Original Research Article

Effect of Potassium and Gibberellic acid on some growth parameters and yield of okra

ABSTRACT

The experiment was conducted at the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka during April to August 2015. BARI Dherosh-1 was used in this experiment. The experiment consisted of two factors viz., Potassiumfertilizer as K0: 0 kg K2O/ha (control) , K1: 60 kg K2O/ha, K2: 90 kgK2O/ha and K3: 120 kg K2O/ha; and Gibberellic acid (3 levels) as G0: 0 ppm GA3 (control) G1: 60 ppm GA3, G2: 90 ppm GA3 respectively. The experiment was laid out in Randomized Complete Block Design with three replications. All the parameters were significantly influenced by different levels of potassium and gibberellic acid. Due to the effect of potassium, the highest yield (19.04 t/ha) was observed from K3 and the lowest yield (12.11 t/ha) from K0. In case of Gibberellic acid, the highest yield (17.08t/ha) was found from G2 and the lowest yield (16.01 t/ha) from G0. From growth, yield and economic point of view, it is apparent that the application of 120 kg K2O/ha with 90 ppm GA3 was the best for growth and yield of okra.

Key words: Okra, Potassium, Gibberellic acid, Growth, Yield

INTRODUCTION

Okra, often referred to as "Dherosh" or "Bhindi" in the local dialect, is a crop belonging to the Malvaceae family (*Abelmoschus esculentus* L.). It is a vegetable crop that is grown annually in tropical and subtropical regions of the globe. It is a vegetable that is used in many parts of the world, particularly in underdeveloped nations,[1]. Okra is prized in particular for its delicate, tasty, and vitamin- and mineral-rich edible pods. Okra's delicate green pods have 2.2% protein, 0.2% fat, 9.7% carbohydrates, 1.0% fiber, and 0.8% ash[2]. One of Bangladesh's principal summer crops is okra. An estimated 30118.73 acres are used for okra farming in Bangladesh, producing roughly 70242.27 tons of green pods annually [3]**.** Gibberellic acid and potassium have a significant impact on okra production. These two nutrients can boost production. Gibberellic acid significantly affects the development of pods and plant height. Auxins, gibberellins, and cytokinins are examples of plant growth regulators that are employed in agriculture to improve growth and yield responses, which in turn increase agricultural productivity[4,5]. Plant responses ranging from germination of seeds to senescence are mediated by gibberellins (GAs)[6].Gibberellic acid (GA3) is the most generally available substance; it promotes fruit setting and growth, germination of seeds, elongation of stems and internodes, and the creation of enzymes during germination[7,8,6]**.**Okra growth and yield were regulated by potassium levels. The activation of several metabolic processes, such as protein synthesis, photosynthesis, and enzyme activation, as well as the development of disease and pest resistance, depend on potassium, an essential macronutrient for plant growth [9].The present study carry out to determine the optimum level of gibberellic acid andpotassium on growth and yield of okra on growth and yield of okra.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Horticulture Farm of Sher-e-Bangla Agricultural University (SAU), Dhaka, during the period from April to August 2015.

Planting materials

BARI Dherosh-1 was used as a planting material in this experiment

Treatment of the experiment

The experiment consisted of two factors:

Factor A: Potassium fertilizer (4 levels) as

i. K0: 0 kg K2O/ha (control)

ii. K1: 60 kg K2O/ha

iii. K2: 90 kg K2O/ha

iv. K3: 120 kg K2O/ha

Factor B: Gibberellic acid (3 levels) as

i. G0: 0 ppm GA3 (control)

ii. G1: 60 ppm GA3

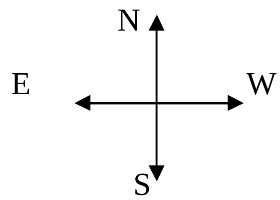
iii. G2: 90 ppm GA3

There were 12 (4 × 3) treatments combination such as K0G0,K0G1,K0G2,K1G0,K1G1,K1G2,K2GO,K2G1,K2G2,K3G0,K3G1,K3G2,

