil (1998) discovered better development by utilizing blend of compost and inorganic manure than just inorganic fertilizer in mungbean.

4.4 Fresh weight of chickpea (g plant^{-1})

Significant differences were found because of the utilization of various dimensions of manure and inorganic composts at 30, 60 and 90 DAS on fresh weight of chickpea plant-1(Appendix VI). The greatest fresh weight plant^{-1} were recorded at 30, 60, 90 DAS (0.95 ,9.03 ,22.62) from treatment F_0 (To control) , F_2 (Recommended dose of fertilizer + cow dung 3 ton ha-1), F_1 = (Recommended dose of fertilizer 45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) respectively . What's

more, the most minimal fresh weight plant-1 were recorded at 30, 60, 90 DAS (0.77, 6.65, 18.31) from treatment F_1(Recommended dose of fertilizer 45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}), and F_0 (To control) respectively .(Figure 7)

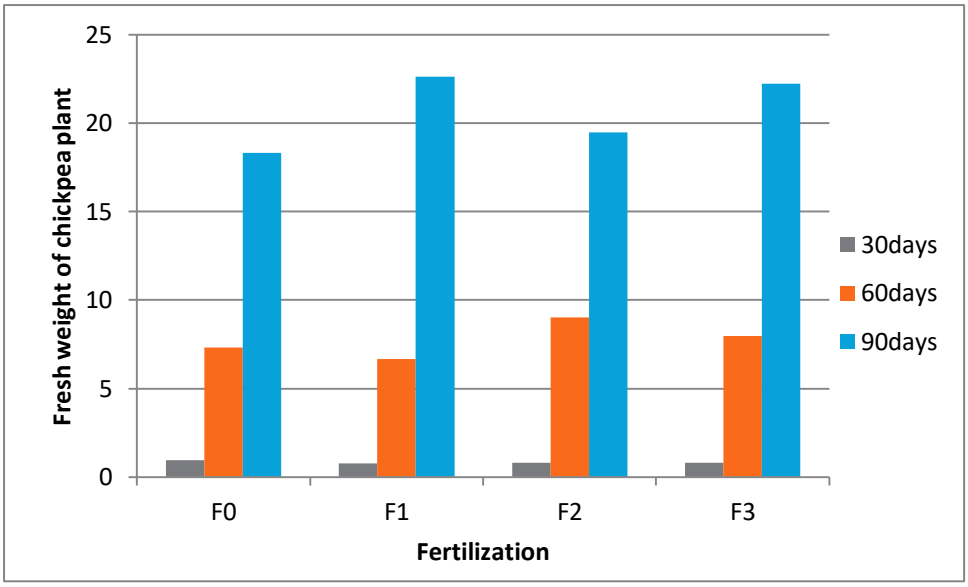


Figure 7: Effect of fertilization on fresh weight of chickpea plant at different days after sowing ($LSD_{0.05}$ = 0.11, 0.46, and 0.74 at 30, 60 and 90 DAS, respectively)

Here F_0= No fertilizer (No fertilizer), F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}), F_2= Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) ,F_3= Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1})

Significance differences were found due to the different levels of sowing date at 30, 60 and 90 DAS on fresh weight of chickpea $plant^{-1}$(Appendix VI). The maximum fresh weight $plant^{-1}$ were recorded at 30, 60, 90 DAS (1.08, 12.20, 28.11) from S_1 sowing . And the lowest fresh weight $plant^{-1}$ were recorded at 30, 60, 90 DAS (0.63, 3.10, 14.55) g $plant^{-1}$ from S_3 sowing (Figure 8).

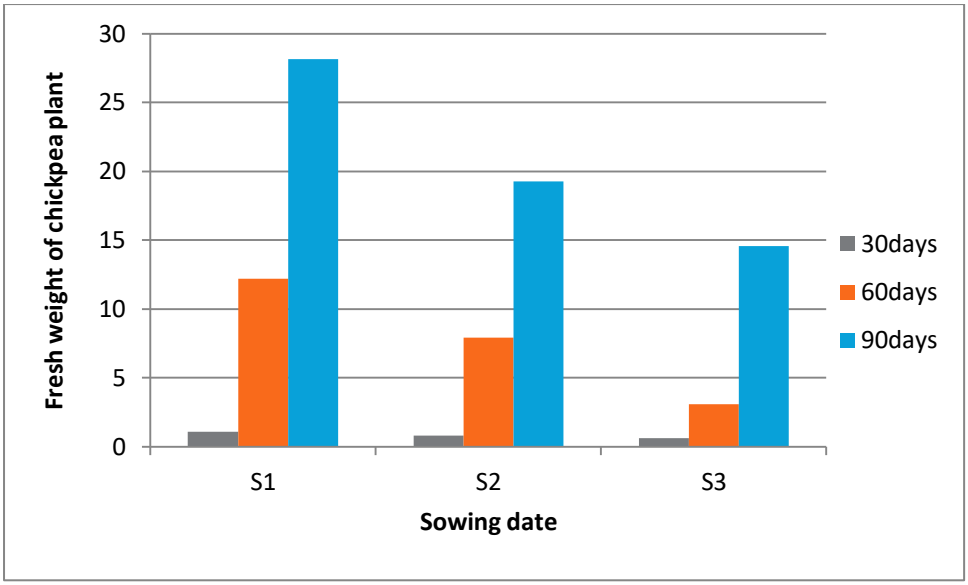


Figure 8: Effect of sowing date on fresh weight of chickpea plant at different days after sowing ($LSD_{0.05}$ = 0.08, 0.59, and 0.72 at 30, 60 and 90 DAS, respectively)

Here, S_1= 07 November , S_2=19 November , S_3=02 December

Combined utilization of various dimensions of composts and sowing date additionally demonstrates fresh weight of chickpea plant^{-1} at 30, 60 ,90 DAS. The maximum weight was recordedat 30. 60 and 90 DAS (1.27, 13.09, 38.33) from the treatment combination F_1S_1, F_2S_1, F_1S_1 respectively . And the minimum weight were recorded (0.42, 2.43, 10.99) from the treatment combination F_1S_3, F_3S_3, F_0S_3 respectively .(Table 4)

Table 4: Interaction effect of fertilization and sowing date on fresh weight of chickpea plant at different days after sowing

Treatment	Fresh weight (g)		
	30 DAS	60 DAS	90 DAS
F_0S_1	0.73 cd	11.51 a	23.70 c
F_1S_1	1.27 a	11.42 a	38.34 a
F_2S_1	1.21 a	13.09 a	23.47 c
F_3S_1	1.12 a	12.79 a	27.02 b
F_0S_2	1.01 abc	6.78 bc	20.25 d
F_1S_2	0.64 cd	11.42 a	14.33 f
F_2S_2	0.72 cd	11.25 a	16.32 ef
F_3S_2	0.78 bcd	8.68 b	26.27 bc
F_0S_3	1.11 ab	3.63 de	10.99 g
F_1S_3	0.42 d	3.59de	15.21 f
F_2S_3	0.51 d	2.75 de	18.58 de
F_3S_3	0.47 d	2.43 e	13.44 fg
LSD $_{(0.05)}$	0.16	1.19	1.44
CV%	23.78	18.88	8.59

In a column means with same letter (s) are not significantly different by LSD at 5% level of significance

Here F_0= To control (No fertilizer) ,F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) , F_2=Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) F_3= Recommended dose of fertilizer + vermicompost (2.5 ton ha^{-1})
S_1= 07 November , S_2=19 November , S_3=02 December
Combination of vermicompost and inorganic fertilizer and cowdung extended the fresh weight of chickpea per plant than sole use of inorganic manure. As regular fertilizer help to improve the soil condition and inorganic compost ensure lively availability of essential enhancement , the blend of two showed better than single usage of the each.

4.5 Dry weight of chickpea (g $plant^{-1}$)

Distinctive significance levels at 30, 60, and 90 DAS was seen on dry weight of chickpea per plant because of various dimension of manures.(Appendix VII). The maximum weight were discovered at 30, 60 and 90 DAS (0.28, 1.70, 5.98 g $plant^{-1}$) from treatment F_1=(Recommended dose of fertilizer 45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}), F_3(Recommended dose of fertilizer + vermicompost (2.5 ton ha^{-1}), F_3= Recommended dose of fertilizer + vermicompost (2.5 ton ha^{-1}) respectively . The most reduced weight were watched (0.21, 1.35, 3.26 g $plant^{-1}$) from treatment F_3 (Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1}) , F_0 (No fertilizer), F_1 (Recommended dose of fertilizer 45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) respectively . (Figure 9).

