# Introduction

Chickpea*(Cicer arietinum* L.) is the most important grain legume crop throughout the world, after dry bean (*Phaseolus vulgaris L.*) and dry pea *(Pisum Sativum L.*) It belongs to the family fabaceae (Leguminosae) and sub-family fabodeae.This crop has ahigh adaptability to awide range of environments ad car successfully be grown under rains, irrigation and under stored soil moisture.It is currently grown in many tropical and subtropical regions as winter crop as well as in Asian winter and temperate regions (Muehlbauer,at.;1997).The total cultivated area of this crop worldwide was estimated at about 13.5 million has, producing more than 10 million tons (FAO, 2016).

Fertilizer, micro dosing technological consists of application of Small quantity of mineral fertilizer together with seeds of the target crop in the planting hole at sowing or few weeks (3 to 4) after planting (hayashi,et al.; 2008, ICRISAT , 2009).

In Sudan chickpea is consbled an important legume crop cultivated in the Northern state and,river Nile state.i tis grown traditionally during winter season as an irrigated crop in some part as well flooded crop such as Wad –Hamid , Abu-Hamed, and Silame.Hawata area in eastern Sudan Jabel marra in western Sudan (South Darfur state ) (Faki, *et al.;* 1993).recently chickpea has been successfully cultivated in Gezira state (Hamid, .2012). The total cultivated area of chickpea in Sudan is about 10/000 ha, with an average yield of 1.92 t/ha. (FAO.2010) .

Crop productivity can be increased by application of chemical organic and biological fertilizers.(Abdalla,*etal.;*2013). Studs showed that Fertilization especially with nitrogen and phosphorus increased dry matter production up to two or three folds . (ELLiott ,et al.; 2003).

In Sudan, the addition of nitrogen is tourd to be very important because the level of nitrogen in most south in Sudan is very low (Elhadi , et al; 1999).

**objectives**

1-To evaluate the effect of fertilizer type and doses on growth and yield of the chickpea

2- To determine the most suitable dose

3-To study micro dosing technique

# CHAPTER TWO

# Literature review

## 2.1.Historcal  back ground

During the period 1999-2004, chickpea was annually grown in an area of approximately 1701-193 hectares.This was mostly in the Northern and southern part of Sudan, which was more suitable for chickpea production compared to the central and southern parts of the country (Sheikh,Mohamed,1995), with alow productivity ranging of 4.2-11.76Kg/ha.

Chickpea production in northern Sudan dropped sharply from 180Kg/feddan to 40Kg/feddan during the years 2000-2009, which compelled farmers to change to other more profitable crops. These included the common bean (*Phaseolus vulgaris*), Fenugreek (Trigo-nella foenum-graecum) and cumin (Cuminum cyminum) (personal contact with farmers).They also cultivated wilt/root-rot susceptible cultivars which were released during these years(El Khedier, 2007).

Chickpea is acool season crop legume and grown as a winter crop in the tropics and as summer or spring in the temperate environment. It likes cool,dry and bright weather,which Chickpea is sensitive to maximum and minimum of temperature lead to flower drop and reduced pod set (Guar,2010).

## 2.2.Adaptation

Chickpea can be successfully grown under rains, irrigation and under stored soil moisture, it is currently grown in many tropical and subtropical regions as winter crop as well as in the mediate winter and temperate regions (Muehlbauer,etal.; 1997). It is grown between 20 $^{o}$N and 40$^{o}$ N in the Northern Hemisphere ,These environments differ in photoperiod, temperature and precipitation, due to the variation in longitude contains.the sowing date also varies from one region to anther (Faujdar,etal.;1995).

Chickpea is a cool season crop legume and grown as a winter crop in the tropics and as a summer or spring crop in the Temperate environments.Temperature,day length and availability of moisture are the three major abiotic factors affecting flowering. Chickpea is sensitive to high temperature at the reproductive stage.Both extremes of temperature land to flower drop and reduced pod set (Guar,*etal.*;2010). The crop performs best at air temperature between 20-35 $^{o}$C. acool and dry climatic is prefered , The crop is not frost tolerant.cool night with dew are necessary (sys,et al.;1993).

**2.3.Importance of chickpea**

It is an important pulse crop grown and consumed all over the world, especially in the AfroAsian countries.It has significant amounts of all the essential amino acids except sulfur containing types, which can be complemented by adding cereals to daily diet (Jukanti1,et al.;2012). Chickpeas are a helpful source of zinc,and protein. They are also very high in dietary fibre and hence a healthy source of carbohydrates for persons with insulin sensitivity or diabetes (Shabeer,et al.; 2015). one hundred grams of mature boiled chickpeas contains 164 calories, 2.6 grams of fat (of which only 0.27 grams is saturated), 7.6 grams of dietary fiber and 8.9grams of protein. Chickpeas also provide dietary phosphorus(49–53 mg/100 g). In the semi-arid tropics, chickpea seeds contain on average 23% protein, 64% total carbohydrates (47% starch, 6% soluble sugar), 5% fat, 6% crude fiber, phosphorus (340 mg/100 g), calcium magnesium (140 mg/100 g), iron (7 mg/100 g) and zinc (3 mg/100 g) (Shabeer,et al . 2015).

**2.4. Fertilization**

Chickpea obtain its nitrogen through nitrogen fixation .It requires optimum amounts of phosphorus, potash, sulfur and other nutrient the response to nutrient application in chickpea depends on the nutrient status of the soil,agro-climatic condition and the genotype. Both organic and inorganic source of nutrients and Rhizobium inoculation have been found to be useful for chickpea growth and yield (Faujdar ,etal.; 1995).

Chickpea is commonly grown in Sudan and is usually under nitrogen fertilization . The fertilizers which supply nitrogen are very expensive especially in the developing , Acountries, where fertilizers are imported.An application of 15-25kg/ha has been found to be optimum for stimulating growth and yield of chickpea in sandy and loamy soils  However when an active symbiotic nitrogen fixing system was present, is no need for adding fertilizers. there was no response to nitrogen application up to 100kg/ha N. in the alluvial soils Application of 30-40kg/ha N .

was found to be profitable under rain fed cultivation (Faujdar,etal.; 1995).

**2. 5.Fertilizer microdosing**

Fertilizer micro dosing technology is the application of asmall quantity of mineral fertilizer together with seeds of the target crop in the planting hole at sowing or few weeks (3 to 4) after planting (hayashi,etal.;2008;ICRISA,2009).