Design and layout of the experiment

The two factors experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The total area of the experimental plot was 175.56 m^2 with length 20.9 m and width 8.4 m. The total area was divided into three equal blocks. Each block was divided into 12 plots where 12 treatments combination were allotted at random. There were 36 unit plots altogether in the experiment. The size of the each plot was 1.8 × 1.2 m. The distance maintained between two blocks and two plots were .75m and 0.5 m, respectively

K_0G_0	K_1G_1	K_3G_2
K_0G_2	K_2G_2	K_0G_0
K_1G_0	K_3G_2	K_2G_0
K_2G_2	K_2G_1	K_1G_0
K_3G_0	K_0G_1	K_2G_1
K_1G_2	K_0G_0	K_0G_2
K_0G_1	K_1G_2	K_3G_0
K_3G_2	K_1G_0	K_3G_1
K_3G_1	K_3G_0	K_1G_1
K_1G_1	K_2G_0	K_1G_2
K_2G_1	K_3G_1	K_0G_1
K_2G_0	K_0G_2	K_2G_2



Plot size=1.81 x.2m

Spacing=60 x 40cm

Plot distance=0.5m

Replication distance=0.75m

Factor A=Potassium(4 levels)as

i. K_0: 0 kg K_2O/ha (control)
ii. K_1: 60 kg K_2O/ha
iii. K_2: 90 kg K_2O/ha
iv. K_3: 120 kg K_2O/ha

Factor B: Gibberellic acid (3 levels) as
i. G_0: 0 ppm GA_3 (control)
ii.G_1: 60 ppm GA_3
iii.G_2: 90 ppm GA_3

Figure 1. Field layout of the experimental plot

Application of manure and fertilizers

Table 1. Dose and method of application of fertilizers in okra field (Fertilizer Recommendation Guide, BARC, 2012)

Manures and Fertilizers	Dose/ha	Application (%)		
		25 DAS	40 DAS	55 DAS
Cowdung	10 tons (basal)	-	-	-
Nitrogen (as urea)	150 kg	33.33	33.33	33.33
P_2O_5 (as TSP)	100 kg (basal)	-	-	-
K_20 (as MP)	As per treatment			

Seeds sowing

The okra seeds were sown in the main field at 25 April in 2015. Seeds were treated with Bavistin @ 2ml/L of water before sowing the seeds to control the seed borne diseases. The seeds were sown in rows having a depth of 2-3 cm with maintaining distance from 40 cm and 60 cm from plant to plant and row to row, respectively.