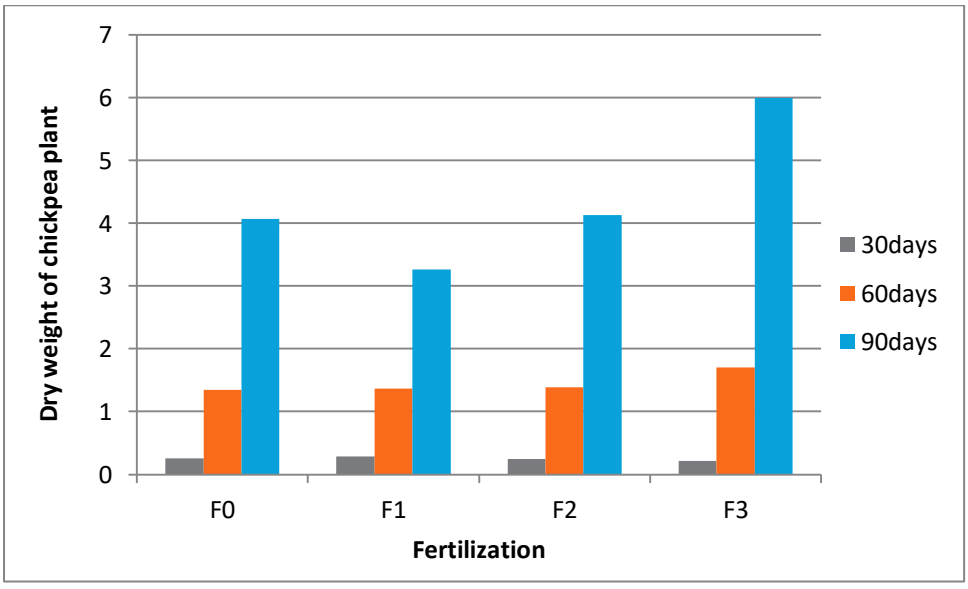


Figure 9: Effect of fertilization on dry weight of chickpea plant at different days after sowing ($LSD_{0.05}$ = 0.03, 0.15, and 0.42 at 30, 60 and 90 DAS, respectively)

Here F_0= To control (No fertilizer), F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) ,F_2= Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) , F_3= Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1}).

Significance differences were found due to the different levels of sowing date at 30, 60 and 90 days after sowing on dry weight of chickpea $plant^{-1}$(Appendix VII). The maximum dry weight $plant^{-1}$ were recorded at 30, 60, 90 DAS (0.37, 2.30, 5.52 g $plant^{-1}$) from S_1 sowing and the lowest dry weight $plant^{-1}$ were recorded at 30, 60, 90 DAS (0.18, 0.77, 2.80 g $plant^{-1}$) from S_3 sowing . (Figure 10)

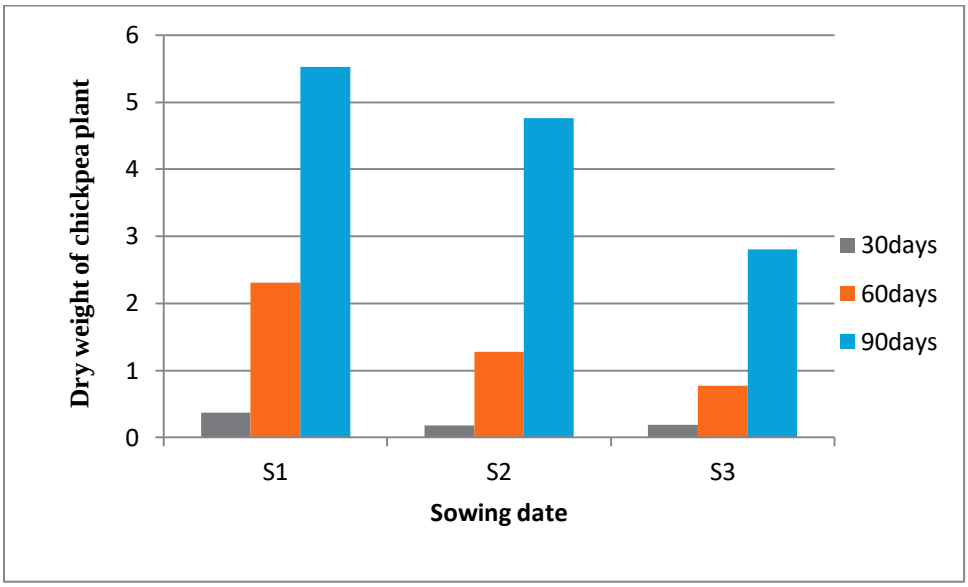


Figure 10: Effect of sowing date on dry weight of chickpea plant at different days after sowing ($LSD_{0.05}$ = 0.05 , 0.15 , 0.29 at 30, 60 and 90 DAS, respectively

Here , S_1= 07 November , S_2=19 November , S_3=02 December

Combined effect of fertilization and sowing date on dry weight of chickpea $plant^{-1}$ were significant at 30, 60 ,90 DAS. The maximum weight was recorded at 30, 60 and 90 DAS (0.45, 2.62, 10.92 g $plant^{-1}$) from the treatment combination F_2S_1, F_3S_1, F_3S_1 respectively and the minimum weight were recorded (0.13, 0.64, 1.89 g $plant^{-1}$) from the treatment combination F_2S_3, F_0S_3, F_0S_3 respectively (Table 5).

Table 5: Interaction effect of fertilization and sowing date on plant dry weight of chickpea plant at different days after sowing

Treatment Combination	Plant dry weight (g)		
	30 DAS	**60 DAS**	**90 DAS**
F_0S_1	0.31 abc	2.04 ab	4.98 bcd
F_1S_1	0.41 ab	2.13 ab	3.35 ef
F_2S_1	0.45 a	2.41 a	2.83 fg
F_3S_1	0.31 abc	2.62 a	10.92 a
F_0S_2	0.24 cd	1.36 cd	5.32 bc
F_1S_2	0.18 cd	1.08 cde	3.82 def
F_2S_2	0.14 d	1.06 cde	5.46 b
F_3S_2	0.16 cd	1.61 bc	4.44 bcde
F_0S_3	0.21 cd	0.64 e	1.89 g
F_1S_3	0.27 bcd	0.89 de	2.61 fg
F_2S_3	0.13 d	0.69 e	4.11 cde
F_3S_3	0.16 cd	0.87 de	2.59 fg
$LSD_{(0.05)}$	0.08	0.30	0.58
CV%	40.12	25.54	16.29

In a column means with same letter (s) are not significantly different by LSD at 5% level of significance

Here F_0= To control (No fertilizer) ,F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) , F_2=Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) F_3= Recommended dose of fertilizer + vermicompost (2.5 ton ha^{-1})

S_1= 07 November , S_2=19 November , S_3=02 December

Application of vermicompost and recommended dose fertilizer help the growth of plant than single application of fertilizer. Chaudhari *et al*. (1998) found a constructive outcome of nitrogen at the rate of 20 and 40 kg ha^{-1} on increasing in chickpea dry weight $plant^{-1}$.

4.6. Days to 80% Flowering and 80% pod formation and pod length

Significant differences were found 80% flowering of chickpea plant due to application of different type of fertilizer (Appendix VIII). The height number of flowering was observed 83.44 DAS from treatment F_0 To control (No fertilizer) which is statistically similar to 82.67 DAS from treatment F_1=Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) . The lowest number of flowering was observed 81.78 due to treatment F_3 Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1}) which is statistically identical to 81.88 from treatment F_2 Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) (Table 6).

Due to different sowing date difference is also found in flowering (Appendix VIII). Highest number of flowering was observed 83.91 from S_2 sowing and lowest 81.33 from S_1 sowing which is statistically similar with 82.08 from S_3 sowing .(Table 6). Significant differences were found at 80% pod formation of chickpea plant due to application of different type of fertilizers (Appendix VIII) .Highest value is found 91.66 for the treatment F_0 (No fertilizer) and lowest value is found 90.11 for the treatment F_3 (Recommended dose of fertilizer +vermicompost(2.5 ton ha^{-1}).
(Table 6).

Different sowing date also show Significant differences on pod formation(Appendix VIII) . Highest value is observed 92.00 for S_1 sowing and lowest value is found 89.17 for S_3 sowing . (Table 6)

Also significant difference were observed on pod length at harvesting stage due to application of different level of manure and fertilizer (Appendix VIII). The highest pod length was found 1.52 cm for treatment F_2 (Recommended dose of fertilizer + cow dung 3 ton ha^{-1}) which is statistically similar to 1.51 cm F_0 (No fertilizer). The lowest pod length was observed 1.45cm for both treatment F_2 (Recommended dose of fertilizer + cow dung 3 ton ha^{-1}) and F_3 (Recommended dose of fertilizer + vermicompost 2.5 ton ha^{-1}).(Table 6)

Due to the different sowing date different significant variation was observed on pod length. The highest length (1.56 cm) was found for S_1 owing and lowest length was found (1.41 cm) for S_2 sowing which is statistically identical with 1.47 for S_3 sowing . (Table 6).

