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Assessment Of Fertilizer types and doses on growth yield and yield components of Wheat(*Triticum aestivum*) microdosing, Shambat

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Abstract

Wheat is one of the most abundant sources of energy and protein for theworld population. The present study was plannedto determine effect of fertilizer types and doses on growth and yield parameters of wheat microdosing. The experiment was conducted at the Demonstration Farm of the Faculty of Agricultural Sciences, Sudan University of science and Technology, Sudan, during the growing seasons winter 2018/2019. The experimental method applied was a split-split plot trial with four replications. The main plot composed of three fertilizer types(mono Ammoniaphosphate, NPK and Urea)in randomized complete block design. Subplots consisted of five doses (0, 1g,2g,3g and 4g) of each of the three types of compound. Growth parameters investigated included plant height, number of tillers per meter square, leaves per plant, spike length, fresh weight, dry weight, 1000grain weight, grain per spike, yield per plant and yield per hectare. In this study the general trend was that the increase in fertilizerdose significantly increased plant height, , fresh weight, dry weight, spike length, grain per spike, yield per plant, yield per hectare where significant increased leaves per plant and grain per spike but there were no significant differences tiller per row meter which were not affected. Generally the results show that there were highly significant

differences in growth and yield parameters between the fertilizer types and doses.

Keywords: Fertilizer, MAP, Micro dosing, Wheat, Yield

Introduction

Wheat *(Triticum aestivumL.*) is the most important cerealcrop of the world. Among the food crops, wheat is one of the most abundant sources of energy and protein for the world population (Salem *et al.,* 2007). The importance of bread wheat as a staple food in economy cannot be ignored. Wheat is one of the most important strategic crops in terms of food security.In the Sudan wheat is the main staple food crop in urban areas and second to sorghum in many irrigated rural areas.In Sudan.Fertilizer microdosing is the application of tiny doses of fertilizers in the planting hole at sowing, or next to the plant two to three weeks after planting.Microdosing is affordable to the poor because of the reduced investment cost, and it results in more rapid early growth, thus avoiding early season drought, and an earlier finish, avoiding or reducing the impact of end of season drought while increasing crop yields (Tabo et al. 2006, Tabo et al. 2007). Farmers use a number of techniques to enhance production and limit soil degradation.These strategies include crop rotation, the use of nitrogen fixing crops, increasing organic matterin the soil, and minimal tillage, among others. In terms of fertilizer applications, the United Nation's Food and Agriculture Organization (FAO) recommends the "judicious use of mineral fertilizers," using precision approaches to promote soil health (Collette et al., 2011). Similarly,the targeted application of small quantities of fertilizer has been promoted as a sustainable 'step up the ladder' of agricultural intensification (Aune&Bationo, 2008). While recommended dosages have been determined through government-sponsored research, these recommended doses are often unaffordable for the rural poor or unattainable given limited availability. In response, researchers at ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) developed a technique known as fertilizer microdosing, involving the precision application of small (less than the recommended dosage) quantities of inorganic fertilizer.Previous studies in West Africa in particular, have found microdosing to be aneconomically advantageous technique, while also addressing limited access (both physical economic)

to inputs, as compared to alternative fertilizer application techniques, such as broadcasting at recommended dosages (Camara et al., 2013; Hayashi et al., 2008; Tabo et al,.2011; Twomlow et al., 2010).Wheat production in Sudan started thousands of years ago on the fertile soil of banks of the Nile in northern and River Nile State. In the Sudan wheat is the main staple food crop in urban areas and second to sorghum in many irrigated rural areas. Recently, however, the demand for the crop increased as a result of the increase in urbanization, increase in population and also due to the change in the consumer's taste (Elamin, 2000). The low productivity of wheat in the Sudan could be attributed to a number of obstacles and constraints top of these non availability of high yielding varieties adaptable to stress environment, and suitable for cultivation in marginal lands, coupled with other constraints, such as plant density, irrigation restrictions, harvesting practices, biological factors, and nutrition or fertilization practices (Ageeb, 1993).

Main objective

1-Study the effect of fertilizer types and doses

2-To determine the most suitable dose

3-To use microdosing as new technique

Materials and Methods

Research site;-

The field of experiment was conducted at the experimental farm, Sudan University of Science and Technology. Collage of Agriculture Studies, Shambat (Lat.15^0 40 N, Long. 32^0 32 E and at of 380 meters above sea level) during winter season (in the period from November 2018 to Fabruary 2019 for winter season). The experiment designed to study andassesse of fertilizer type and doses on performance of wheat growth, yield and yield components. The experiment was arranged in split plot based on arandomized complete block designwith four replications. The main plot was allotted for the three type of fertilizers, the Urea(46% N), NPK(20.20.20) and Monoamonium phosphate (MAP,12.61.0). The sub plot is denoted to the amount added (zero, 1, 2, 3 and 4 g). The three types of fertilizer added to the experiment at sowing date and together with watering intervals which was conducted every 10-13 days. Each three type was planted in ridges, 4meters-long, 70 cm between ridges and

20 cm between holes. Seeds rate was 3-5 seeds/holes, the seeds were sown manually. Weeding was done manually whenever needed.Variety is argeen obtained from Department of crop science college of agriculture University of Bahri.

Parameters Studied;-

Plant height (cm)

The plant height was measured from soil surface to the tip of the plant and average means from five randomly selected plants from middle two rows of each plot was calculated.

Number of leaves/plant

The average number of leaves per plant from five randomly selected plants from middle two rows of each plot was calculated.

Number of tillers/row meter

Average number of tillers per row meter from two random lengths of two middle rows was recorded.