In the Sahelian countries,fertilizer micro dosing relies on smaller quantities (2 to 6 g/ hill$^{-1}$)of placed mineral fertilizer targeting priority the most limiting element,phosphorus (Buerkert,et al.;,2001;Tabo,et al.; 2007). Micro dosing decreasesed substantially the recommended amount of fertilizer that smallholder farmers need to apply per hectare , that is from 200 to 20/ kg ha$^{-1}$in the case of di-ammonium phosphate (Hayashi *,et al.;* 2008).Twomlow etal.(2010) reported significant increases in cereal grainyield with 17/kgN ha-1(approximately 25%of recommended levels) compared to recommended rates of 55/kg ha However,Institut de l‟Environnement et de Recherches Agricoles (INERA) has developed a method of micro-dosing which is based on application of only 62/kg of fertilizer per hectare, a reduction of one-third,of the recommended rate. The technique requires only about one-9tenth of the amount typically used on wheat, and one-twentieth of the amount used on corn in the USA (INERA, 2010). The techniques of applying fertilizer depending on soil and climatic conditions. In southern Africa, farmers use fertilizer measured out in an empty soft drink or beer bottle cap, while in western Africa, the farmers measure fertilizer with a three-finger pinch (ICRISAT, 2009). Athree-finger pinch is equivalent to 6 gram doses of fertilizer which is about a full soft drink bottle cap. With ammonium nitrate fertilizer for instance, a beer bottle cap is equal to 4.5 g which is equivalent to 17/ kg N ha-1(Twomlow, et al.; 2010).Farmers in the Sahel use a soda bottle cap to allocate fertilizer, hence fertilizer micro-dosing is popularly known as the Coca-Cola technique (Tabo, et al.; 2006). Applying fertilizer in micro-dose permits more precise and better timed fertilizer Place mentand hence appropriate management of fertilizer (Sanginga, etal.; 2009). This technology may be strategically combined with other practices such as seed priming, water harvesting, planting holes, addition of livestock manure or crop residue and compost prepared from household and garden wastes.

**2:6 Benefits of micro-dosing fertilizer**

Micro-dosing fertilizer was developed in an attempt to increase the affordability of mineral fertilizer while giving plants enough nutrients for optimal growth (Hayashi, et al.; 2008). High rates of fertilizer input have been recommended to farmers for a long time to maximize yields, but smallholder farmers could not afford to buy such quantities fertilizer. Small amounts are more affordable for farmers (Bationo,etal.;2001) because of reduced investment cost (Tabo,et al.;2006, 2007). Hence, the technology minimizes input cost and reduces investments risk while increasing crop yields.

# CHAPTER THREE

## MATERIALES AND METHODS

### 3.1.Experimental site

The experiment was carried out at the farm of the College of Agricultural Studies . Sudan University of Science of Technology at Shambat , Khartoum North , longitude 32º-32 E and latitude 15º- 40 N and alatitude 280m, sea level , during the winter 2018-2019 season to study the effects of the fertilizer type and microdosing on growth and yield component of chickpea. The relative humidity ranges between 17-27% during dry season and 31-51%during wet season (Adam,2002). The soil type is loamy clay with PH of 7.8-8.5, characterized by a deep cracking , and moderately alkaline low permeability and nitrogen content(Abdel-Hafeez,2001).

### 3.2.Materials

**Plant material**

Seed of Chickpea*(Cicer arietinum* obtained from College of Agricultural Studies(CAS) Shambat.Cultivar Atmor, Shendi.

**Fertilizers**

Superphosphate(P2O560%),NPK(20-20-20),andMonoammonium phosphate (MAP12-61-0).

### 3.3.Methods

The land was ploughed, harrowed ,leveled and ridged. Then the land was divided to three sub-plots each one contains 12plots.The plot size 3×4cm, Each plot consist of four ridges 70cm. The treatments arranged in split plot based on randomized complete block design with four replications. The main plot was allotted for three type off fertilizer, the Superphosphate,NPK,and Monoammonium phosphate (MAP).

### 3.4.Cultural practices

The seed was sown manually in winter on 11/1/2018 three seed were planted in each hole.

Irrigation was immediately done after sowing the frequent irrigation was practiced every week moreover two weeding was carried out.

### 3.5.Data collection and Analysis

Data pertaining plant height(cm),number of branch/plant , number of pod/plant , fresh Weight(g), dry weight(g), 100 seed weight(g) , yield per plant (g), yield par hectare(t/h) were collected randomly The collected data were statically analysis using (MSTACT-C).

# CHAPTAR FOUR

## Results and Discussion

### 4.1.Plant height

The plant height was significant for the fertilizer types and dosing while it was not significant for interaction. (table1).

MAP and NPK Showed significantly higher plant height (42.9 ,40.5 cm). than Super phosphate (table 2). This might be due to the fact that MAP and NPK have Nitrogen That increased the growth. This was not agreed with the study by (seid,etal.;2015).

Control gave higher plant height (44.8cm) than the others,1,2,3 and 4g. This may be due to the fact that soil might have enough nitrogen or chickpea as a legume may fix the nitrogen (table 3).

There were non significant different for interaction where the highest plant height was obtained by control (46.1cm) and the lowest by super phosphate with 3g (26) (table 4).The trend of growth with time was shown in figures 1,2 and 3 for the the three fertilizer as the height increased with time to reach the maximum in 90 days with MAP having the highest plant height than NPK and superphosphate.

### 4.2.Leaf per plant

leaf per plant was non significant for fertilizer types and dosing and interaction. (table 1)

NPK and Super phosphate and MAP were non significantly different but MAP had less leaf than others(table 2) .This finding did not agree with the result of Shoman, 2017.control ,1,2,3,and4g were not significant, where the highest number of leaves was obtained by the control (281) and the lowest by 3g (187) (table 3) Also there was non significant differences for interaction where the highest was given by NPK with 4g (269) and the lowest by super phosphate with 3g (151)( table 4).The increase in number of leaves per plant with time was shown in figures 4,5 and 6 with NPK with the highest number at maturity. This might be due to the fact that NPK is a complete fertilizer containing the three macronutrient.

Table 1:Summary of ANOVA table for chickpea parameter studed

| Source of Variation | Degree of freedom | Plant height (cm) | Leaf/ Plant | Number Of pods/ plant | Fresh Weight (g) | Dry Weight (g) | 100 seed weigh(g) | yield/ plant (g) | Yield /tons Hectare |
|---|---|---|---|---|---|---|---|---|---|
| Replication | 2 | 1.22 | 2.17 | 1.64 | 2.33 | 4.78 | 1.75 | 3.36 | 2.25 |
| Fertilizer | 2 | 6.82* | 0.35NS | 1.00NS | 1.09NS | 32.77** | 0.92NS | 0.11NS | 0.06NS |
| Error A | 4 | - | - | - | - | - | - | - | - |
| Concentration | 4 | 3.10* | 1.81NS | 0.84NS | 1.48NS | 0.04NS | 3.04* | 1.22NS | 1.26NS |
| F*C | 8 | 1.10NS | 0.4NS | 0.58NS | 1.56NS | 0.19NS | 2.04* | 1.35NS | 1.40NS |
| Error | 24 | - | - | - | - | - | - | - | - |
| Total | 44 | - | - | - | - | - | - | - | - |
| C.V | - | 15.1 | 33.9 | 34.03 | 43.8 | 42.21 | 11.92 | 41.09 | 42.20 |

NS= not significant - * = significant(5%)- ** = highly significant(1%).

### 4.3.Number of pods per plant

The number of pods per plant was non significant for type and dosing and interaction (table 1).

MAP and NPK and super phosphate were non significant for number of pods per plant where the highest was given by NPK (94.8) and the lowest by super phosphate (86.8) (table 2).This might be due to the fact that NPK is a complete fertilizer containing the three major fertilizers while superphosphate contains only phosphors .Similar result was obtained by Imdad, et al.; 2015.

Control,1 ,2 , 3,and 4g were non significantly different for pods per plant where highest by 1g (105) and the lowest by 3g (79.5) (table 3).

The interaction showed non significant difference and the highest was obtained by super phosphate with 1g (115) and the lowest by super phosphate with (68) (table 4).