Table 6: Effect of fertilization and sowing date on 80% flowering ,80% pod formation and pod length of chickpea plant

Fertilization	**DAS to 80% flowering**	**DAS to 80% pod formation**	**Pod length**
F_0	83.444 a	91.667 a	1.5056 ab
F_1	82.667 ab	91.222 ab	1.5200 a
F_2	81.889 b	91.000 ab	1.4567 b
F_3	81.778 b	90.111 b	1.4567 b
LSD (0.05)	0.43	0.51	0.02
CV%	1.12	1.20	3.49
Sowing date	**DAS to 80% flowering**	**DAS to 80% pod formation**	**Pod length**
S1	81.33 b	92.000 a	1.5625 a
S2	83.917 a	91.833 a	1.4133 b
S3	82.083 b	89.167 b	1.4783 b
LSD (0.05)	0.37	0.32	0.04
CV%	1.11	0.85	5.92

In a column means with same letter (s) are not significantly different by LSD at 5% level of significance

Here F_0= No fertilizer (No fertilizer) ,F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) ,F_2=

Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) , F_3= Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1})

S_1= 07 November , S_2=19 November , S_3=02 December

Combined utilization of various dimensions of fertilizer and sowing date shows significant differences on 80% flowering . 80% pod formation and pod length.

Here the highest value is found for flowering 84.66 from treatment combination F_0S_2 and the lowest value is found 80.33 from treatment combination F_3S_1 and there is no significant difference was observed.(Table 7)

Significant differences were observed due to Combined utilization of various levels of fertilizer and sowing date on pod formation . The highest days to pod formation was found 93.33 for the treatment combination F_0S_1, which is statistically similar with treatment combination F_1S_1, F_0S_2, F_1S_2, F_2S_2. The lowest days to pod formation was observed 88.66 from treatment combination F_3S_3, which is statistically similar with F_0S_3, F_1S_3, F_2S_3. (Table 7).

Significant differences were observed due to combined utilization of various dimensions of fertilizer and sowing date on pod length at harvesting stage . The highest pod length was found 1.64 from treatment combination F_1S_1 , which is statistically similar with treatment combination F_0S_1 , F_3S_1 ,F_0S_3 and the lowest length was found 1.36 from treatment F_3S_2 ,which is statistically similar with treatment combination F_2S_1, F_0S_2, F_1S_2, F_2S_2, F_1S_3, F_3S_3. (Table 7).

Table 7 : Interaction effect of fertilization and sowing date on 80% flowering , 80% pod formation and pod length of chickpea plant

Treatment	DAS to 80% flowering	DAS to 80% pod formation	Pod length
F_0S_1	82.66	93.33 a	1.53 abcd
F_1S_1	81.66	92.33 abc	1.64 a
F_2S_1	80.66	91.33 bcd	1.486 bcde
F_3S_1	80.33	91.00 cde	1.58 abc
F_0S_2	84.66	92.00 abcd	1.38 de
F_1S_2	84.33	92.00 abcd	1.46 bcde
F_2S_2	83.33	92.66 ab	1.44 de
F_3S_2	83.33	90.66 def	1.36 e
F_0S_3	83.00	89.66 efg	1.59 ab
F_1S_3	82.00	89.33 fg	1.45 cde
F_2S_3	81.66	89.00 g	1.44 de
F_3S_3	81.66	88.66 g	1.42 de
LSD (0.05)	0.74	0.63	0.07
CV%	1.11	0.85	5.92

In a column means with same letter (s) are not significantly different by LSD at 5% level of significance

Here F_0= No fertilizer (No fertilizer) ,F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) ,F_2= Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) , F_3= Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1})

S_1= 07 November, S_2=19 November , S_3=02 December

4.7 Number of pods $plant^{-1}$, seed pod^{-1}, and 100 seed weight

Significant differences were observed due to utilization of various dimensions of fertilizer and sowing date on number of pod $plant^{-1}$ at harvesting stage . The highest number is found 70.00 for treatment F_3 (Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1}) on the other hand lowest number is found 48.48 for treatment F_0(No fertilizer). And there is no statistically similar value.(Table 8)

Significant dissimilarity was also noticed due to different sowing date on number of pod $plant^{-1}$ at harvesting stage. The highest value was found 86.03 for S_2 sowing . And lowest value was found 36.71 for S_3 sowing . (Table 8)

Significant dissimilarity was noticed due to different sowing date on number of seed pod^{-1} at harvesting stage. Highest value was found 1.50 for S_3 sowing which is statistically similar with 1.33 for S_1 sowing . Lowest value was observed 1.25 for S_2 sowing which is statistically similar with 1.33 for S_1 sowing (Table 8) .

Significant differences were observed due to utilization of various level of fertilizer , manure and sowing date on 100 seed weight at harvesting stage (Appendix IX).

Highest value was found 13.47 for treatment F_1(Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) which is statistically similar with F_2(Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) F_3(Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1}) lowest value was observed 12.32 for treatment F_0(No fertilizer) which is statistically similar with F_2(Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) F_3(Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1}). (Table 8)

There is no Significant differences due to different level of sowing date on 100 seed weight . the highest value was observed 13.26 for S_1 sowing and lowest value was 12.45 for S_3 sowing . Both are statistically similar with S_2 sowing . (Table 8) .

Table 8: Effect of fertilization and sowing date on no of pod plant^{-1}, seeds pod^{-1}, 100 seed weight

Fertilization	**Number of pod plant^{-1}**	**Number of seed pod^{-1}**	**100 seed weight**
F_0	48.48 c	1.406 a	12.32 b
F_1	56.20 b	1.482 a	13.47 a
F_2	57.92 b	1.258 a	12.74 ab
F_3	70.00 a	1.293 a	12.94 ab
LSD (0.05)	1.22	0.15	0.39
CV%	4.47	24.03	6.49
Sowing date	**Number of pod plant^{-1}**	**Number of seed pod^{-1}**	**100 seed weight**
S1	51.71 b	1.33 ab	13.26 a
S2	86.03 a	1.248 b	12.89 a
S3	36.706 c	1.50 a	12.45 a
LSD (0.05)	1.03	0.08	0.42
CV%	4.35	14.77	8.12

In a column means with same letter (s) are not significantly different by LSD at 5% level of significance

Here F_0= No fertilizer (No fertilizer) ,F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) ,F_2= Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) , F_3= Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1})

S_1= 07 November, S_2=19 November , S_3=02 December

Significant differences were found because of the utilization of various dimensions of manure and inorganic fertilizer and sowing date on no of pod plant^{-1}, seed pod^{-1} and 100 seed Weight of chickpea plant at harvesting stage. The highest number of pod plant^{-1} was found 114.60 for the treatment combination F_3S_2 and there is no statistical similar value and lowest number of pod plant^{-1} was found 23.11 for the treatment combination F_1S_3 which is statically similar with 26.0 for the treatment combination F_0S_1. The highest number of seed pod^{-1} was found 1.55 which is statistically similar with all treatment combination and the lowest value was found 1.22. The maximum value of 100 seed weight was observed 14.79 for treatment combination F_3S_1 which is statistically similar with F_1S_1, F_0S_2, F_1S_2, F_2S_2 . The minimum value was observed 11.35 for treatment F_3S_2 which is statistically similar with F_0S_1 , F_1S_1 ,F_2S_1 ,F_2S_2 ,F_0S_3 ,F_3S_3 ,F_2S_3 ,F_1S_3. (Table 9)

Table 9: Interaction effect of fertilization and sowing date on no of pod plant^{-1}, seed pod^{-1} and 1000 seed Weight

Treatment Combination	Number of pod plant^{-1}	Number of seed pod^{-1}	100 seed weight
F_0S_1	26.0 f	1.44	12.37 bc
F_1S_1	69.42 c	1.44	13.05 abc
F_2S_1	55.78 d	1.11	12.56 bc
F_3S_1	55.66 d	1.33	14.79 a
F_0S_2	77.56 b	1.22	13.05 abc
F_1S_2	76.08 b	1.44	14.08 ab
F_2S_2	75.92 b	1.55	13.07 abc
F_3S_2	114.60 a	1.55	11.35 c
F_0S_3	41.89 e	1.55	11.54 c
F_1S_3	23.11 f	1.55	12.99 bc
F_2S_3	42.08 e	1.55	12.58 bc
F_3S_3	39.74 e	1.33	12.68 bc
LSD (0.05)	2.06	0.16	0.85
CV%	4.35	14.77	8.12

In a column means with same letter (s) are not significantly different by LSD at 5% level of significance

Here F_0= No fertilizer (No fertilizer) ,F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) ,F_2= Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) , F_3= Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1})

S_1= 07 November , S_2=19 November , S_3=02 December

Combination of vermicompost and inorganic fertilizer expanded the quantity of seed per plant . This might be on the grounds that mix of compost and inorganic manure improves soil physical properties which gives wellbeing and positive soil condition to upgrade supplement use productivity. comparative outcome were accounted for by Channaveerswami (2005) in mungbean and ground nut . Patra and Padhi (1989) noticed in chickpea increased number of seeds pod-1 over control with 20 kg N along with 40 kg P ha^{-1}.

4.8 Stover yield, Seed yield (t ha^{-1}), Biological yield and Harvest index

Significant differences were observed due to utilization of various dimensions of fertilizer and sowing date on Stover yield , Seed yield (t/ha) ,biological yield & harvest index of chickpea at harvesting stage. (Appendix IX).