Spike length (cm)

The average of spike length was measured from five randomly selected spikesfrom two middle rows of each plot.

Number of grains/spike

Average number of grain per spike was counted from five randomly selected spikes from middle two rows of each plot was calculated.

1000 grain weight(g)

The grain weight was obtained by weighing 1000 grain selected at random from each plots.

Fresh weight (g)

Average of five plants from randomly selected plot were weighed and the fresh weight per plant was recorded.

Dry weight (g)

Average of five plants from randomly selected plot were dried by sun, weighed and the dry weight per plant was recorded.

Yield /plant (g)

Average of five plants from randomly selected plot weretaken and the seed per plant was recorded.

Yield/hectare (Kg)

The yield per plot of (12 m^2) was converted in to kg/ha.

By the equation.

Seed weight*square meter*10000/1000

Statistical analysis

The data collected was analyzed by the standard analysis of variance means (ANOVA) using MSTATC-C. Then the means were separated using LSD**.**

Results and Discussion

Plant growth and yield parameters:-

Plant height (cm)

The plant height was significant for the fertilizer type and for interaction, while it was highly significant for dosing (table 1).

Urea gave highly significant plant height (90.5cm) than the other two type. However, NPK and MAP gave non-significant different (table 2)Similar results were given by Kenbaw& Sade 2002. Also there was significant difference for interaction and Urea with 4g dosing which gave tallest plant height (90.5cm) where the lowest was given by control(63cm) (table 4).There was highly significant difference for dosing and 1g,2g and 4g gave the highest plant height(82.9cm) where the lowest was given by control(66.5cm) table3.This might be due to the effect of fertilization on wheat growth.Similar results were given by Ragaei, (2008). The growth rate of the plant height showed increasing rate with time and highest height was observed at 90days for MAP(Figure 1),NPK(Figure 2) and Urea(Figure 3). However, Urea had the highest plant height than MAP and NPK at all growth stages.this was due to the highest amount of nitrogen in Urea than in the other fertilizers.

Leaves/plant

The leaves per plant were significant different for fertilizer type and dosing, while it was not-significant for interaction table 1.

Urea gave significant higher leaves per plant(5.5) than the other two type. Howevere, NPK and MAP gave non-significant difference(table 2). 1g,2g,3g and 4g micro dosing was non-significant and the highest was given by 4g(5.6) where lower the by control(4.7) (table 3).The increase in number of leaves per plant with Urea might be due to promotion of growth as Urea had a higher nitrogen percentage than the other fertilizers. Similar result were given by Khalil et al., (2011). Table 4 showed non-significant different for interaction. The growth rate of the leaves per plant showed increasing rate with time and the highest number of leaves per plant was observed at 90days for MAP (Figure 4),NPK (Figure 5) and Urea (Figure 6). However, Urea had the highest number of leaves per plant than MAP and NPK at all growth stages.This is obvious as Urea contains more nitrogen which can move faster in both soil and plant.

Spike Length (cm)

The spike length was highly significant for fertilizer type and dosing, while it was non-significant different for interaction table (1).

Urea gave highly significant spike length (9.1 cm) than the other two type. However, NPK and MAP gave non-significant different (table 2), also there was highly significant different for dosing and 3g dosing had the highest spike length (9.2cm) where the lowest was obtained by control (7.5cm)the spike length increased with increasing dosing (table 3), while there was non-significant different for interaction (table 4).The increase of spike length with increase of dosing might be due to the effect of increasing dose of nitrogen. The results were in agreement with Ling &Silberbush (2002), Woolflok et al., (2002) and Okoetal., (2003).

Number of grains/spike

Table 1 showed significant different for fertilizer type and dosing, while it was non-significant different for interaction.

Urea gave significantlyhigher grain per spike (32.5) than the other two type. However, NPK and MAP gave non-significant different (table 2), 1g,2g,3g and 4g gave significantlyhigher (31,31,31.2,32)than the control(29) (table 3), while it was non-significant different for interaction (table 4).Increasing the dose in all fertilizers increase number of grains

per spike as the plant benefited from the available fertilizer. These results were in accordance with Alam et al., (2007).

Fresh Weight(g)

The effect of fertilizer type and dosing was highly significant on fresh weight, while it was non-significant different for interaction (table 1) .Urea gave highly significant fresh weight (203.8 g) than the other two type . However MAP and NPK showed non-significant different (178g) (table 2), 3g and g4 gave highly significant difference(204g)than the other where 1g,2g and control were not significant with the lowest weight for the control (147g)and highest weight by 4g(204g) (table 3).the high fresh weight for Urea can be explained by the fact that Urea contains more nitrogen than the others and the higher dose was properly utilized.Similar results were given by(Mohamed , 2016) , while there was non-significant difference for interaction(table 4).

Dry weight (g)

The dry weight was highly significant different for fertilizer type and dosing , while there was non-significant different for interaction (table 1).Urea gave highly significant dry weight (49.9g) than the other two type. However NPK and MAP were non-significant different(table 2).Similar results were given by(Mohamed , 2016). 2g,3g and 4g gave highly significant different for dry weight(51g) than the 1g and control(40g) (table 3), while there was non-significant different for interaction (table4).

Number of tillers/row meter

The tiller per row meter was highly significant different for fertilizer type, while it was non-significant different for dosing and interaction (table 1)Urea gave significant different tiller per row meter (217 plant) than the other two type. However, NPK and MAP gave non-significant difference(165.2,157 plant) (table 2).Urea might be due to the higher nitrogen content than the other two fertilizer s as nitrogen promote growth.These results were in line with Bakht etal., (2010)and might be due to the fact that nitrogen is an essential element for growth and development and thus promoted the vegetative growth., these was no-significant difference for dosing and the highest by 3g(186plant) and lowest by control (174) (table 3), and interaction effect on tiller per row meter was non-significant different (table 4).