Table 2:the effect of different type of fertilizer on some agronomic yield of chickpea-Shambat-sudan(2018).

| Fertilizer | Plant height(cm) | Leaf /plant | Number of pods/plant | Fresh Weight(g) | Day Weight(g) | 100 seed weigh(g) | Yield /plant(g) | Yield/tons hectare |
|---|---|---|---|---|---|---|---|---|
| MAP | 42.99$^{a}$ | 223.1$^{a}$ | 91.50$^{a}$ | 254.1$^{a}$ | 89.5$^{c}$ | 16.20$^{a}$ | 22.03$^{a}$ | 3.21$^{a}$ |
| NPk | 40.50$^{a}$ | 239.4$^{a}$ | 94.80$^{a}$ | 200.5$^{a}$ | 104$^{b}$ | 15.40$^{a}$ | 21.04$^{a}$ | 3.14$^{a}$ |
| P2O5 | 35.72$^{b}$ | 240.3$^{a}$ | 86.80$^{a}$ | 247.8$^{a}$ | 150.1$^{a}$ | 16.33$^{a}$ | 22.50$^{a}$ | 3.32$^{a}$ |
| Mean | 39.7 | 234.2 | 91 | 234.1 | 114.5 | 16 | 21.8 | 3.22 |

Means followed by the same letter for each parameter were not significantly different at 5% level(LSD).

## 4.4.Fresh weight

Fresh weight was non significant for fertilizer types and dosing and interaction ( table 1).

MAP , NPK and Super phosphate were non significantly different for the fresh weight where the highest was seen by MAP (254g) and the lowest by NPK (205g) (table2).Similar results were shown by ( Mona ,(2015).

Control ,1g, 2g ,3g , and 4g , were non significant for fresh weight where the highest was obtained by 1g (305.2g) and the lowest by 2g (200.4g) ( table 3).there was non significant difference for interaction where the highest was seen by the MAP with 1g (466g) and the lowest by MAP with 2g (153 g) (Table 4).

**4.5.Dry weight**

Dry weight was highly significant for fertilizer types it was non significant for the dosing and interaction (table1).

Super phosphate gave highly significantly difference for dry weight compared with two types. However, MAP and NPK were non significantly different (Table 2).Similar results was found by Rodinei, et al.; 2018.control ,1,2,3,and 4g were not significant for dry weight where the highest was recorded by 3g(116.6g) and the lowest by 4g (108.8g) (Table 3).there was non significant difference for interaction where the highest was recorded by the super phosphate with 2g (162.4g) and the lowest by MAP with 3g (75.2g) (table 4).

Table:3 Effect of fertilizer concentration level an yield component of chickpea-Shambat –sudan (2018)

| Concention | Plant height(cm ) | Leaf /Plant | Number of pods/plant | Fresh Weight(g) | Dry Weight(g) | 100 seed weight(g) | Yield /Plant(g) | Yield /tons hectare |
|---|---|---|---|---|---|---|---|---|
| Control | 44.84[a] | 281.0[a] | 92.0[a] | 213.4[a] | 116.5[a] | 15.3[b] | 26.9[a] | 4.01[a] |
| 1g | 38.16[a] | 216.9[a] | 105.7[a] | 305.2[a] | 114.4[a] | 17.3[a] | 21.6[a] | 3.30[a] |
| 2g | 38.93[a] | 187.7[a] | 87.6[a] | 200.4[a] | 116.1[a] | 14.9[b] | 20.3[a] | 3.01[a] |
| 3g | 35.50[b] | 231.3[a] | 89.6[a] | 234.8[a] | 116.7[a] | 15.3[b] | 22.6[a] | 3.18[a] |
| 4g | 41.24[a] | 254.3[a] | 90.3[a] | 216.9[a] | 108.8[a] | 17.0[a] | 18.0[a] | 2.62[a] |
| Mean | 39.7 | 234.2 | 91 | 234.1 | 114.5 | 16 | 21.8 | 3.22 |

Means followed by the same letter for each parameter were not significantly different at 5% level(LSD)

### 4.6.100 seed weight

100 seed weight was non significant for fertilizer types and interaction, while it was significant for dosing ( Table 1).

MAP , NPK and Super phosphate were non significant for 100 seed weigh where the highest was shown by Super phosphate (16.3g) and the lowest by NPK ( 15.4) (table 2).similarly results were obtained by Karteti, et al .;2017.

Where 1g,and 4g of fertilizer applied the results showed significant different for the 100 seed weight (17.3 , 17.0g) than others doses which may be due to that fact soil might have nitrogen before adding the fertilizer doses. (table 3).There was non significant difference for interaction where the highest seed weight(20g) was shown by super phosphate with and the lowest seed weght (14g) was obtained by the application of 2g fertilizer (table 4).

### 4.7.Yield per plant

Yield per plant was non significant for fertilizer type, dosing and interaction (table 1).the appellation of MAP, NPK and Super phosphate ware non significant different for yield per plant The highest yield was recorded by the appellation of the Super phosphate (22.5g) and the lowest by NPK (21g) (table 2). However, the control application of ,1,2,and3g, showed non significantly different for yield per plant. the highest yield was shown control (26.9g) and the lowest by application of 4g fertilizer (17.9g) (Table 3). Obtained by the result was not on line with Moin, *et al.*; 2014.There were non significant difference for interaction where the highest yield was obtained by control the application of 3g (32g)and the lowest by NPK 4g (12.3g)(table 4).

**4.8.Yield(t/h)**

The analyses is showed that yield per hectare was non significant different for fertilizer types dosing and interaction ( table 1) the application of MAP, NPK and Super phosphate showed non significantly difference for yield (t/h) the highest.yield(3.3t/ha was obtained through the application of by super phosphate but lowest yield (3.1t/h) was obtained by the application NPK (table 2).This could be due to the nature of chickpea as alegume that can fix nitrogen but needs more Superphosphates to complete its of growth cycle however the contro,l, 2, 3, and 4g of fertilizer showed non significant for yield per hectare, where the highest yield (4t/ha) was obtained by the applicaton of 4g fertilier lowest(2.6t/h) ( table3).This is because the plant can fix nitrogen and or the soil had enough fertilizer.this was dose not agree with result obtained by shabeer, *et al.*; 2015.

Table 4: Effect of the Interaction between the fertilizer level(conc) the yield component of chickpea micro dosing-Shambat –sudan(2018).