Due to application of different level of manure and inorganic fertilizer Significant differences were observed on Stover yield .The highest value was found 1.40 from treatment F_3 (Recommended dose of fertilizer + vermicompost 2.5 ton ha^{-1}) and

lowest value was found 0.89 from treatment F_2(Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) which is statistically similar with treatment F_1 Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}). (table 10)

Incase of Seed yield (t/ha) maximum value was found 1.71 from treatment F_3 Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1}) and the lowest value was 0.34 from the treatment F_0 (No fertilizer). (table 10)

Significance variation was also observed on biological yield due to different level of fertilizer. The highest value was found 3.11 from treatment F_3 (Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1}) and the lowest value was found 1.65 from treatment F_1(Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}). (table 10)

Incase of harvest index Significance variation was also observed due to different level of fertilizer. The highest value was found 54.13 from treatment F_2 Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) which is statistically similar with F_3 (Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1}) and the lowest value was found 38.89 from treatment F_0 (No fertilizer) which is statistically similar with F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}). (table 10)

Due to different sowing date Significance variation was seen on Stover yield , Seed yield (t/ha) ,biological yield & harvest index of chickpea at harvesting stage. (table 10)

The highest value of Stover yield was observed 1.43 from S_2 sowing and lowest value 0.76 from S_3 sowing . Incase of Seed yield (t/ha) highest value was observed 1.32 from S_2 sowing and the lowest value 1.37 from S_3 sowing . For biological yield highest value was observed 3.02 from S_2 sowing and the lowest value 1.37 from S_3 sowing . And incase of harvest index maximum value was found 49.34 from S_2 sowing which is statistically similar with S_1 sowing and S_3 sowing . (Table 10).

Table 10: Effect of fertilization and sowing date on Stover yield , biological yield & harvest index of chickpea

Fertilization	Stover yield (t ha^{-1})	Seed yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
F_0	0.95 b	0.34 d	1.86 c	38.89 b
F_1	0.92 c	0.75 c	1.65 d	43.56 b
F_2	0.89 c	1.15 b	2.09 b	54.13 a
F_3	1.40 a	1.71 a	3.11 a	53.52 a
LSD (0.05)	3.61	0.04	0.07	2.50
CV%	3.01	3.68	7.11	11.17
Sowing date	**Stover yield (t ha^{-1})**	**Seed yield (t ha^{-1})**	**Biological yield (t ha^{-1})**	**Harvest index (%)**
S1	0.96 b	1.11 b	2.15 b	48.54 a
S2	1.43 a	1.32 a	3.017 a	49.34a
S3	0.76 c	0.53 c	1.378 c	44.72 a
LSD (0.05)	2.90	0.04	0.07	2.59
CV%	3.23	4.27	8.49	13.37

In a column means with same letter (s) are not significantly different by LSD at 5% level of significance

Here F_0= No fertilizer (No fertilizer) ,F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) ,F_2= Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) , F_3= Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1})

S_1= 07 November , S_2=19 November , S_3=02 December

Significant differences were found because of the combined utilization of various levels of manure and inorganic fertilizer and sowing date on stover yield , Seed yield (t/ha) , biological yield & harvest index of chickpea at harvesting stage.(Table 11).

For Stover yield highest value was found 1.82 from the treatment combination F_0S_2 and the lowest value 0.48 form the treatment combination F_0S_1. Incase of seed yield (t ha^{-1}) highest value was found 2.54 form treatment combination F_3S_2 and lowest value 0.25 from treatment combination F_0S_1 which is statistically similar with treatment combination F_0S_3 , F_1S_3. Maximum value for biological yield was seen 4.27 from treatment combination F_3S_2 and minimum value 0.82 from treatment combination F_1S_3 which is statistically similar with treatment combinationF_0S_3 F_0S_1. And incase of harvest index of chickpea at harvesting stage maximum value was found 65.14 from treatment combination F_2S_1 which is statistically similar with treatment combination F_2S_2 , F_3S_2 . (Table 11).

Table 11: Interaction effect of fertilization and sowing date on stover yield, biological yield & harvest index of chickpea

Treatment Combination	Stover yield (t/ha)	Seed yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
F_0S_1	0.48 h	0.25 g	1.06 g	27.25 f
F_1S_1	0.82 e	0.84 e	1.63 ef	49.77 bcd
F_2S_1	0.83 e	1.55 c	2.38 c	65.14 a
F_3S_1	1.7 b	1.83 b	3.54 b	51.98 bc
F_0S_2	1.82 a	0.51 f	3.33 b	35.32 ef
F_1S_2	1.32 c	1.12 d	2.44 c	45.79 cde
F_2S_2	0.73 f	1.32 d	2.02 d	56.53 abc
F_3S_2	1.72 b	2.54 a	4.27 a	59.67 ab
F_0S_3	0.55 g	0.28 g	1.97 g	54.12 bc
F_1S_3	0.57 g	0.31 g	0.82 g	35.14 ef
F_2S_3	1.12 d	0.76 e	1.89 de	40.70 de
F_3S_3	0.78 ef	0.74 e	1.53 f	48.9 bcd
LSD (0.05)	5.94	0.07	0.15	5.18
CV%	3.23	4.27	8.49	13.37

In a column means with same letter (s) are not significantly different by LSD at 5% level of significance

Here F_0= No fertilizer (No fertilizer) ,F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}) ,F_2= Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) , F_3= Recommended dose of fertilizer + vermicompost(2.5 ton ha^{-1})

S_1= 07 November , S_2=19 November , S_3=02 December

Vermicompost and inorganic manure increase the seed yield(t ha^{-1}) . This might be on the grounds that manure are known to content plant supplement , development advancing substances and benificial microflora which in blend with inorganic fertilizer give positive soil condition to upgrade supplement use proficiency. Channaveerswami (2005) found that application of combination of vermicompost @ 2.5 t per ha + (25:50:50 kg NPK per ha) + copper ore tailing recorded higher plant height (43.94 cm), number of branches (6.92) and minimum number of days to 50% flowering (35.15) , number of matured pod (17.06) , pod yield (3337 kh per ha) and kernel yield (2362 kg per ha) , 100 seed weight (35.26 g). Pawar et al. (1995) applied vermicompost @ 2.50 t per ha along with 100% RDF recorded significantly higher seed yield (74.80 q per ha).

CHAPTER V

Summary and conclusion

A study on "Effect of integrated fertilizer management and sowing date on growth and yield of chickpea" was conducted at the Agronomy field of Sher-e-Bangla agricultural University, Dhaka-1207 during November, 2017 to April, 2018.

The experiment was laid out in split plot design with three replications having fertilization in the main plot and sowing date in the sub plot. The individual plot size was 2.4m×1.25m. There were 12 treatment combinations and the total number of plots were 36. The experiment consists of two factors. In factor A , the treatments are four , they are F_0=To control (No fertilizer) , F_1= Recommended dose of fertilizer (45kg urea ha^{-1} + 85 kg TSP ha^{-1} + 35 kg MP ha^{-1}+ 12 kg boric acid ha^{-1}), F_2= Recommended dose of fertilizer + cow dung (3 ton ha^{-1}) , F_3= Recommended dose of fertilizer + vermicompost (2.5 ton ha^{-1}). In factor B there are three treatments and they are S_1= 07 November, S_2= 19 November , S_3= 02 December . Experimental data were recorded from 30(DAS) and continued until harvest at an interval of 30 days.

Data on different parameters yield and yield contributing characters were recorded and variation was observed. Results indicated that the maximum height of plant 13.70 cm from treatment F_2 and 30.32cm ,48.14 cm from F_3 treatment at 30, 60,and 90 DAS respectively and shortest plant was recorded (13.16, 24.93 ,41.51 cm) at 30, 60, 90 DAS respectively from treatment F_0. The tallest plant was recorded (15.18, 31.27, 50.52cm) respectively from S_1 sowing . On the other hand shortest plant was found (12.16, 23.16, 40.40 cm) respectively from S_3 sowing . For treatment combination the tallest plant was recorded 15.93 cm from F_2S_1 and 41.13cm from F_3S_1 and 56.30 cm from F_2S_1 at 30, 60, and 90 DAS respectively and the smallest plant height was found (10.85 , 21.30, 36.02 cm) at 30, 60 , 90 DAS respectively from treatment F_0S_3.

The most elevated number of branches were discovered 5.97 ,27.32 and 39.87 from treatment F_3 treatment at 30, 60,and 90 DAS separately. The most reduced number of branches were watched 4.63 from treatment F_2 and 13.44, 20.94 from treatment F_0 at 30, 60, 90 DAS separately. The highest number of branches were found 5.55 at 30 DAS from S_2 sowing and 30.88 39.58 at 60 and 90 DAS respectively from S_1 sowing . The lowest number of branches were recorded 4.75 and 21.51 at 30, 90 DAS respectively from S_3 sowing and 11.46 at 60 DAS from S_2 sowing . The most noteworthy number of branches were discovered 6.55 from treatment F_2S_1 at 30 DAS and altogether comparative outcome was seen from F_0S_1 .At 60 and 90 DAS the most highest number of branches were determined 50.72, 54.00 individually from treatment F_3S_1 . The most minimal number of branches was discovered 3.96 at 30 DAS from F_1S_3 treatment and at 60 , 90 DAS 6.67, 14.16 individually from F_0S_3 interaction .