Thousand grain weight (g)

Table 1 indicated that there was highly significant difference for type and dosing, while it was significant different for interaction (table 1).Urea and NPK gave highly significant thousand grain weight(43.3g) than the MAP (table 2), 4g dosing gave highly significant different for thousand grain weight(42.9g) than the other doses (table 3)The increase in 1000-grain weight in 4g dosing could be related to flag leaffeeding and its closeness to spike (sink).Similar results were reported by(Rajaei etal,2008), these was significant difference for interaction and Urea with 2g had the highest thousand grain weight(46g) (table 4).

Yield/plant (g)

The yield per plant was highly significant for fertilizer type and dosing, while it was non-significant different for interaction (table 1). Urea gave highly significant yield per plant (2.9 g) than the other two types. However, NPK and MAP gave non-significant different(table 2).1g,2g,3g and 4g gave highly significant different yield per plant(2.8 g) than the control (2.2) (table 3)Theincrease in grain yield was due to the increase in appliedN rate which formed a strongsource.Similar results were shown by(Yasin et al 2014).these was nosignificant difference for interaction (table 4).

Yield /hectare (kg/ha)

The yield per hectare was highly significant different at(p.0.01)for fertilizer type, dosing and interaction(table 1).Table 2 showed highly significant different at for fertilizer type and Urea gave highest yield per hectare (1028.3kg/ha) where lowest by MAP (778.2kg/ha) (table 2), also 1g,2g,3g and 4g gave highly significant different yield per hectare (1023kg/ha) than the control (520.9kg/ha) (table 3) the increase yield with increase dose for all fertilizers was due to utilization of the plant to the different forms of fertilizers.Similar results were obtained by(Yasin et al 2014). While urea with 1g,2g,3g and 4g gave highly significant different yield per hectare(1233kg/ha) than the others where the lowest was obtained by control (555kg/ha)(table 4)Application of

N had significantly increased grain weight as compared withcontrol and increased with increase in N.These results were in agreement with Kambhar eat al,(2007).

Table 1:Summary of ANOVA table for wheat experiment

Source of variation	DF	Plant hight (cm)	leave/ plant	Spike Length (cm)	grain/ spike	Fresh weight (g)	Dry weight (g)	Tililer/ row meter	thousand (g)	yield/ plant	yield/ hactar
Replication	3	2.77	0.65	6.52	0.65	3.99	2.33	0.26	3.39	0.56	1.64
FERTI.. LIZER	2	10.14^{*}	4.50^{*}	8.20^{**}	11.48^{*}	15.9^{**}	96.5^{**}	13.19^{**}	15.9^{**}	30.17^{**}	52.39^{**}
EROR A	6	--	--	--	--	--	--	--	--	--	--
Concentration	4	6.53^{**}	2.69^{*}	4.19^{**}	3.44^{*}	12.77^{**}	19.6^{**}	0.28	12.8^{**}	10.01^{**}	110.76^{**}
F*C	8	1.93^{*}	0.94^{Ns}	0.20^{Ns}	0.86^{Ns}	0.27^{Ns}	1.08^{NS}	0.37^{Ns}	0.27^{*}	1.81^{NS}	6.81^{**}
EROR B	36	--	--	--	--	--	--	--	--	--	--
TOT	59	--	--	--	--	--	--	--	--	--	--
C.V		11.60	13.0	13.07	5.93	12.33	7.31	17.79	12.33	10.09	7.66

NB.* indicates significance difference ,** means high significant difference. Ns indicate non-significant difference**.**

Table 2: Means of fertilizer type for yield parameters in wheat

fertilizer	Plant hight (cm)	Leave /plant	Spike length (cm)	Grain/ Spike	Fresh weight (g)	Dry weight (g)	Tililer/ row meter	thousand (g)	Yield /plant (g)	yield/ hactar (g)
MAP	70.31[b]	5.10[c]	8.24[b]	29.70[b]	170[b]	44.3[b]	165.15[c]	36.89[b]	2.27[c]	778.22[c]
NPK	71.48[b]	5.30[b]	8.29[b]	30.90[b]	178.7[b]	46.3[b]	157.05[c]	40.91[a]	2.49[b]	812.38[b]
Urea	90.50[a]	5.50[a]	9.12[a]	32.08[a]	203.8[a]	49.9[a]	217.76[a]	43.58[a]	2.91[a]	1028.34[a]
Mean	77.4	5.3	8.6	31.1		46.9	180	40.7	2.6	873

Means within column followed by the same letter(s) were not significantly different according to LSD test at 5% level.

Table:3 fertilizer concentration for yield component of wheat microdosing.

Concentration	Plant hight (cm)	Leave/Plant	SPike Length (CM)	Grain/SPike	Fresh weight (g)	Dry weight (G)	Tililer/ row meter	thousand (G)	yield/ plant	yield/hactar
Control	66.6[c]	4.7[b]	7.46[c]	29.70[ab]	147[c]	40.3[b]	174.75[ab]	33.9[b]	2.18[c]	520.98[c]
1g	82.8[a]	5.4[a]	8.58[ab]	31.17[a]	179.3[b]	44.6[b]	175.25[ab]	40.4[a]	2.4[ab]	883.4[b]
2g	81.3[a]	5.4[a]	8.33[ab]	31.42[a]	186.9[b]	48[a]	181.08[a]	41[a]	2.68[a]	959[ab]
3g	75.8[ab]	5.3[a]	9.22[a]	31.16[a]	203.4[a]	49[a]	186[a]	42.2[a]	2.68[a]	977.8[ab]
4g	80.8[a]	5.6[a]	8.87[a]	32.55[a]	204.3[a]	51[a]	182.8[a]	44.7[a]	2.76[a]	1023.9[a]
Mean	77.4	5.3	8.6	31.1	184.2	46.9	180	40.7	2.6	873

Means within column followed by the same letter(s) were not significantly different according to LSD test at 5% level.