Data collection

Data were collected on following parameters

1 Plant height

2 Number of leaves per plant

3 Number of branches per plant

4 Days required for flowering

5 Number of flower buds per plant

6 Number of pods per plant

7 Yield per hectare

Statistical analysis

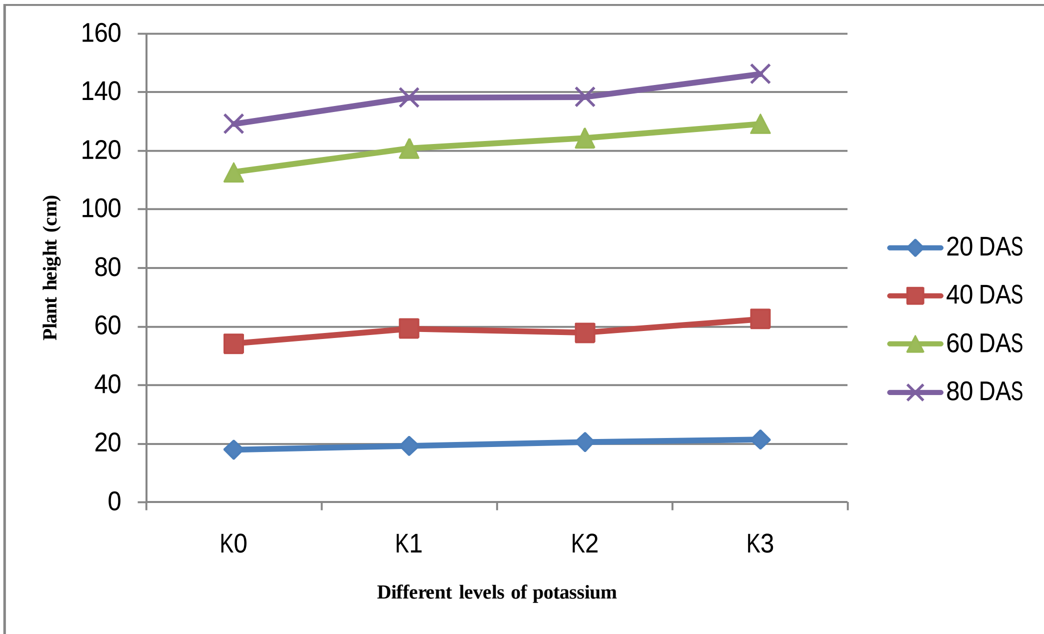
The data obtained for different characters were statistically analyzed by using MSTAT-C software to find out the significance of the difference for potassium and gibberellic acid on growth and yield of okra. The mean values of all the recorded characters were evaluated and analysis of variance was performed by the ‘F’ (variance ratio) test. The significance of the difference among the means of treatment combinations was estimated by Duncan’s Multiple Range Test (DMRT) at 5% level of probability [10].

RESULT AND DISCUSSION

Plant height

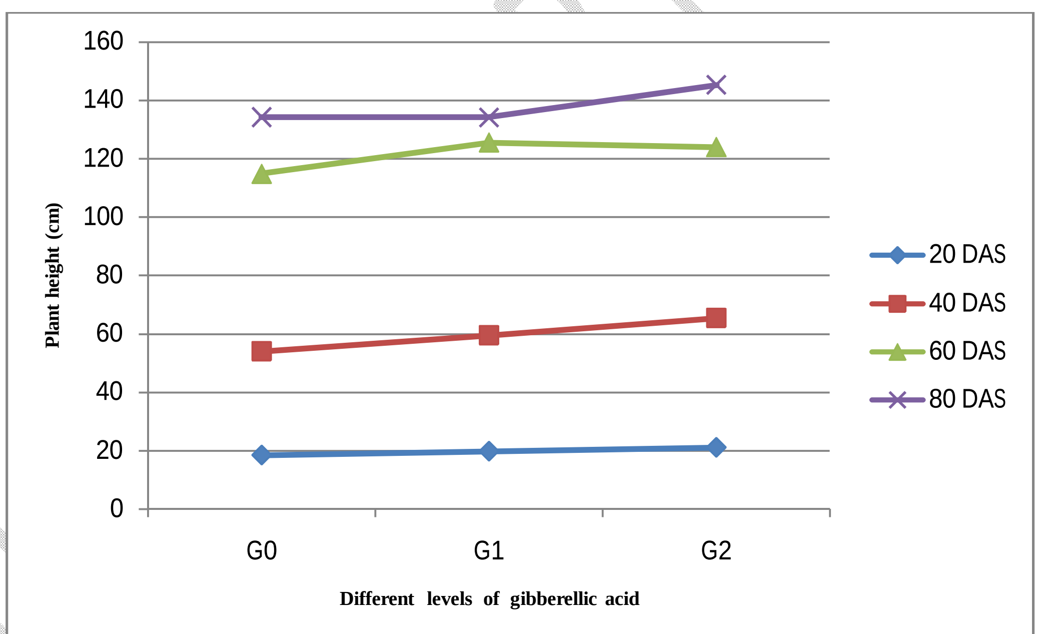
Plant height of okra varied significantly due to application of different levels of potassium at 20, 40, 60 and 80 DAS (Figure 2). Bhai and Singh stated that K application significantly increased the plant height[11]. At 20, 40, 60 and 80 DAS the tallest plant (21.4, 62.58, 129.2 and 146.2 cm) was recorded from K_3 (120 kg K/ha), whereas the shortest plant (18.04, 54.2, 112.7 and 129.2 cm) was obtained from K_0 (0 kg K/ha i.e. control condition). It was revealed that with the increase of potassium plant height increased up to a certain level. Potassium ensured favorable condition for the growth of okra plant with optimum vegetative growth and the ultimate results was tallest plant.