The maximum number of leaves plant^{-1} were recorded at 30, 60, 90 DAS (22.95, 99.21, 210.33) from treatment F_0 (To control) , F_3, F_3 respectively. And the lowest number of leaves plant^{-1} were recorded at 30, 60, 90 DAS (18.87, 63.13,172.73) from treatment F_3, F_1 , F_0 (To control) respectively. The maximum number of leaves plant^{-1} were recorded at 30, 60, 90 DAS (24.92, 113.21, 294.05) from S_1 sowing and the lowest number of leaves plant^{-1} were recorded at 30, 60, 90 DAS (17.90, 48.94, 136.86) from S_3 sowing . The highest number of leaves was recorded (34.47, 152.85, 326.11) from the treatment combination F_2S_1, F_3S_1, F_3S_1 respectively . And the minimum number of leaves were recorded (12.47, 44.60, 113.98) from the treatment combination F_2S_3 , F_0S_3 , F_0S_3 respectively.

The greatest fresh weight plant-1 were recorded at 30, 60, 90 DAS (0.95,9.03,22.62) from treatment F_0 (To control) , F_2 , F_1 respectively . What's more, the most minimal fresh weight plant-1 were recorded at 30, 60, 90 DAS (0.77, 6.65, 18.31) from treatment F_1, and F_0 (To control) respectively. The maximum fresh weight plant^{-1} were recorded at 30, 60, 90 DAS (1.08, 12.20, 28.11) from S_1 sowing and the lowest fresh weight plant^{-1} were recorded at 30, 60, 90 DAS (0.63, 3.10, 14.55) from S_3 sowing . The maximum weight was recorded at 30. 60 and 90 DAS (1.27, 13.09, 38.33) from the treatment combination F_1S_1, F_2S_1, F_1S_1 respectively . And the minimum weight were recorded (0.42, 2.43, 10.99) from the treatment combination F_1S_3, F_3S_3, F_0S_3 respectively .

The maximum weight were discovered at 30, 60 and 90 DAS (0.28, 1.70, 5.98) from treatment F_1, F_3 , F_3 respectively . The most reduced weight were watched (0.21, 1.35, 3.26) from treatment F_3 , F_0 , F_1 respectively . The maximum dry weight plant^{-1} were recorded at 30, 60, 90 DAS (0.37, 2.30, 5.52) from S_1 sowing . And the lowest dry weight plant^{-1} were recorded at 30, 60, 90 DAS (0.18, 0.77, 2.80) from S_3 sowing . The maximum weight was recorded at 30. 60 and 90 DAS (0.45, 2.62, 10.92) from the treatment combination F_2S_1, F_3S_1, F_3S_1 respectively . And the minimum weight were recorded (0.13, 0.64, 1.89) from the treatment combination F_2S_3, F_0S_3, F_0S_3 , respectively.

The highest number is found on number of pod plant^{-1} at harvesting stage 70.00 for treatment F_3 on the other hand lowest number is found 48.48 for treatment F_0. The highest value was found 86.03 for S_2 sowing and lowest value was found 36.71 for S_3 sowing .

Highest value of 1000 seed weight was found 13.47 for fertilization F_1. Lowest value was observed 12.32 for treatment F_0 which is statistically similar with F_2. The highest value was observed 13.26 for S_1 sowing and lowest value was 12.45 for S_3 sowing . Both are statistically similar with S_2 sowing .

The highest number of pod plant^{-1} was found 114.60 for the treatment combination F_3S_2. The lowest number of pod plant^{-1} was found 23.11 for the treatment combination F_1S_3. The maximum value of 1000 seed weight was observed 14.79 for treatment combination F_3S_1. The minimum value was observed 11.35 for treatment F_3S_2.

The maximum Seed yield(1.71 t ha^{-1}) from fertilization F_3 and the lowest value was (0.34 t ha^{-1})from the treatment F_0 .

The highest value of HI% was found 54.13% from treatment F_2 and the lowest value

was found 38.89% from treatment F_0 .
Incase of Seed yield highest value was observed (1.32 t ha^{-1})from S_2 sowing and the lowest value (1.37 t ha^{-1}) from S_3 sowing .
Harvest index maximum value was found 49.34 from S_2 sowing which is statistically similar with S_1 and S_3 sowing .

From the results of present study it can be concluded that manure influenced individual plant with vigorous growth consequently produced maximum yield contributing characters and S_2 sowing date is more preferable for chickpea production.

Recommendation

Considering the situation of the present experiment, further studies in the following areas may be suggested:

- Such study needs to be conducted under different agro ecological zones.
- Such study can be conducted on other varieties of chickpea.

References

Abbasi, A., Jafari, D. and Sharifi. R. S. (2013). Nitrogen rates effects and seed inoculation with *Rhizobium legominosarum* and plant growth promoting rhizobacteria (PGPR) on yield and total dry matter of chickpea *(Cicer arietinum L.). Tec. J. Eng. Appl. Sci.*. **3**(23): 3275-3280.

Ahmed M. A., Badr, E .A. (2009). Effect of bio and mineral phosphorus fertilizer on the growth, productivity and nutritional value of some chickpea cultivars (*Cicer arietinum* L.) in newly cultivated land. *Austr. J. Basic Appl*. Sci. **3**:4656-4664.

Akhtar, M., M. Nazir , R. Hussain ,Yasin, M.S. and. (1984). Effect of phosphorus and potash application on the yield of mung bean (*Phaseolus aureus*) planted on different dates. *J. Agric.Res*. **22**: 321-325.

Akiolona , J.O., and Whiteman, P.C. (1975). Agronomic studies on pigeon pea (*Cajanaus cajan* L. Mllsp.) field response to sowing time . *Australian Journal of Agricultural Research* . **26**(1) :43-56.

Ali, M. A., Abbas ,G., Mohy-ud-Din Q., Ullah ,K Abbas , G. and Aslam, M. (2010). Response of Mungbean (Vigna Radiata) to phosphatic fertilizer under arid climate. *J. Anim. Plant Sci*., **20** (2): 83-86.

Ali, A., Malik, M. A. , Ahmad , R. and Atif , T.S. (1996). Response of mungbean to potassium fertilizer. *Pakistan J. Agric. Sci*.**33** (1-4): 44-45.

Aliloo, A. A. Khorsandy, H. Mustafavi, S. H. (2012). Response of chickpea *(Cicer arietinum*L.*)* cultivars to nitrogen applications at vegetative and reproductive stages. *Cereal Agron. Moidova.* **45**(4): 49-59.

Arif, M., Arshad, M., Khalid, A. and Hannan, A. (2008). Differential response of rice genotypes at deficit and adequate potassium regimes under controlled conditions. Soil and Environ. **27**(1) 52-57.

Arya, R. L., Kushwaha, B .L ., Singh, B .N. (2002). Effect of phosphorus management on growth, yield attributes and yield of maize-chickpea cropping system. *Indian J. Pulse Res*. **15**:161-165.

Arya, M.P.S and Kalara. G.S. (1988). Effect of phosphorus doses on the growth, yield and quality of summer mung and soil nitrogen. *Ind. J. Agri. Res*. **3**:23-30.

Asghar, M. Malik, M. Farrukh, S., Asghar, A. and Ijaz, M. (2003). Effect of nitrogen and phosphorus application on growth yield and quality of mungbean (*Vigna radiata* L.) *Pak. J. Agri. Sci.* **40**(3-4).

Baboo, R. and Mishra, S .K. (2001).Growth and pod production of cowpea (*Vigna sinensis*) as affected by inoculation, nitrogen & phosphorus. *Ann. Agric. Res.* **22**:104-106.

BBS (Bangladesh Bureau of Statistics). (2010). Statistical Year Book of Bangladesh. Bangladesh Bureau of statistics, Ministry of Planning, Govt. People's Republic of Bangladesh.

BBS (Bangladesh Bureau of Statistics) . (2012). Statistical Year Book of Bangladesh. Ministry of Planning, Govt. People's Republic of Bangladesh.P.145.

Bharti, N., Murtaza, M. and Singh, A. P. (2002). Effect of boron Rhizobium relationship on yield, nitrogen and boron nutrition of chickpea. *J. Res. Birsa Agric. Univ*. **14**(2), 175-179.

Bhattarai, S. (2003). Quality compost production with vermicompost from the farm and household waste. In: Proceedings international conference on woman, science and technology for poverty alleviation, 31 March to 2 April 2003, Katmandu, Nepal.