Table:4 Interaction of fertilizer and concentration of yield component of wheat microdosing.

Fertilizer	Concentration	Plant height (cm)	leavs/ plant	Spike lengh (cm)	grain/ spike	Fresh weight (g)	Dry weight (g)	tillers/ row meter	1000 (g)	Yield/ pant (g)	Yield/ hectare (g)
MAP	Cont	67.8^{ab}	4.8^{ab}	7.3^{b}	28.8^{ab}	137^{c}	42^{b}	170^{a} b	33^{b}	2.2^{ab}	555^{c}
	1g	72.3a	5^{a}	8.1^{ab}	30.3^{a}	170^{b}	40^{b}	145^{c}	34.9^{b}	2.2^{ab}	793.4^{b}
	2g	76.6^{a}	5.4^{a}	8.2^{ab}	29.8^{ab}	170^{b}	45^{a}	165^{b}	36.5^{ab}	2.3^{a}	840.3^{a}
	3g	67.5^{ab}	5^{a}	9.1^{a}	29.8^{ab}	185^{a}	47^{a}	180^{a}	38^{a}	2.4^{a}	850^{a}
	4g	67.5^{ab}	5.5^{a}	8.5^{ab}	30^{a}	187^{a}	45^{a}	165^{b}	41.6^{a}	2.3^{a}	852.5^{a}
NPK	Cont	63.2^{c}	4.5^{ab}	7.3^{b}	30^{a}	145^{c}	38^{c}	140^{b}	35^{c}	2.1^{ab}	494^{c}
	1g	76.8^{a}	5.8^{a}	8.1^{ab}	31^{a}	170^{b}	45^{b}	161^{a}	40^{b}	2.5^{ab}	805.4^{b}
	2g	72^{ab}	5^{a}	8.5^{ab}	30.75 a	185^{b}	48^{a}	160^{a}	40^{b}	2.7^{a}	876.4^{ab}
	3g	70.2^{ab}	5.8^{a}	9.1^{a}	31^{a}	197^{a}	48^{a}	158^{a}	42.6^{a}	2.5^{ab}	900^{ab}
	4g	75.3^{a}	5.5^{a}	8.5^{ab}	31.75 a	195^{a}	52^{a}	165^{a}	45.5^{a}	2.7^{a}	985.8^{a}
Urea	Cont	68.7^{b}	5^{ab}	7.9^{ab}	29.5^{ab}	157^{c}	40^{b}	214^{b}	33^{b}	2.3^{ab}	513.9^{c}
	1g	99.3^{a}	5.5^{ab}	90^{a}	32.3^{a}	197^{b}	47^{a}	219^{a}	45^{a}	2.8^{ab}	1051^{b}
	2g	95.3^{a}	6^{a}	9.3^{a}	33.8^{a}	205^{b}	52^{a}	218^{a}	45.7^{a}	3.03^{a}	1160^{ab}
	3g	89.7^{ab}	5.3^{ab}	9.4^{a}	32.8^{a}	227^{a}	53^{a}	220^{a}	46^{a}	3.2^{a}	1182^{ab}
	4g	99.6^{a}	5.8^{ab}	9.6^{a}	34.5^{a}	230^{a}	55^{a}	217^{a}	47.1^{a}	3.3^{a}	1233^{a}
Mean		77.4	5.3	8.6	31.1	184.1	46.9	180	40.7	2.6	873

Means within column followed by the same letter(s) were not significantly different according to LSD test at 5% level.