Different levels of gibberellic acid showed significant variation on plant height of okra at 20, 40, 60 and 80 DAS (Figure 3). Singh reported that GA_3 increased plant height of okra[12] .At 20, 40, 60 and 80 DAS the tallest plant (21.11, 62.02, 65.4 and 145.30 cm) was observed from G_2 (90ppm), and the shortest plant (18.57, 54.05, 114.90 and 134.40 cm) was observed from G_0.



(K_0: 0 kg K_2O/ha (control), K_1: 60 kg K_2O/ha, K_2: 90 kg K_2O/ha, K_3: 120 kg K_2O/ha)

Figure 2: Effect of different levels of potassium on plant height of okra.



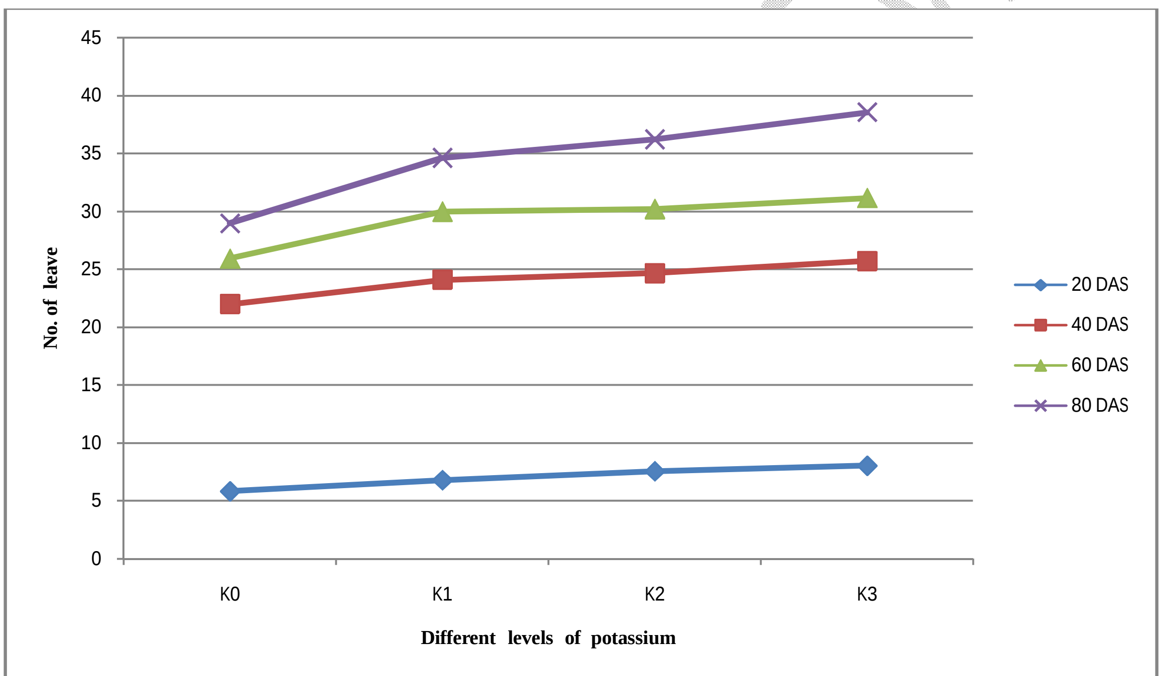
(G_0:0ppm GA_3, G_1: 60ppm GA_3, G_2:90ppm GA_3)

Figure 3: Effect of different levels of gibberellic acid on plant height of okra.