| Fertilizers | contention | Plant height(cm) | Leaf/Plant | Number of pods/plant | Fresh Weight (g) | Dry Weight(g) | 100 seed weigh(g) | Yield/ Plant(g) | Yield/tons hectare |
|---|---|---|---|---|---|---|---|---|---|
| MAP | Control | $46.1^{a}$ | $268.3^{a}$ | $95.7^{a}$ | $215.0^{a}$ | $98.9^{a}$ | $15.0^{b}$ | $32.8^{a}$ | $4.90^{a}$ |
| | 1g | $37.8^{a}$ | $218.3^{a}$ | $91.7^{a}$ | $466.1^{a}$ | $90.7^{a}$ | $18.3^{a}$ | $19.5^{a}$ | $3.13^{a}$ |
| | 2g | $43.9^{a}$ | $193.7^{a}$ | $99.7^{a}$ | $153.0^{a}$ | $84.9^{a}$ | $16.3^{b}$ | $16.4^{a}$ | $2.39^{a}$ |
| | 3g | $43.1^{a}$ | $204.7^{a}$ | $83.0^{a}$ | $231.6^{a}$ | $75.1^{a}$ | $14.7^{b}$ | $21.1^{a}$ | $2.54^{a}$ |
| | 4g | $43.9^{a}$ | $230.3^{a}$ | $87.3^{a}$ | $2.04.7^{a}$ | $97.6^{a}$ | $16.7^{b}$ | $20.4^{a}$ | $3.06^{a}$ |
| NPK | Control | $47.1^{a}$ | $250.7^{a}$ | $103.0^{a}$ | $197.7^{a}$ | $105.9^{a}$ | $15.3^{b}$ | $19.0^{a}$ | $2.81^{a}$ |
| | 1g | $40^{a}$ | $203.7^{a}$ | $109.7^{a}$ | $164.4^{a}$ | $104.4^{a}$ | $17.3^{b}$ | $23.4^{a}$ | $3.49^{a}$ |
| | 2g | $38.8^{a}$ | $218.3^{a}$ | $94.3^{a}$ | $214.9^{a}$ | $101.0^{a}$ | $14.3^{b}$ | $20.0^{a}$ | $2.98^{a}$ |
| | 3g | $37.3^{a}$ | $255.0^{a}$ | $86.7^{a}$ | $234.4^{a}$ | $123.1^{a}$ | $15.7^{b}$ | $30.6^{a}$ | $4.58^{a}$ |
| | 4g | $39.1^{a}$ | $269.3^{a}$ | $80.3^{a}$ | $191.0^{a}$ | $85.5^{a}$ | $14.3^{b}$ | $12.4^{a}$ | $1.84^{a}$ |
| Superphosphate | Control | $41.3^{a}$ | $324.0^{a}$ | $77.3^{a}$ | $227.5^{a}$ | $145.0^{a}$ | $15.7^{b}$ | $29.0^{a}$ | $4.33^{a}$ |
| | 1g | $36.7^{a}$ | $228.7^{a}$ | $115.7^{a}$ | $285.0^{a}$ | $148.3^{a}$ | $16.3^{b}$ | $21.8^{a}$ | $3.27^{a}$ |
| | 2g | $34.0^{a}$ | $151.0^{a}$ | $68.7^{a}$ | $233.1^{a}$ | $162.5^{a}$ | $14.0^{b}$ | $24.5^{a}$ | $3.65^{a}$ |
| | 3g | $26.0^{a}$ | $234.3^{a}$ | $69.0^{a}$ | $238.3^{a}$ | $151.7^{a}$ | $15.7^{b}$ | $16.2^{a}$ | $2.42^{a}$ |
| | 4g | $40.7^{a}$ | $263.3^{a}$ | $103.3^{a}$ | $255.0^{a}$ | $143.3^{a}$ | $20.0^{a}$ | $21.0^{a}$ | $2.95^{a}$ |
| Mean | | 39.7 | 234.2 | 91 | 234.1 | 114.5 | 16 | 21.9 | 3.22 |

Means followed by the same letter for each parameter were not significantly different at 5% level(LSD).

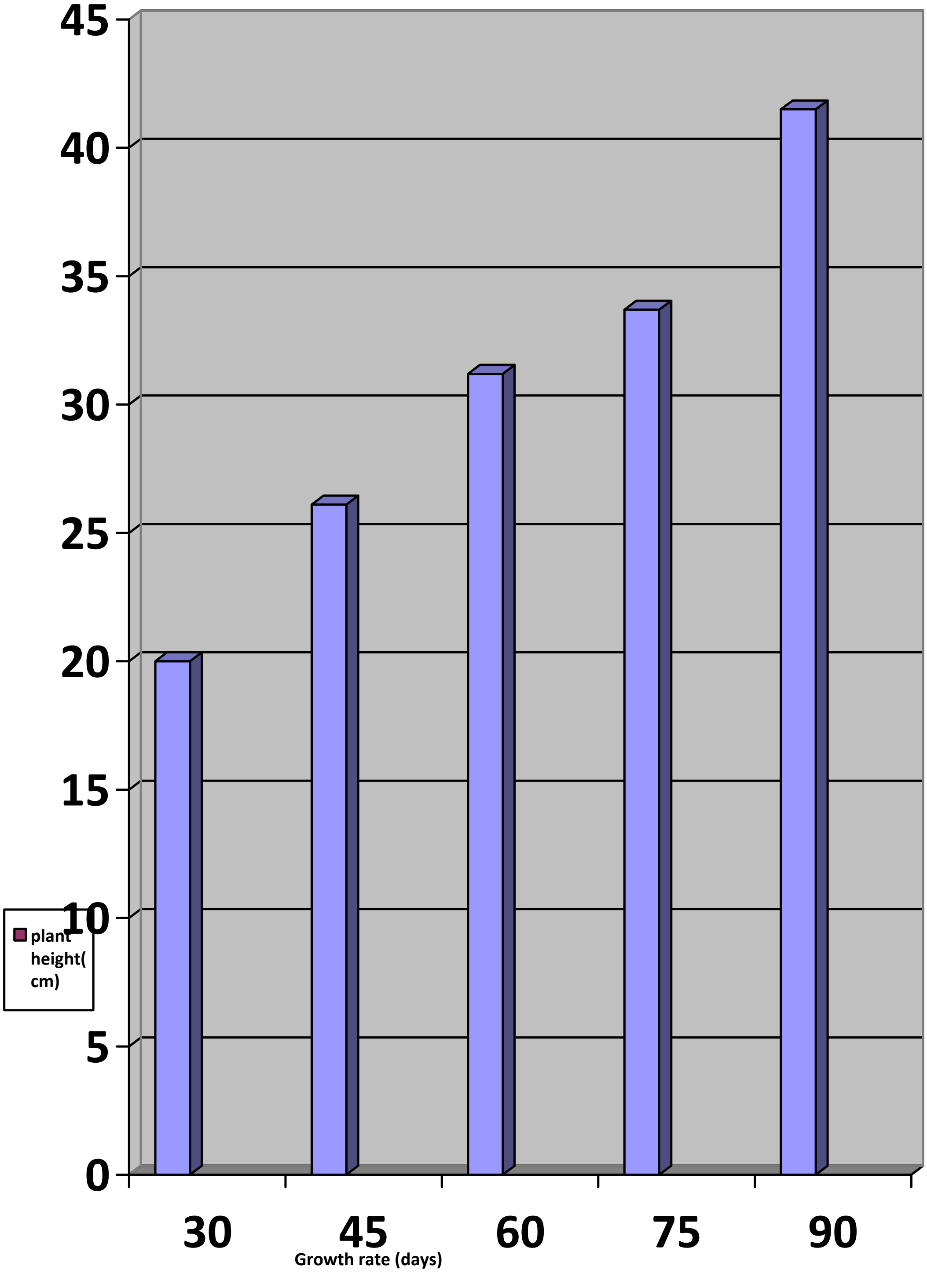


Figure (1) Effect of MAP on plant height and growth rate (days) .