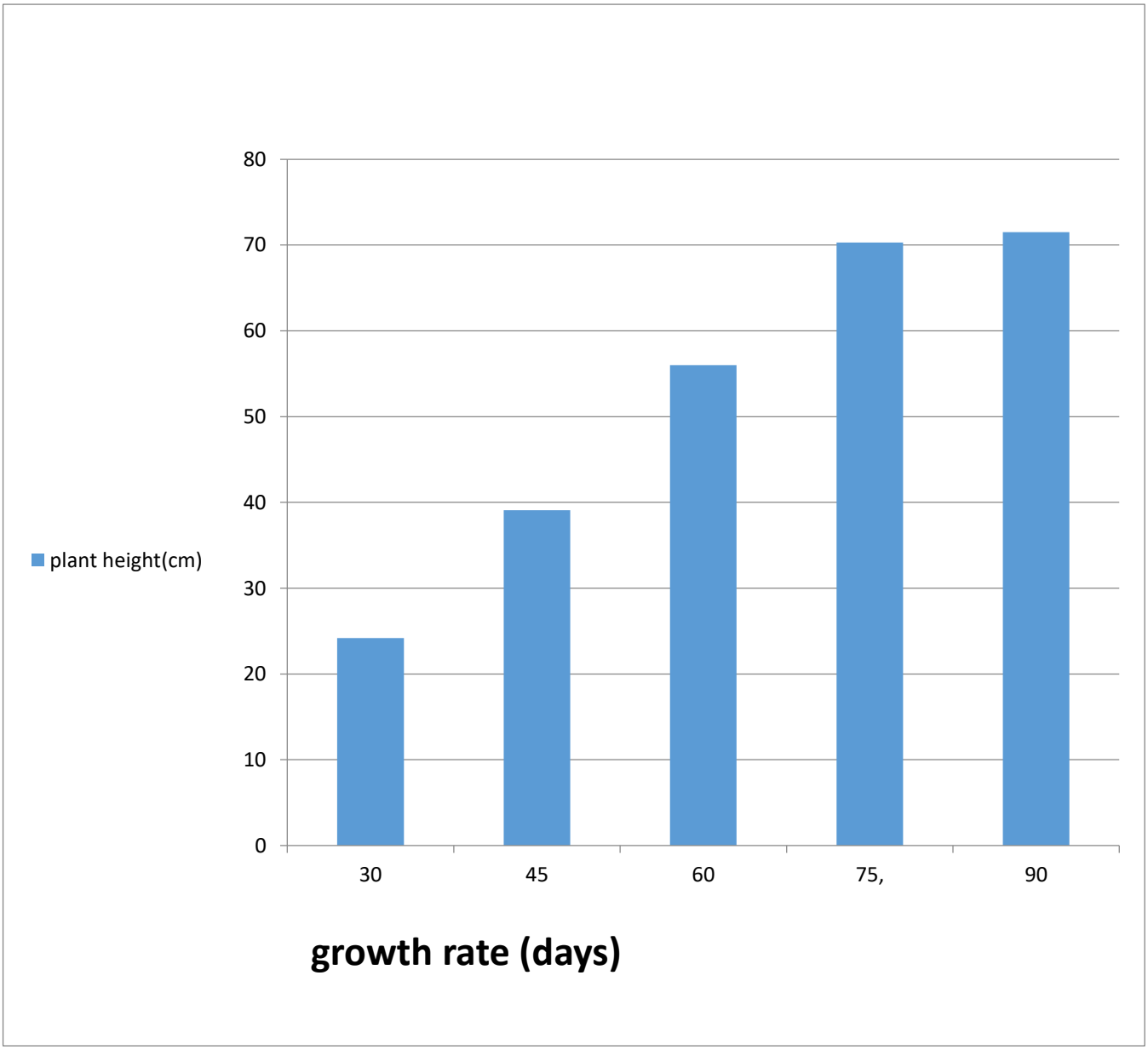

Figure (1) Effect of MAP on plant height and growth rate (days).

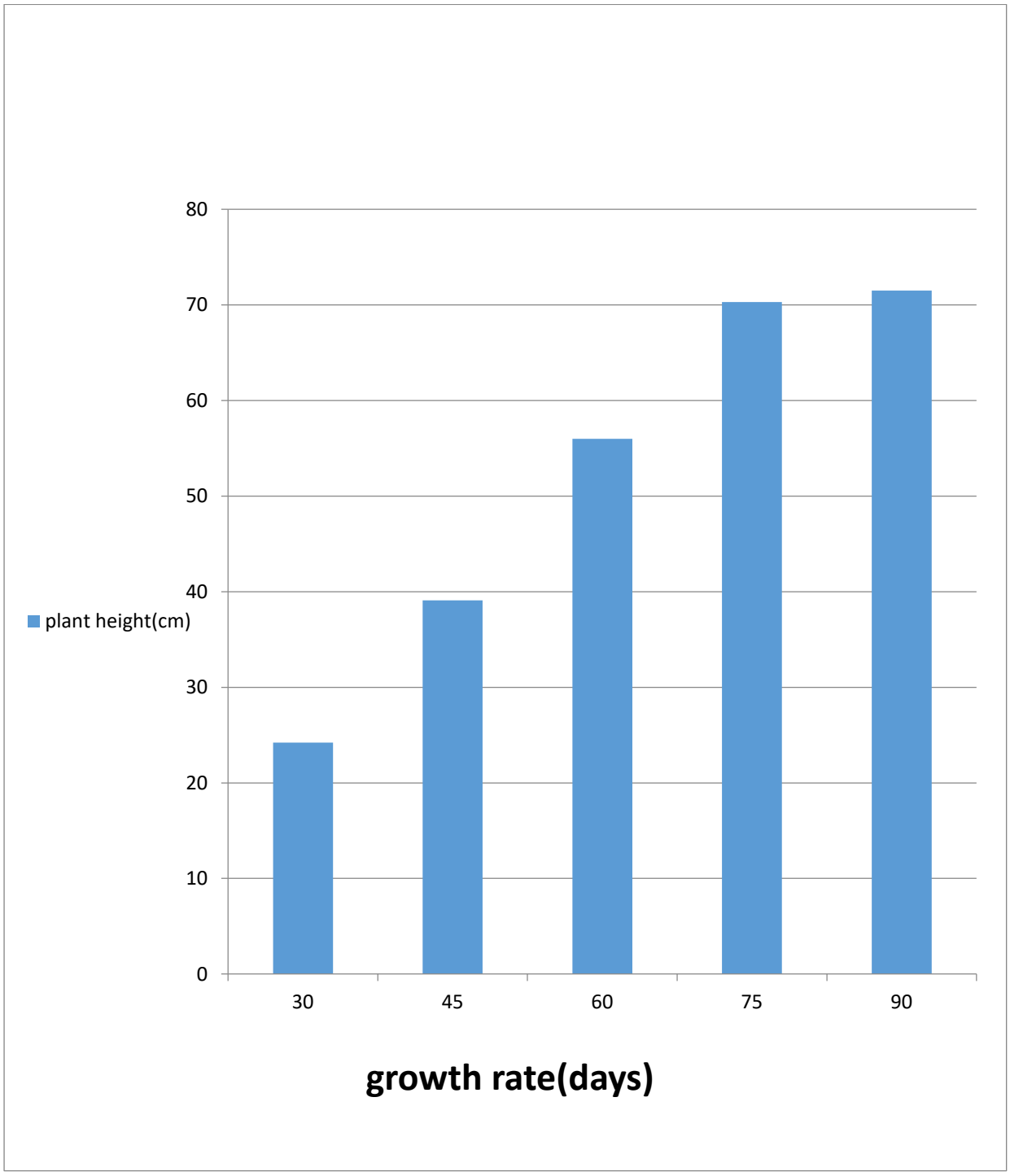

Figure (2) Effect of NPK on plant height and growth rate (days).