Bhuiyan, M. A. H., Khanam, D. Khatun, M. R. and Hassan, M. S. (1998). Effect of molybdenum, boron and Rhizobium on nodulation, growth and yield of chickpea Bull. *Inst. Trop. Agric.* 21, 1-7.

Channaveerswami , A. S . (2005). Studies on integrated nutrient management and planting methods on seed yield and quality of ground nut . Ph.D. thesis ,Univ. Agric . Sci. Dharwad , Karnataka (India).

Chaudhari, R. K.. Patel, T. D., Patel, J. B. and Patel R. H. (1998). Response of chickpea cultivars to irrigation, nitrogen and phosphorus on sandy loam soil. *Intl Chickpea Newsl.* **5**: 24-26.

Choudhary, V .K. , Goswami ,V .K. (2005). Effect of phosphorus and sulphur fertilization on chickpea (*Cicer arietinum* L.) cultivar. *Ann. Agric. Res.* **26**:322-325.

Dahiya, S. S., Singh, M. and Singh. M. (1993). Relative growth performance of chickpea genotypes to irrigation and fertilizers application. *Haryana .J. Agron.*, **9**(2): 172-175.

Devi, U. and Singh, K.P. (2005). Integrated nutrient management in chickpea (*Cicer arietinum* L.). *Haryana J . Agron.*,21-74.

Edris. K. M., Islam , A. T. M. F., Chowdhury. M. S. and Haque. A. K. M. (1979). Detailed Soil Survey of Bangladesh Agricultural Uinivcrsity Farm. Mymensingh. Dept. Soil Survey, Govt.Peoples Republic of Bangladesh.118p.

Eilitta, M . Mureithi, J .and Derpsch, R. (2000). Green Manure Cover Crops Systems of Smallholder Farmers. Kluwer Academic Publishers. London.

El-Awady, R.M., Gendy ,E. N. and Montaser, S.Y. (1993). Effect of phosphate and Zinc application on lentil plants and somechemical compositions ofalluvial soils. *Egyptian J. of A gric. Res.* **71**(4): 873-882.

Gitari , J. N., Mureithi ,J .G . (2003). Effect of phosphorus fertilization on legume nodule formation and biomass production in Mount Kenya Region. *East AfrAgric For J.***69**: 183–187.

Goldani, M. (1997). Assessment of possibility of chick pea fall planting in Mashhad. M.S. Thesis. Agriculture College. Ferdowsi university of Mashhad. Mashhad. Iran.

Hakoomat , A ,Muhammad , A. k. and Shakeel ,A .R. .(2004). Interactive effect ofseed inoculation and phosphorus application on growth and yield of chickpea (*Cicer arietinum* L.). *International Journal of Agriculture & Biology*.

Humayun, M. Khan , S. A., Khan , A. L. ,Shinwari, Z. K. Nadim, A. and Lee, I. , (2011). Effect of foliar and soil application of nitrogen, phosphorus and potassium on yield components of lentil. *Pak. J. Bot.,* **43**(1): 391-396.

Hussain, A. (1983). Isolation and identification of effective root nodule bacteria for important grain legumes of Pakistan. Project Report. Dept. of Science Soil, University of Agric. Faisalabad.pp. 73.

Hussain, F. Malik, A. Haji ,U. M. A. and Malghani ,A. L. (2011). Growth and yield response of two cultivars of mungbean (*vigna Radiata* l.) To different potassium levels. The Journal of Anim & Plant Sci. **21**(3): Page: 622-625.

Hussain, T. A. (1994). Effect of NPK application on the growth and yield of mungbean (*Vigna radiata* L.). Agron., **37**(3): 549-551.

Islam, B. (2005). Requirement of boron for mustard, wheat and chickpea based cropping pattern. Unpublished [Ph.D. Thesis], Department of Soil Science, Bangladesh Agricultural University, Mymensingh. 124 pp.

Jaleel, A., Manivannan, C. P., Shankar, B., Kishorikumar, A., Gopi, R., Somasundaram, R. and Panneerselvam, R. (2007). *Pseudomonas fluorescens* enhances biomass yield and ajmalicine production in *Catharanthus roseus* and under water deficit stress. Colloids and surface B: *Bioninter faces,* **60**: 7-11. .

Jarande, N . N, Mankar, P .S. , Khawale, V . S. , Kanase, A . A. Mendhe, J. T . (2006). Response of chickpea (Cicer arietinum L.) to different levels of phosphorus through inorganic and organic sources. *J. Soils Crops* **16**:240-243.

Karmegam , N. and Daniel , T. (2000) . Effect of biodigested slurry and vermicompost on the growth and yield of cowpea(*vigna unguiculata).* Environ. Ecology. **18**(2):367-370.

Karadavut, U. and Ozdemir, S. (2001). Effect of *Rhizobium* inoculation and nitrogen application on yield and yield characters of chickpea. *Tuna Bit Idler! Bolumu.* **11**(1): 14-22.

Keyvan Shamsi. (2010). The effect of sowing date and row spacing on yield and yield components on Hashem chickpea variety under rainfed condition African Journal of Biotechno. **9** (1). 007-011.

Khan, H., Haqqani, A. M., Khan, M. A. and Malik, B. A. (1992). Biological and Chemical fertilizer studies in chickpea grown under and conditions of Thai (Pakistan). *Sarhadi. Ar/c.,* **8**(3): 32 1-327.

Khoja, J .R., Khangarot, S .S. , Gupta, A .K. , Kulhari, A .K. (2002). Effect of fertility and biofertilizer on growth and yield of chickpea. *Ann. Plant Soil Res.* **4**:357-358.

Krishnareddy, S.V. and Ahlawate, I. P .S. (1996). Growth and yield response of lentil cultivars to phosphorus. Zinc and bio-fertilizers. -59. *J of Agric. Crop. Sci.,* **177**(1): 49.

Kumar, V, Dwivedi ,V . N. , Tiwari, D. D. (2009). Effect of phosphorus and iron onyield and mineral nutrition in chickpea. *Ann. Plant Soil Res*.**11**:16- 18.

Kushwaha, V. S. (2007). Response of chickpea to biofertilizer, nitrogen, phosphorus fertilization under rainfed environment. *J. Food legumes*. **16**:179-181.

Mitra, S., Rhattacharya, S. K. Datta M. and Banik, S.. (1999). Effect of variety, rock phosphate and phosphate solubilizing bacteria on growth and yield of green gram in acid soils of Tripura. *Environ Econ.* **17**: 926-930.

Meena ,L. R. , Singh , R .K. , Gautam, R. C. (2001). Effect of conserved soil moisture, phosphorus levels and bacterial inoculation on dry matter production and uptake pattern of phosphorus by chickpea. *Indian J. Pulse Res.* **18:**32-35.

Meena, L .R. , Singh, R. K. , Gautam, R. C. (2002). Effect of moisture conservation practices, phosphorus levels and bacterial inoculation on chickpea under rainfed condition. *Indian J. Agron.* **47:**398-404.

Meena ,L .R ., Singh, R. K. , Gautam, R. C. (2004). Response of chickpea (*Cicer arietinum* L.) to moisture conservation practices, phosphorus levels and bacterial inoculation under rainfed condition. Indian J. Trop. Agric. **22**:49- 60.

Meena ,K. N., Pareek, R. G., Jat , R. S. (2005). Effect of phosphorus and biofertilizers on yield and quality of chickpea. Ann. Agric. Res. New Series. **22**:388-390.

MoA (Ministry of Agriculture). (2006). Hand Book of Agricultural Statistics. Ministry of Agriculture, Govt. People's Repub of Bangladesh.

Mukesh, K. (2006). Impact of the starter doses of nitrogen on nodulation, yield andyield attributes of chickpea under irrigated conditions. *Intl. J. Ag/i. Sci.*, **2**(1): 253-255.

Namvar. A., Sharili. R. S., Khandan. T. and Moghadam, M. J. (2013). Seed inoculation and inorganic nitrogen fertiIition effects on some physiological and agronomical traits of chickpea *(Cicer arietinwn L,)*in irngated condition..1 *Central European Agric.*, **14**(3): 2840.

Okaz, A. M .A., E. A. E-Ghareib, W. Kadry, A.Y. Negm and F.A.F. Zahran, (1994). Response of lentil plants to potassium and phosphorus applicationin newly reclaimed sandy soils. Proc. 6th Conf. Agron., Al-Azhar Univ., Cairo, Egypt, Sept. 1994 II: 753-771.

Patel, R.S., and Patel, Z.G. (1991). Effect of FYM, N, P and *Rhizobium* inoculationon the growth and yield of gram (*Cicer arietinum*). *Ann. Agric* . *Res.* **12** (2) : 200-202.

Patel, R.S. and Z.G. Patel, (1991). Effect of farmyard manure, nitrogen, phosphorusand *Rhizobium* inoculation on the growth and yield of gram (*Cicer arietinum* L.). *Ann. Agri. Res.*, **12**: 200–02.