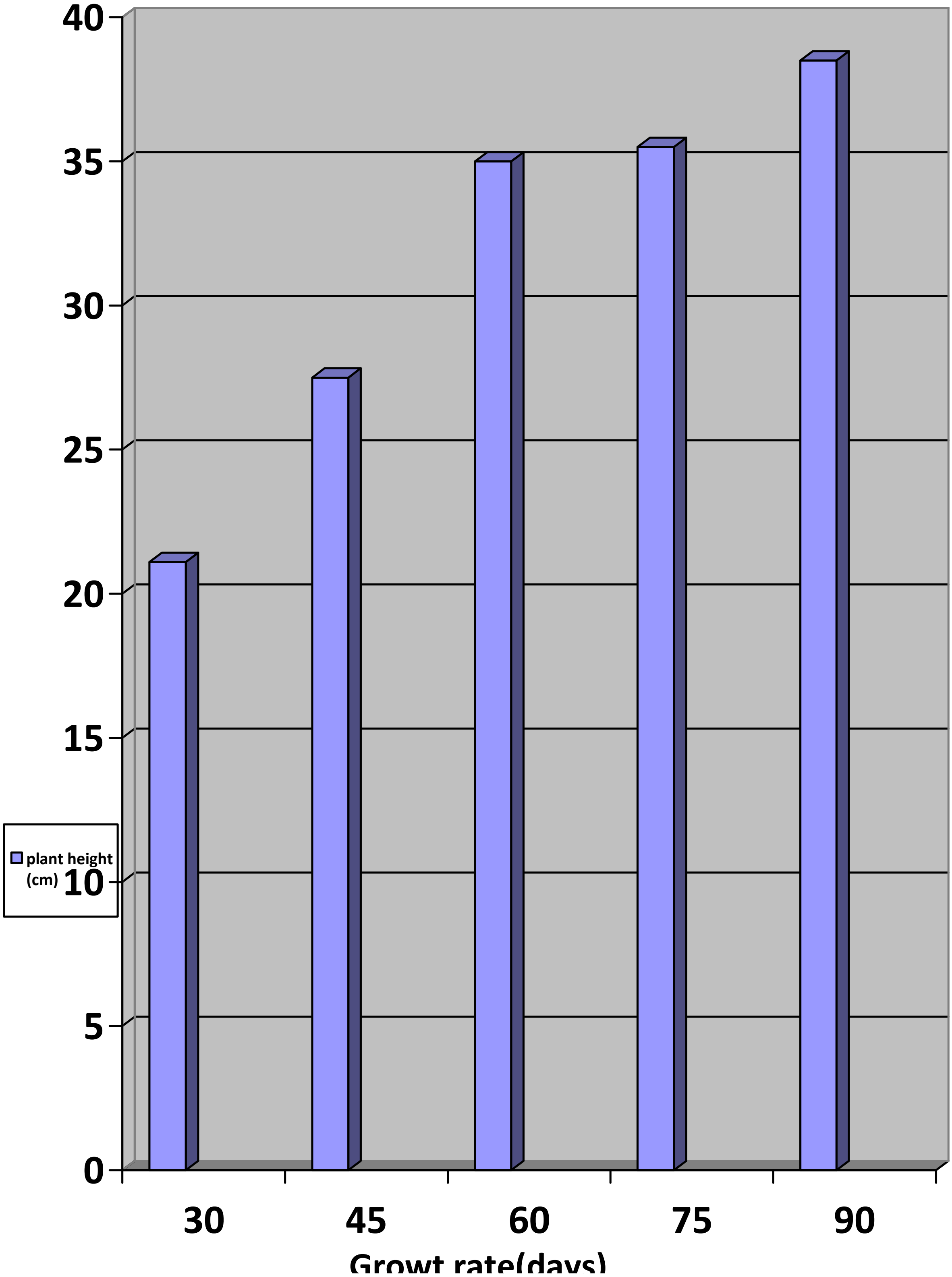


Figure (2) Effect of NPK on plant height and growth rate (days) .

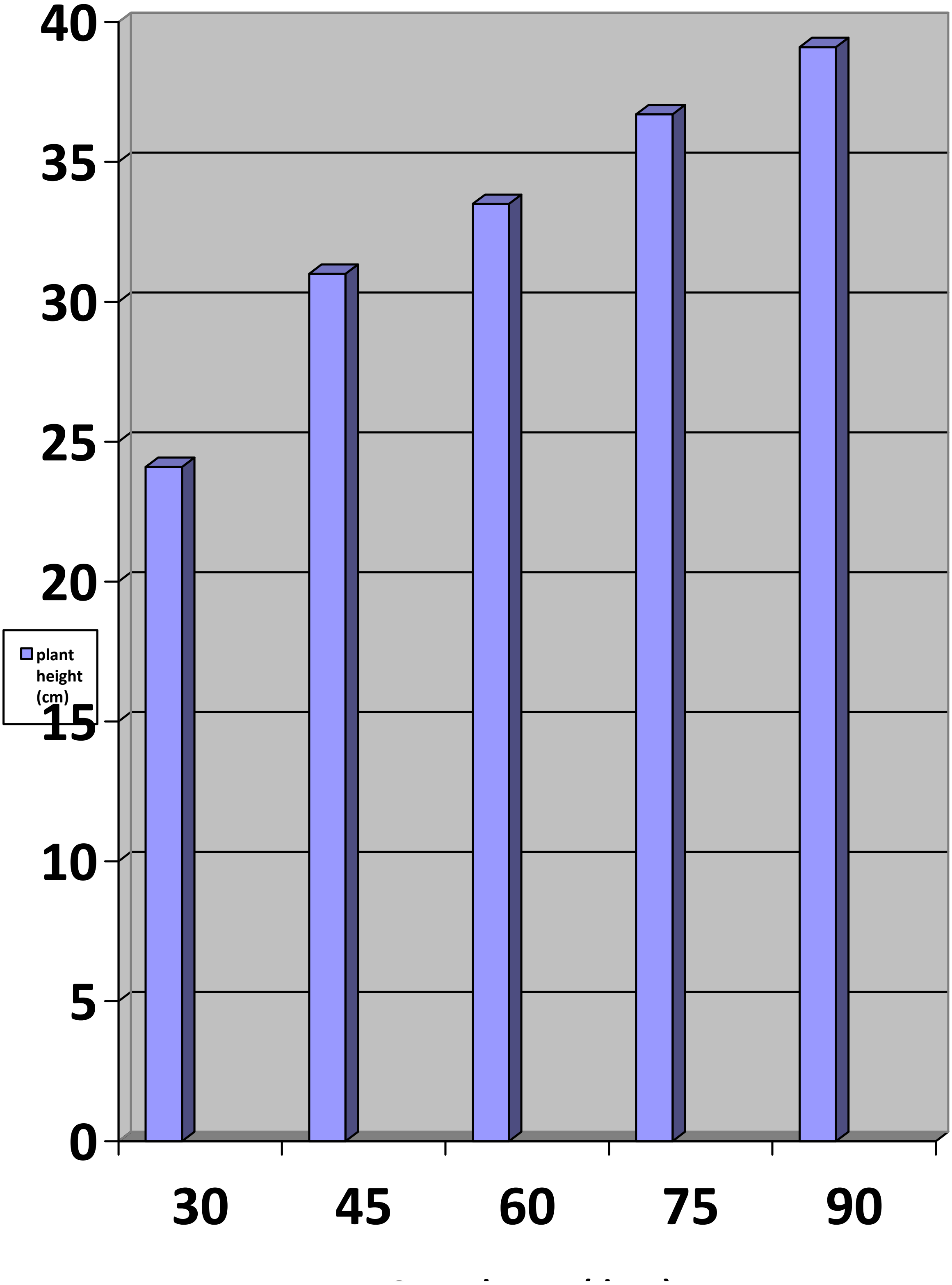


Figure (3) Effect of Superphosphate on plant height and growth rate (days) .