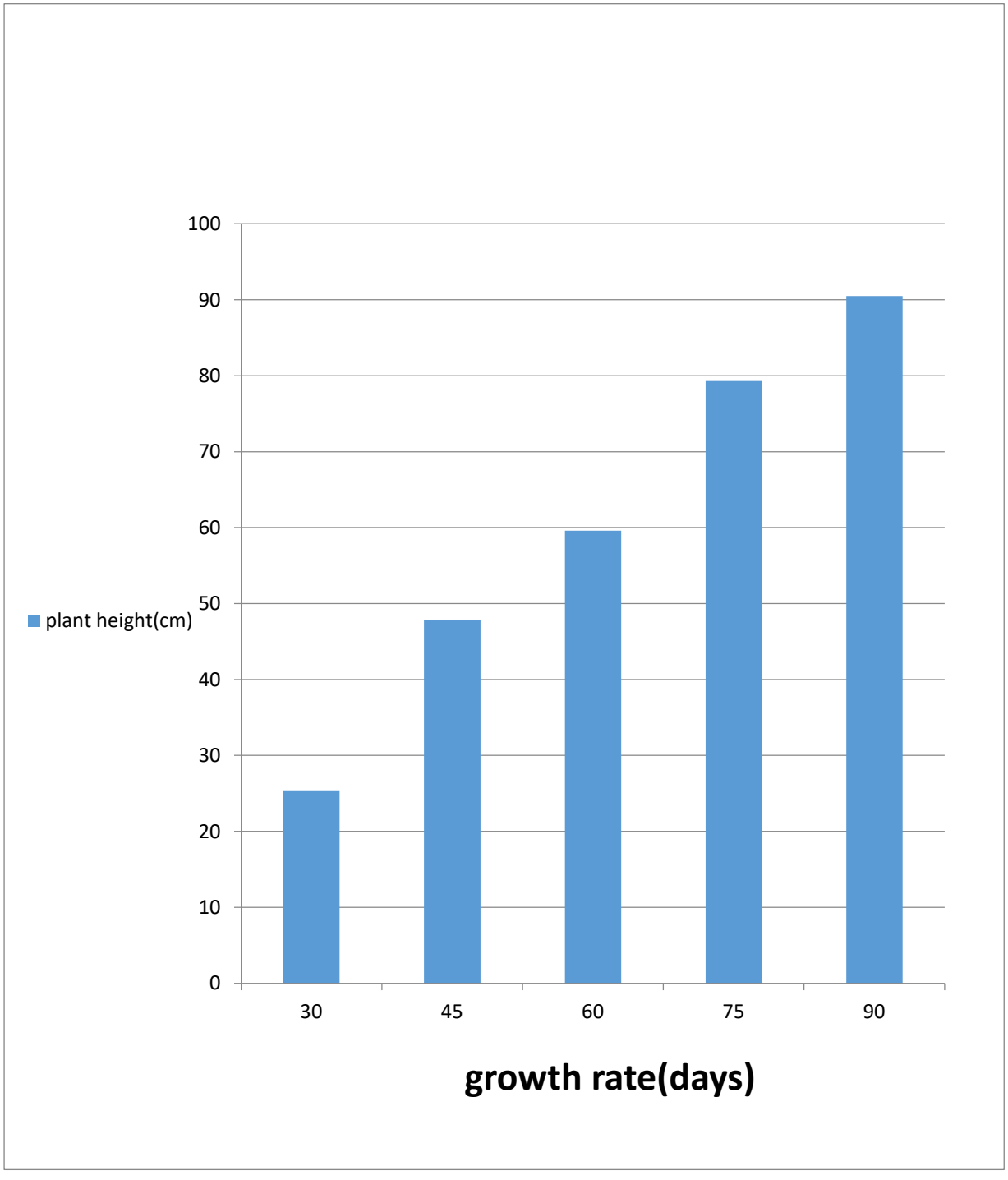

Figure (3) Effect of Urea on plant height and growth rate (days).