Number of leaves per plant

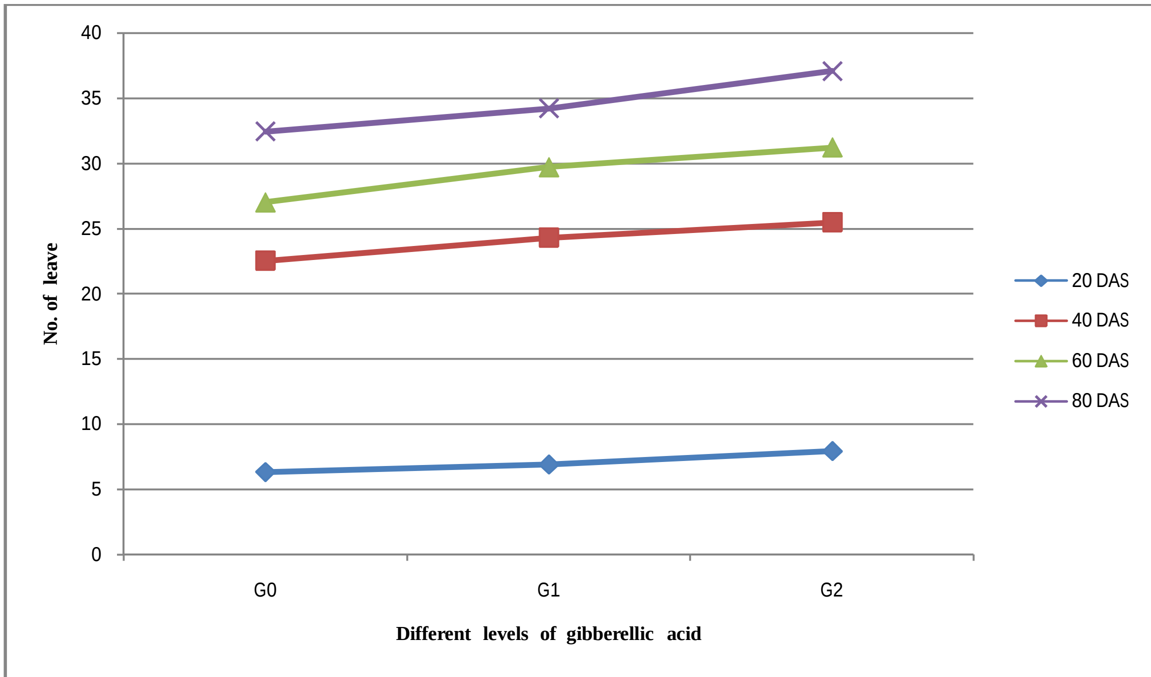
Significant variation was recorded for number of leaves per plant for different levels of potassium at 20, 40, 60 and 80 DAS of okra under the present trial (Figure 4). Rain andLal stated that okra showed superior performance during potassium fertilizer application with respect to number of leaves [13]. At 20, 40, 60 and 80 DAS the maximum number of leaves per plant (8.056, 25.72, 38.56 and 31.18) was recorded from K_3 while whereas the minimum number (5.867.22.01, 28.99 and 25.57) from K_0.

Due to application of different levels of gibberellic acid showed significant differences on number ofleaves at 20, 40, 60 and 80 DAS (Figure 5). Abdul reported that GA_3 increased leaf number [14]. At 20, 40, 60 and 80 DAS the maximum number of leaves per plant (7.958, 25.51, 31.25 and 37.1) was observed in G_2, while the minimum number of leaves per plant (6.367, 22.55, 27.04 and 32.47) was recorded from G_0 at the same days of observations.



(K_0: 0 kg K_2O/ha (control), K_1: 60 kg K_2O/ha, K_2: 90 kg K_2O/ha, K_3: 120 kg K_2O/ha)

Figure 4: Effect of different levels of potassium on number of leave of okra.