Patil,S.V. and Halikatti,S.I. Hiremath,S.M. Babalad,H.B. Sreenivasa,M.N. Hebs ur,N.S. and Somanagouda , G. (2012). *Effect of organics on growth and yield of chickpea (Cicer arietinum L.) in vertisols. Karnataka Journalof Agricultural Sciences,* **25** (3). pp. 326-331.

Patra, S. K. and Padhi, A. K. (1989). Response of rice to sources, methods and levels of N. *IntL Rice Res. News!.*. 14(6): 20-27.

Pawar ,R . B, Patil, C.V, Prakash , S.S and Yeledhalli, N.A. (1995). Dynamics of earthworm soil-plant relationship in semiarid tropics . In :Abstracts : seminar on conservation of Natural resourses for sustainable Production,16-17. November 1995. Univ. Agric . Sci., Dharwad , Karnataka .pp.37

Pramanik K, Singh RK (2003). Effect of levels and mode of phosphorus and biofertilizers on chickpea under dryland conditions. *Indian J. Agron.* **48**:294-296.

Rajkhowa , D.J., Saikiara , M. and Rajkhowa K.M. (2002) . effect of vermicompost with and without fertilizer on Greengram. Legume Res.25(4):295-296.

Ram, S. N., Dixit, R. S. (2001). Growth, yield attributing parameters and quality ofsummer green gram as influenced by dates of sowing and phosphorus. *Indian J. Agric. Res.* **35**:275-277.

Rathore, A. L. and Patel, S. L. (1991). Response of Tate sown chickpea to method of sowing, seed rate and fertilizer. *Indian. Agron.* **36**(2): 180-183.

Raut, R.S. and Kohire, O.D. (1991). Phosphorus response in chickpea (*Cicer arietinum* L.) with *Rhizobium* inoculation. *Legume Res.*, **14**: 78–2.

Rawls, W. J. ,Pachepsky, Y. A., Ritchie, J . C ., Sobecki, T. M. and Bloodworth, H. (2003). Crop management factors influencing yield and quality of crop residues. *Field Crops Research* **84**: 57–77.

Robinson, R. G. , (1973). Elemental composition and response to nitrogen of sunflower and corn. **Agron J**. **65**: 318-320.

Rumana Aktar . (2014). Performance of prilled urea and urea super granules in chickpea cultivation.

Saha, A., Mandal, B. K. and Mukhopadyay, P. (1996). Residual effect of boron and molybdenum on the yield of succeeding mungbean in summer. *Indian Agriculturist*. **40**(1), 11-16.

Sanu, K. Bajracharya, and Suresh, K. Rai. (2009). Study on the Effects of Vermicompost on the Nodulation and the Yield of Chickpea. *Nepal Agric. Res. J. Vol. 9.*

Saxena, M.C., and Yadav, D.S. (1975).Some agronomic considerations of pigeonpea and Chickpeas. Proceeding of the international workshop on grain legumes, 13-16 Jan 1975, ICRISAT center, Hyderabad, India: International Crop Research Institute for the Sem Arid Tropics.$P_{p.}$ 31-62.

Saxena, M. C. (1981). Agronomy of lentils. In *Lentils,* 111-129 (Eds C. Webb and G. Hawtin). Slough: Commonwealth Agricultural Bureaux (CAB).

Saxena, M. C, Murinda, M. V.,Turk, M. & Trabulsi, N. (1983). Productivity and water use efficiency of lentils as affected by date of sowing. *LENS Newsletter* . **10** (l):28-29.

Sherman, F. & Todd, J. N. (1938). Cowpea curculio. *South Carolina Experimental Station Annual Report* 51:71-75.

Saxena , N.P. and Sheldrake ,A.R. (1980). Physiology of growth , development andyield of chickpea in India. Pages 89-96 in proceedings of the international workshop on chickpea improvement , 28 Feb- 2 Mar 1979, ICRISAT center , India . Patancheru A.P. 502-324 , India : International crop research institute for the semi arid tropics .

Sekhon, B. S., Sandhu, H. S., Thapar, S., Dhillon, K. S., and Singh, R. (1988). Effect of nitrogen at sowing and post flowering stages on nitrogen assimilation and seed yield of chickpea. Plant Physiology and Biochemistry, 15(1):92-96.

Shil, N. Noor, S. and Hossain , M. (2007). Effect of boron and molybdenum on tield of chickpea. *Journal of Agriculture and Rural Development.* **5**(1): 17-24.

Sivasankar ,A., Reddy , P.R.and Singh, B.G. (1982). Effect of phosphorous on N fixation and dry matter partitioning of legume crops . *Indian Agric* . *Res* . 7(3) : pp.102-105.

Shivakumar, B .S. , Balloli, S. S. , Saraf, C. S. (2004). Effect of sources and levels of phosphorus with and without seed inoculation on the performance of rainfed chickpea. *Ann. Agric. Res.* New Series. **25**:320-326.

Shukla , L. and Tyagi, S. P. (2009). Effect of integrated application of organic manures on soil parameters and growth of mungbean (*Vigna radiata*) *Indian Journal of Agricultural Sciences.* **79** (3): 174–7.

Silimf, S. N. Saxena , M. C. *and* Erskine, V. J. (1991). Effect of sowing date on the growth and yield of lentil in a rainfed mediterranean environment *ExplAgric.*,volume 27, pp. 145-154.

Singh, G, Sekhon, H. S. , Ram, H., Sharma, P. (2010). Effect of farmyard manure, phosphorus and phosphate solubilizing bacteria on nodulation, growth and yield of kabuli chickpea. *J. Food Legumes*. **23**:226-229.

Singh, A, Vaishya, R. D. (2001). Effect of weed management techniques and phosphorus levels on weed infestation and yield of late sown chickpea. Indian J. Pulse Res. **14**:119-121.

Srinivasarao, C., Masood, A. Ganeshamurthy, A. N. and Singh, K . K.(2003). Potassium requirements of pulse crops. Better Crops International. **17**(1): 8 –11.

Takankhar, V.G., S.S. Mane, B.G. Kamble and A.P. Surivanshi, 1998. Phosphorus uptake at different stages and yield attributes of gram crop as affected by P and N fertilization and *Rhizobium* inoculation. *J. Soil and Crops,* **8**: 53–7.

Tayo, T.O. , and Togun, A .O . , (1984). 'Ole response of pigenonpea (Cajan/lS cajan) to the application of fertilisers, *Ann App/, Bioi"* **195** : 293-302.

Thenua ,O.V.S., Singh SP, Shivakumar, B. G. (2010). Productivity and economics of chickpea (Cicer arietinum) + fodder sorghum (Sorghum bicolor) cropping systems as influenced by phosphorus sources, bio-fertilizers and irrigation to chickpea. *Indian J. Agron*. **55**:22-27.

Tiwari, V. N., Lehri, L. K. and Pathak, A. N. (1989). Rhizobium inoculation of legumes as influenced by phosphorus and molybdenum fertilization *J. Indian Soc. Soil Sci.* **37**: 712-716.

Tripathy ,R. K., Pandey, N., Mishra, P. K. , Rajput, R. S. (2004). Branching behavior and production of chickpea as influenced by residual effect of cowdung blended nutrients applied to hybrid rice and direct application of nutrient to chickpea under hybrid rice-chickpea cropping system. *Ann. Agric. Res.* New Series **25**:498-501.

Uddin , M. (2011). Performance of chickpea under different levels of nitrogen and phosphorous with Rhizobium inocula.

Vadavia, A. 1., Kalaria, K. K., Patel. J. C. and Baidha, N.M. (1991). Influence of organic, inorganic and biofertilizers on growth, yield and nodulation of chickpea. *Indian.! Agron.*, **36**(2): 263-264.

Verma, L. P., Ram, P. C. and Maurya, B. R.(1988). Response of chickpea to phosphorus and molybdenum in alluvium of Eastern Uttar Pradesh. Inter chickpea Newsletter. **18** :31-33.

Walley, F. L. , Kyei-Boahen, S. , Hnatowich, G. , Stevenson, C. (2005). Nitrogen and phosphorus fertility management for *desi* and *kabuli* chickpea. Can *J Plant Sci* **85**: 73–79.

Yami, K. D. , Bhattarai, S. and Adhikari, S. (2003). Vermicomposting and microflora analysis of vermicompost and gut of red earthworm. *Nepal Journal of Science and Technology* **5**:127-132.

Zahran, F. A., Negm, A. Y., Bassiem, M. M. and Ismail, K.M. (1998). Foliar fertilization of lentil and lupine in sandy soils with the supernatant of superphosphate and potassium sulphate. *Egyptian J. Agril. Res*. **76**(1): 19-31.