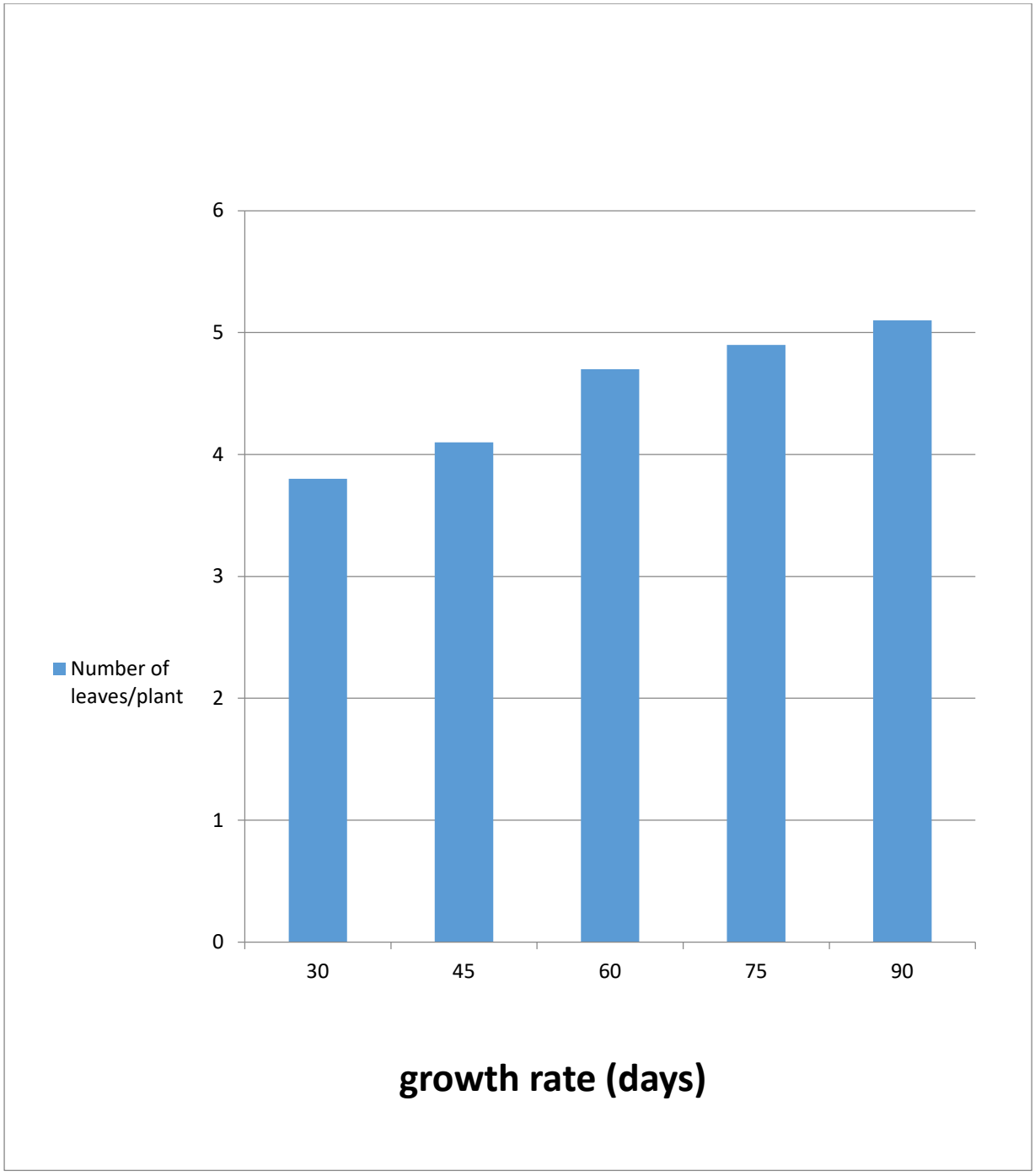

Figure (4) Effect of MAP on leaves per plant and growth rate (days) .