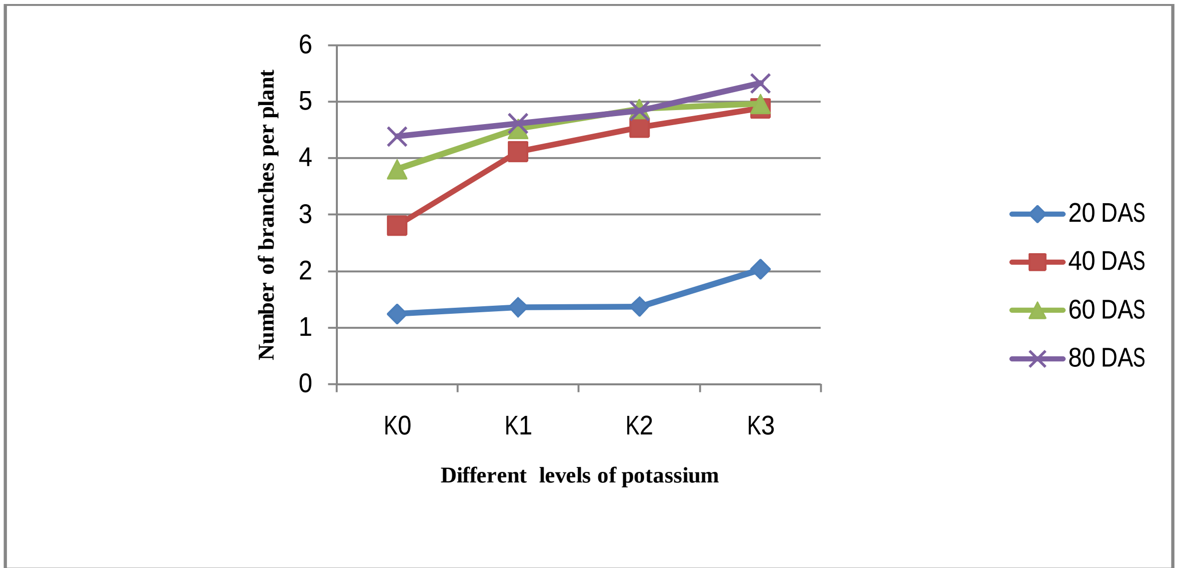
(G_0:0ppm GA_3, G_1:60ppm GA_3, G_2:90ppm GA_3)

Figure 5: Effect of different levels of gibberellic acid on number of leave of okra.

Number of branches per plant

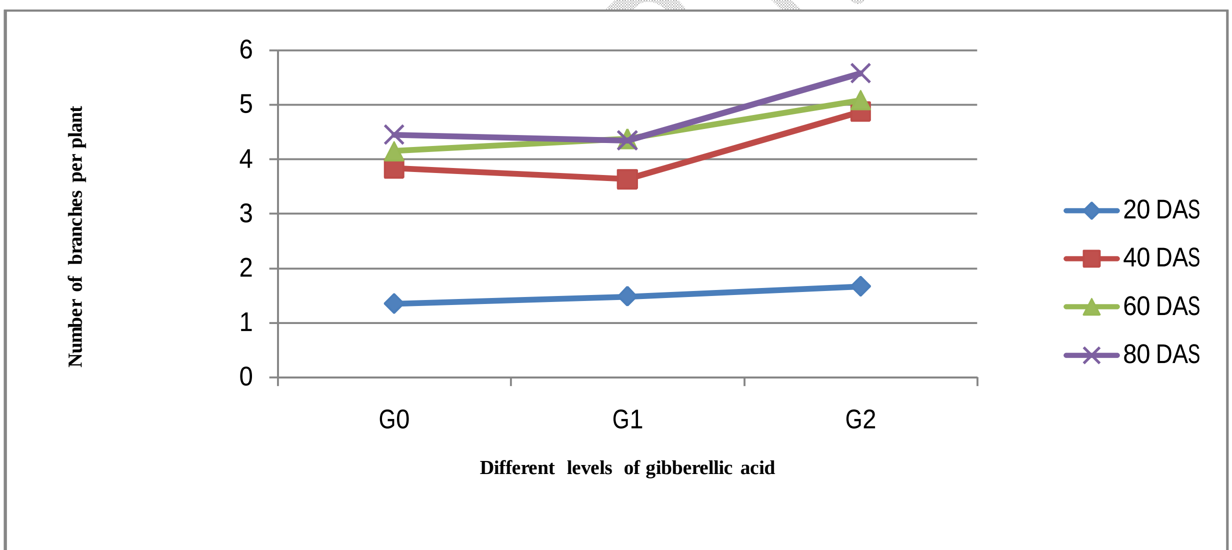
Number of branches per plant showed significant variation due to application of different levels of potassium at 20, 40, 60 and 80 DAS of okra under the present trial (Figure 6). At 20, 40, 60 and 80 DAS the maximum number of branches per plant (2.033, 4.889,4.967 and 5.333) was recorded from K_3 which was closely followed (1.378, 4.544, 4.878 and 4.844) by K_2, whereas the minimum number of branches per plant (1.248, 2.811, 3.811 and 4.389) from K_0.