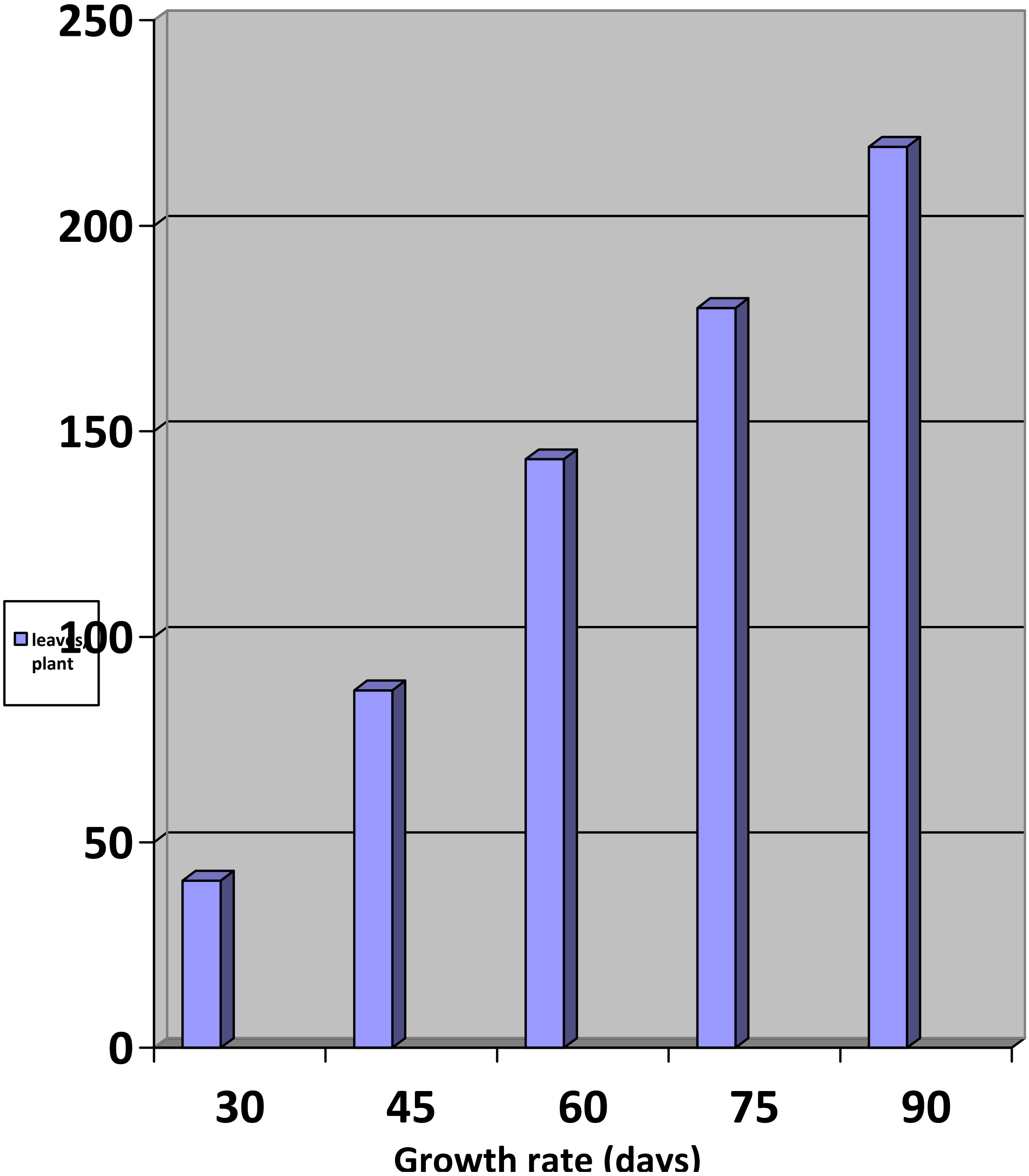


Figure (4) Effect of MAP on leaves per plant and growth rate (days) .

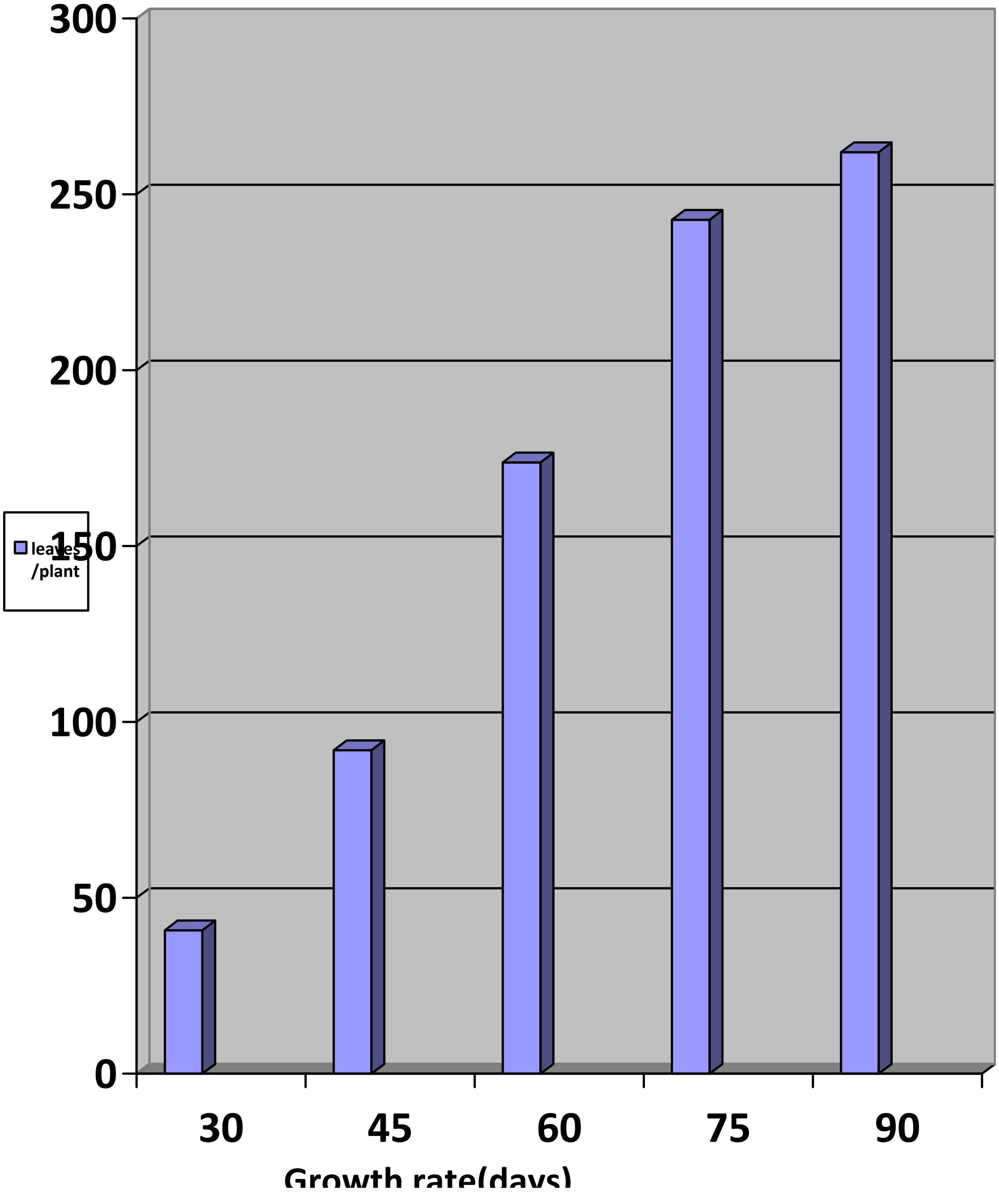


Figure (5) Effect of NPK on leaves per plant and growth rate (days) .