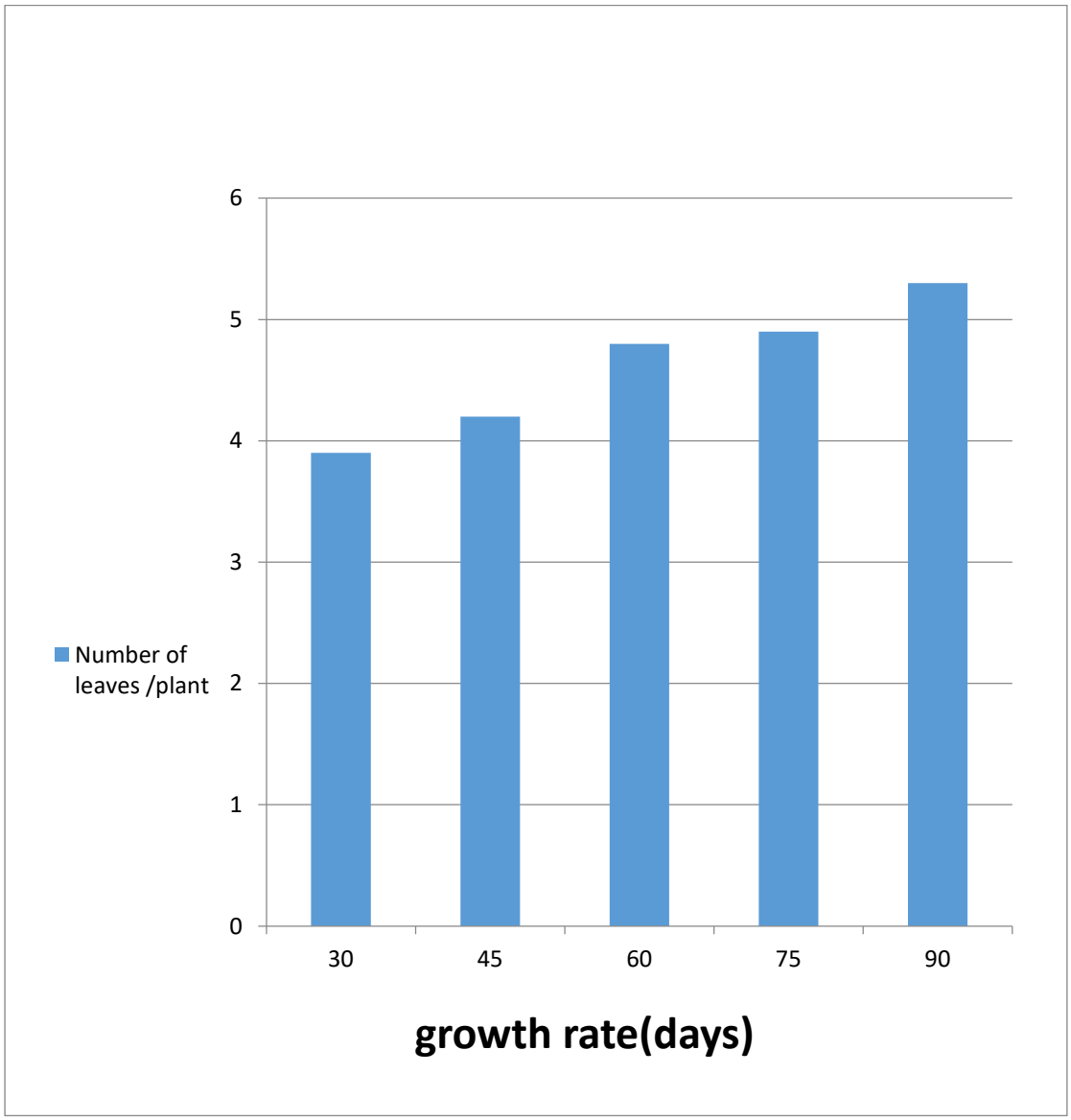

Figure (5) Effect of NPK on leaves per plant and growth rate (days) .

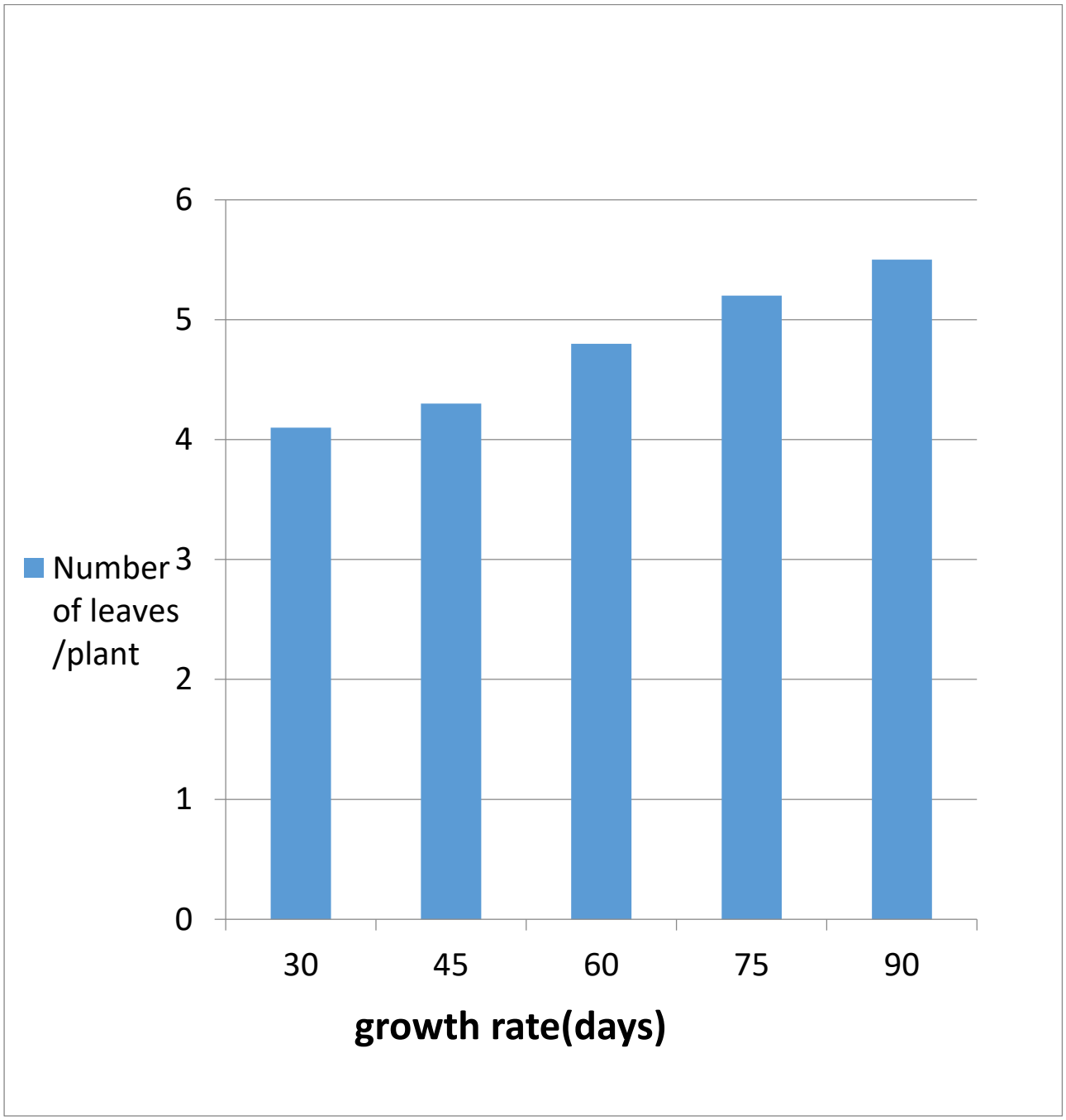

Figure (6) Effect of Urea on leaves per plant and growth rate (days) .

CONCLUSIONS

- The present study indicated that :-

1- fertilizer types and dosing significantly affected the dual purpose of Wheat micro-dosing.

2- Urea applied with 4g doses increased grain yield per hectare (kg/ha).

3- It is economically and sound for small household farmers to use microdosing.

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

- **It could be recommended that more research is needed to evaluate effect of microdosing**.

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