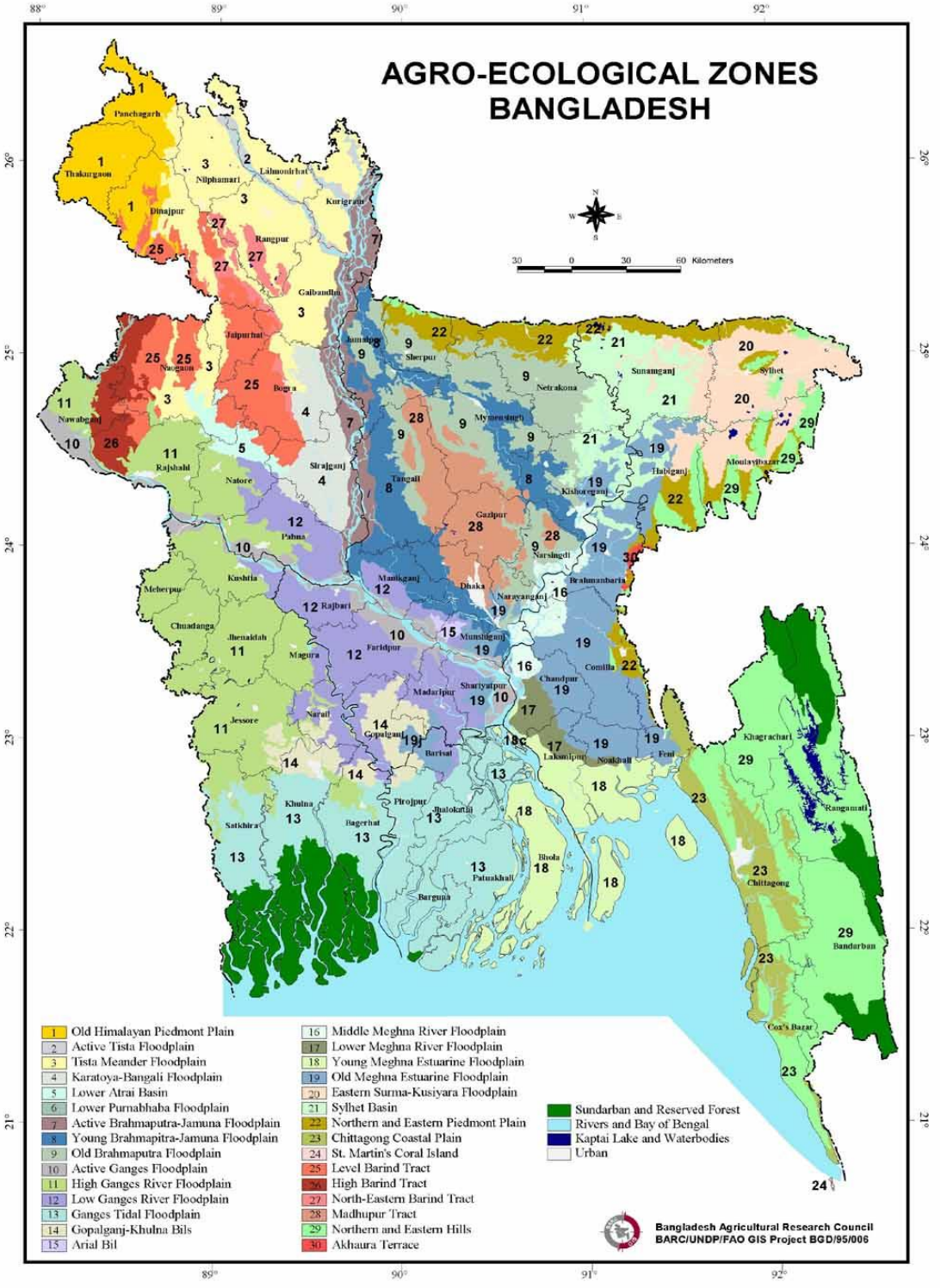
Zahan, S. A., Alim, M. A. , Hassan , M. M. , Kabiraj, U. K. and Hossain, M. B.(2009). Effect of potassium on the growth , yield and yield attributes of lentil. Int. J. Sustain crop prod.**4**(6):1-6.

Zaman, A. K. M. M, Alam, M. S., Biswas, B. K., Roy, B. and Beg, A. H. (1996). Effect of B and Mo application on mungbean. *Bangladesh J. Agril. Res*. **21**, 118-124.

Zeidan, M. S. (2007). Effect of Organic manure and Phosphorus Fertilizers on Growth,Yield and Quality of Lentil Plants in Sandy Soil. *Res. J. Agric Biolo. Sci.*, **3**(6): 7

APPENDICES

Appendix I : Photograph showing location of experimental site.



Appendix II : **Characteristics of experimental soil was analyzed at Soil Resources Development Institute (SRDI). Farmgate. Dhaka.**

A. Mechanical analysis

Constituents	Percentage (%)
Sand	28.78
Silt	42.12
Clay	29.1

B. Chemical analysis

Soil properties	Amount
Soil pH	5.8
Organic carbon (%)	0.95
Organic matter (%)	0.77
Total nitrogen (%)	0.075
Available P (ppm)	15.07
Exchangeable K (%)	0.32
Available S (ppm)	16.17

Source: Soil Resource Development Institute (SRDI)

Appendix III : Mean sum square of plant height of chickpea as influenced by fertilization sowing date at different days after sowing (DAS)

Plant height data at(30,60,90 days) and their interaction			
	Mean square		
Source of variation	30DAS	60 DAS	90 DAS
Replication	4.3957	20.668	14.72
Fertilization	0.4912 NS	53.84*	80.92*
Error I	0.4731	8.039	2.539
Sowing date	28.445*	206.69*	309.731*
Fertilization X sowing date	1.9065 NS	42.538*	30.023*
Error II	1.5296	9.47	2.795

*****means 5% level of significant

Appendix IV, **:** Mean sum square of number of branches of chickpea as influenced by fertilization sowing date at different days after sowing (DAS)

Number of branches data at(30,60,90 days) and their interaction			
	Mean square		
Source of variation	30 DAS	60 DAS	90 DAS
Replication	0.3534	5.14	16.34
Fertilization	3.767*	327.34*	553.93*
Error I	0.3994	1.43	26.29
Sowing date	3.622**	1364 .92*	1011.71*
Fertilization X sowing date	1.002	150.88*	70.90 NS
Error II	0.723	0.75	26.72

*****means 5% level of significant, ** means 1% level of significant

Appendix V : Mean sum square of number of leaves of chickpea as influenced by fertilization sowing date at different days after sowing (DAS)

Number of leaves data at(30,60,90 days) and their interaction			
	Mean square		
Source of variation	30 DAS	60 DAS	90 DAS
Replication	0.383	25.3	7.9
Fertilization	32.956*	2603.7*	2282.2*
Error I	1.295	10.4	6.4
Sowing date	138.143*	12559.8*	98161.4*
Fertilization X sowing date	149.794*	1580.7*	404.3*
Error II	2.268	20.9	9.8

*****means 5% level of significant

Appendix VI : Mean sum square of fresh weight of chickpea as influenced by fertilization sowing date at different days after sowing (DAS)

Fresh weight data at(30,60,90 days) and their interaction			
	Mean square		
Source of variation	30 DAS	60 DAS	90 DAS
Replication	0.805	3.117	1.029
Fertilization	0.0553 NS	9.299*	39.900*
Error I	0.0557	0.953	2.480
Sowing date	0.627*	248.884*	569.971*
Fertilization X sowing date	0.256*	7.952**	110.195*
Error II	0.039	2.136	3.147

*****means 5% level of significant

Appendix VII : Mean sum square of dry weight of chickpea as influenced by fertilization sowing date at different days after sowing (DAS)

Dry weight data at(30,60,90 days) and their interaction			
	Mean square		
Source of variation	30 DAS	60 DAS	90 DAS
Replication	0.0033	0.5941	0.4026
Fertilization	0.0079 NS	0.2534**	12.0040*
Error I	0.00485	0.0997	0.7881
Sowing date	0.1357*	7.3136*	23.6076*
Fertilization X sowing date	0.0107 NS	0.1053 NS	16.9271*
Error II	0.01001	0.1375	0.5048

*****means 5% level of significant **,** ** means 1% level of significant , NS means non significant

Appendix VIII : Mean sum square of days of 80% pod formation , 80% flowering, pod length of chickpea as influenced by fertilization sowing date.

	Mean square		
Source of variation	Days to pod formation	Days to flowering	Pod length
Replication	0.58	0.22	0.67
Fertilization	1234.01 NS	16.22 NS	11.56 NS
Error I	4.05	5.11	7.11
Sowing date	2616.31 NS	42.38 NS	60.67 NS
Fertilization X sowing date	812.65 NS	1.61 NS	6.44 NS
Error II	10.10	13.33	9.56

NS means non significant

Appendix IX : Mean sum square of fresh weight , dry weight and 1 m^2 stover yield after harvesting of chickpea as influenced by fertilization sowing date .

	Mean square		
Source of variation	Fresh weight	Dry weight	$1m^2$ stover yield
Replication	16.56	2.62	41.0
Fertilization	1059.77NS	760.13NS	15855.1NS
Error I	14.37	13.05	58.8
Sowing date	428.96NS	430.90NS	2608.3NS
Fertilization X sowing date	440.96NS	387.80NS	36721.2NS
Error II	19.04	60.08	180.3