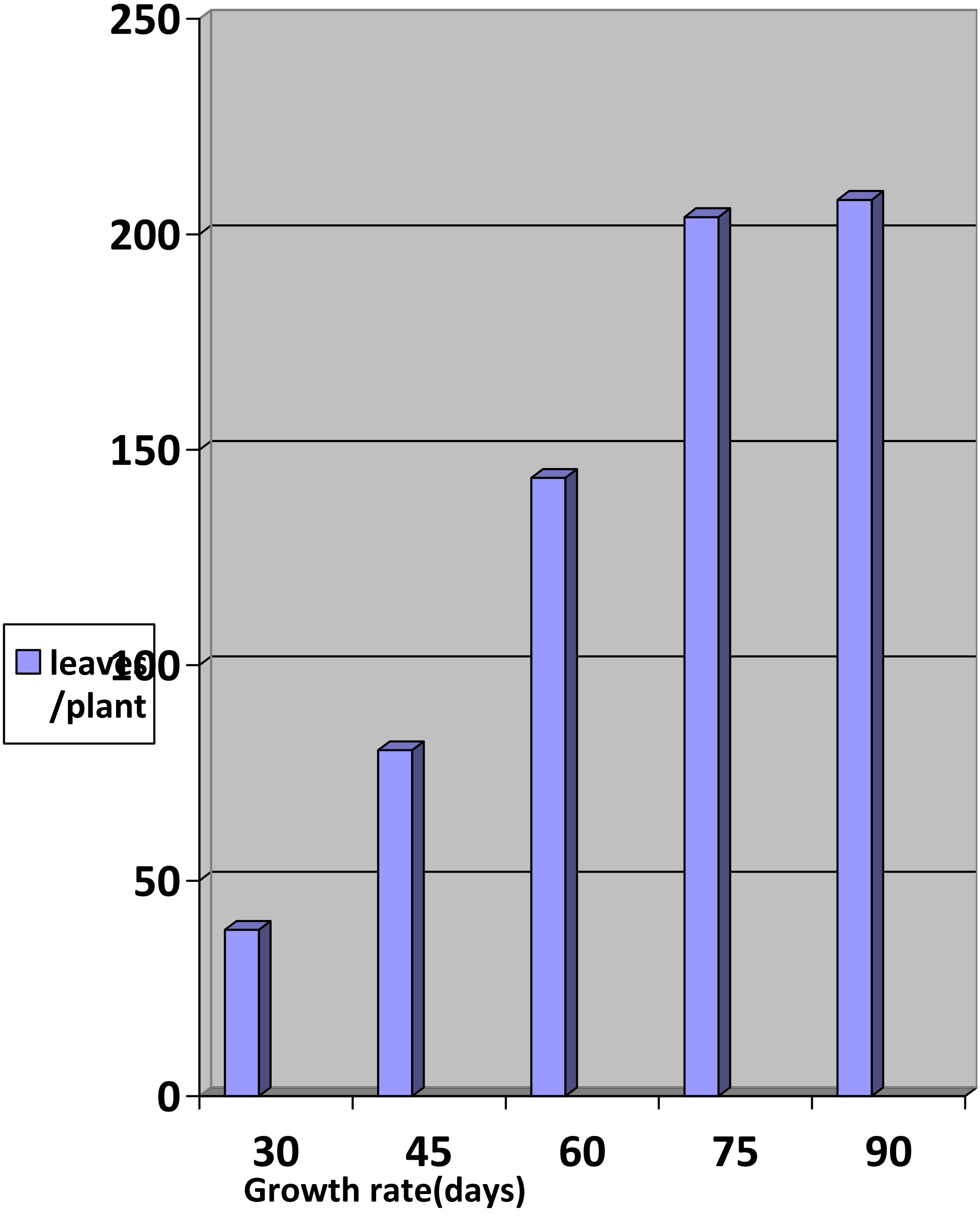


Figure (6) Effect of Superphosphate on leaves per plant and growth rate (days) .

## CHAPTAR FIVE

### 5.1. Conclusion and Recommendation

1-This study aimed to determine the effect of fertilizer types and doses on the growth and yield parameters of chickpeas microdoses .Fertilizer types and dosing did not significantly affected the dual purpose of Chickpea micro-dosing.

2-Microdosing is easy technique and reduce labor such as fertilizer application equipment for small areas.

3-Since chickpea is leguminous crop it is required for nitrogen fertilizers negligible.

4-Most parameters increased with time and increased microdosing

5-It is recommended that more research is needed to evaluate effect of microdosing.

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# Appendix 1.plant height(cm)

**A N A L Y S I S   O F   V A R I A N C E   T A B L E**

| K Value | Source | Degrees of Freedom | Sum of Squares | Mean Square | F Value | Prob |
|---|---|---|---|---|---|---|
| 1 | Replication | 2 | 72.880 | 36.440 | 1.2177 | 0.3863 |
| 2 | Factor A | 2 | 408.379 | 204.190 | 6.8232 | 0.0514 |
| -3 | Error | 4 | 119.702 | 29.926 | | |
| 4 | Factor B | 4 | 444.801 | 111.200 | 3.0999 | 0.0343 |
| 6 | AB | 8 | 307.019 | 38.377 | 1.0698 | 0.4158 |
| -7 | Error | 24 | 860.924 | 35.872 | | |
| | Total | 44 | 2213.706 | | | |

Coefficient of Variation: 15.07%

s_ for means group 1: 1.4125 Number of Observations: 15
y

s_ for means group 2: 1.4125 Number of Observations: 15
y

s_ for means group 4: 1.9964 Number of Observations: 9
y

s_ for means group 6: 3.4579 Number of Observations: 3
y

# Appendix 2. leaves/plant

**A N A L Y S I S   O F   V A R I A N C E   T A B L E**

| K Value | Source | Degrees of Freedom | Sum of Squares | Mean Square | F Value | Prob |
|---|---|---|---|---|---|---|
| 1 | Replication | 2 | 17288.711 | 8644.356 | 2.1695 | 0.2301 |
| 2 | Factor A | 2 | 2816.844 | 1408.422 | 0.3535 | |
| -3 | Error | 4 | 15937.956 | 3984.489 | | |
| 4 | Factor B | 4 | 45619.422 | 11404.856 | 1.8074 | 0.1603 |
| 6 | AB | 8 | 20368.044 | 2546.006 | 0.4035 | |
| -7 | Error | 24 | 151445.333 | 6310.222 | | |
| | Total | 44 | 253476.311 | | | |

Coefficient of Variation: 33.91%

$s_{\bar{y}}$ for means group 1: 16.2982 Number of Observations: 15

$s_{\bar{y}}$ for means group 2: 16.2982 Number of Observations: 15

$s_{\bar{y}}$ for means group 4: 26.4790 Number of Observations: 9

$s_{\bar{y}}$ for means group 6: 45.8629 Number of Observations: 3

## Appendix 3.number of pod/plant

**A N A L Y S I S   O F   V A R I A N C E   T A B L E**

| K Value | Source | Degrees of Freedom | Sum of Squares | Mean Square | F Value | Prob |
|---|---|---|---|---|---|---|
| 1 | Replication | 2 | 795.511 | 397.756 | 1.6466 | 0.3008 |
| 2 | Factor A | 2 | 484.444 | 242.222 | 1.0028 | 0.4436 |
| -3 | Error | 4 | 966.222 | 241.556 | | |
| 4 | Factor B | 4 | 3234.533 | 808.633 | 0.8430 | |
| 6 | AB | 8 | 4504.000 | 563.000 | 0.5869 | |
| -7 | Error | 24 | 23022.267 | 959.261 | | |
| | Total | 44 | 33006.978 | | | |

Coefficient of Variation: 34.03%

$s_{\bar{y}}$ for means group 1: 4.0129 Number of Observations: 15

$s_{\bar{y}}$ for means group 2: 4.0129 Number of Observations: 15

$s_{\bar{y}}$ for means group 4: 10.3240 Number of Observations: 9

$s_{\bar{y}}$ for means group 6: 17.8817 Number of Observations: 3

# Appendix 4 .fresh weight(g)

A N A L Y S I S   O F   V A R I A N C E   T A B L E

| K Value | Source | Degrees of Freedom | Sum of Squares | Mean Square | F Value | Prob |
|---|---|---|---|---|---|---|
| 1 | Replication | 2 | 55214.228 | 27607.114 | 2.3328 | 0.2131 |
| 2 | Factor A | 2 | 25725.530 | 12862.765 | 1.0869 | 0.4198 |
| -3 | Error | 4 | 47336.700 | 11834.175 | | |
| 4 | Factor B | 4 | 62223.609 | 15555.902 | 1.4798 | 0.2395 |
| 6 | AB | 8 | 131404.947 | 16425.618 | 1.5625 | 0.1886 |
| -7 | Error | 24 | 252294.455 | 10512.269 | | |
| | Total | 44 | 574199.470 | | | |

Coefficient of Variation: 43.79%

s_ for means group 1:    28.0882       Number of Observations: 15
 y

s_ for means group 2:    28.0882       Number of Observations: 15
 y

s_ for means group 4:    34.1765       Number of Observations: 9
 y

s_ for means group 6:    59.1954       Number of Observations: 3
 y

# Appendix 5. dry weight (g)

**A N A L Y S I S   O F   V A R I A N C E   T A B L E**

| K Value | Source | Degrees of Freedom | Sum of Squares | Mean Square | F Value | Prob |
|---|---|---|---|---|---|---|
| 1 | Replication | 2 | 4393.512 | 2196.756 | 4.7809 | 0.0870 |
| 2 | Factor A | 2 | 30118.006 | 15059.003 | 32.7734 | 0.0033 |
| -3 | Error | 4 | 1837.952 | 459.488 | | |
| 4 | Factor B | 4 | 391.131 | 97.783 | 0.0419 | |
| 6 | AB | 8 | 3607.901 | 450.988 | 0.1930 | |
| -7 | Error | 24 | 56072.501 | 2336.354 | | |
| | Total | 44 | 96421.003 | | | |

Coefficient of Variation: 42.21%

s_ for means group 1: 5.5347 Number of Observations: 15
y

s_ for means group 2: 5.5347 Number of Observations: 15
y

s_ for means group 4: 16.1119 Number of Observations: 9
y

s_ for means group 6: 27.9067 Number of Observations: 3

# Appendix 6.100 seed weigh(g)

A N A L Y S I S   O F   V A R I A N C E   T A B L E

| K Value | Source | Degrees of Freedom | Sum of Squares | Mean Square | F Value | Prob |
|---|---|---|---|---|---|---|
| 1 | Replication | 2 | 14.444 | 7.222 | 1.7520 | 0.2841 |
| 2 | Factor A | 2 | 7.644 | 3.822 | 0.9272 | |
| -3 | Error | 4 | 16.489 | 4.122 | | |
| 4 | Factor B | 4 | 44.089 | 11.022 | 3.0383 | 0.0369 |
| 6 | AB | 8 | 59.244 | 7.406 | 2.0413 | 0.0844 |
| -7 | Error | 24 | 87.067 | 3.628 | | |
| | Total | 44 | 228.978 | | | |

Coefficient of Variation: 11.92%

$s_{\bar{y}}$ for means group 1: 0.5242 Number of Observations: 15

$s_{\bar{y}}$ for means group 2: 0.5242 Number of Observations: 15

$s_{\bar{y}}$ for means group 4: 0.6349 Number of Observations: 9

$s_{\bar{y}}$ for means group 6: 1.0997 Number of Observations: 3

## Appendix 7.yield/plant(g)

**A N A L Y S I S   O F   V A R I A N C E   T A B L E**

| K Value | Source | Degrees of Freedom | Sum of Squares | Mean Square | F Value | Prob |
|---|---|---|---|---|---|---|
| 1 | Replication | 2 | 497.857 | 248.929 | 3.3621 | 0.1391 |
| 2 | Factor A | 2 | 17.053 | 8.526 | 0.1152 | |
| -3 | Error | 4 | 296.163 | 74.041 | | |
| 4 | Factor B | 4 | 395.872 | 98.968 | 1.2257 | 0.3262 |
| 6 | AB | 8 | 873.321 | 109.165 | 1.3520 | 0.2668 |
| -7 | Error | 24 | 1937.898 | 80.746 | | |
| | Total | 44 | 4018.165 | | | |

Coefficient of Variation: 41.09%

$s_{\bar{y}}$ for means group 1: 2.2217 Number of Observations: 15

$s_{\bar{y}}$ for means group 2: 2.2217 Number of Observations: 15

$s_{\bar{y}}$ for means group 4: 2.9953 Number of Observations: 9

$s_{\bar{y}}$ for means group 6: 5.1880 Number of Observations: 3

# Appendix 8.yield/hactar

**A N A L Y S I S   O F   V A R I A N C E   T A B L E**

| K Value | Source | Degrees of Freedom | Sum of Squares | Mean Square | F Value | Prob |
|---|---|---|---|---|---|---|
| 1 | Replication | 2 | 10.259 | 5.129 | 2.2495 | 0.2215 |
| 2 | Factor A | 2 | 0.256 | 0.128 | 0.0562 | |
| -3 | Error | 4 | 9.121 | 2.280 | | |
| 4 | Factor B | 4 | 9.354 | 2.338 | 1.2615 | 0.3124 |
| 6 | AB | 8 | 20.845 | 2.606 | 1.4057 | 0.2444 |
| -7 | Error | 24 | 44.488 | 1.854 | | |
| | Total | 44 | 94.322 | | | |

Coefficient of Variation: 42.20%

s_ for means group 1: 0.3899 Number of Observations: 15
y

s_ for means group 2: 0.3899 Number of Observations: 15
y

s_ for means group 4: 0.4538 Number of Observations: 9
y

s_ for means group 6: 0.7861 Number of Observations: 3
y