A significant variation was recorded on number of branches per plant of okra at 20, 40, 60 and 80 DAS due to effect of different levels of gibberellic acid (Figure 7). Singh and Singh stated that maximum number of branchesper plant obtained 10-30 ppm GA_3[15]. At 20, 40, 60 and 80 DAS the maximum number of branches per plant (1.673, 4.88, 5.092 and 5.583) was observed in G_2, which was closely followed (1.488, 3.84, 4.158 and 4.458) by G_1 and the minimum number of branches per plant (1.357, 3.84, 4.158 and 4.458) was recorded from G_0.



(K_0: 0 kg K_2O/ha (control), K_1: 60 kg K_2O/ha, K_2: 90 kg K_2O/ha, K_3: 120 kg K_2O/ha)

Figure 6: Effect of different levels of potassium on number of branches per plant of okra.



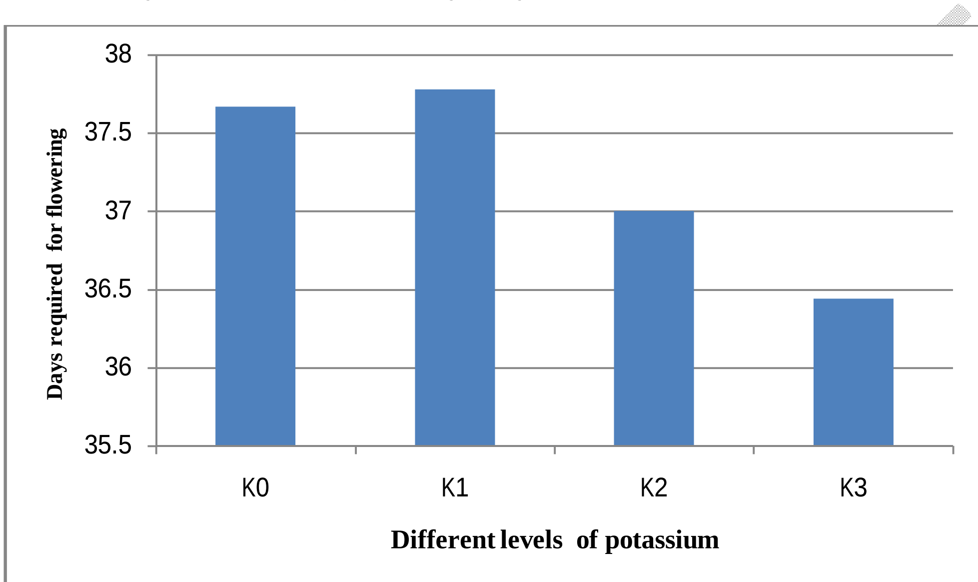
(G_0:0ppm, GA_3, G_1:60ppm GA_3, G_2: 90ppm GA_3)

Figure 7: Effect of different levelsof gibberellic acid on number of branches per plant of okra.

Days required for flowering

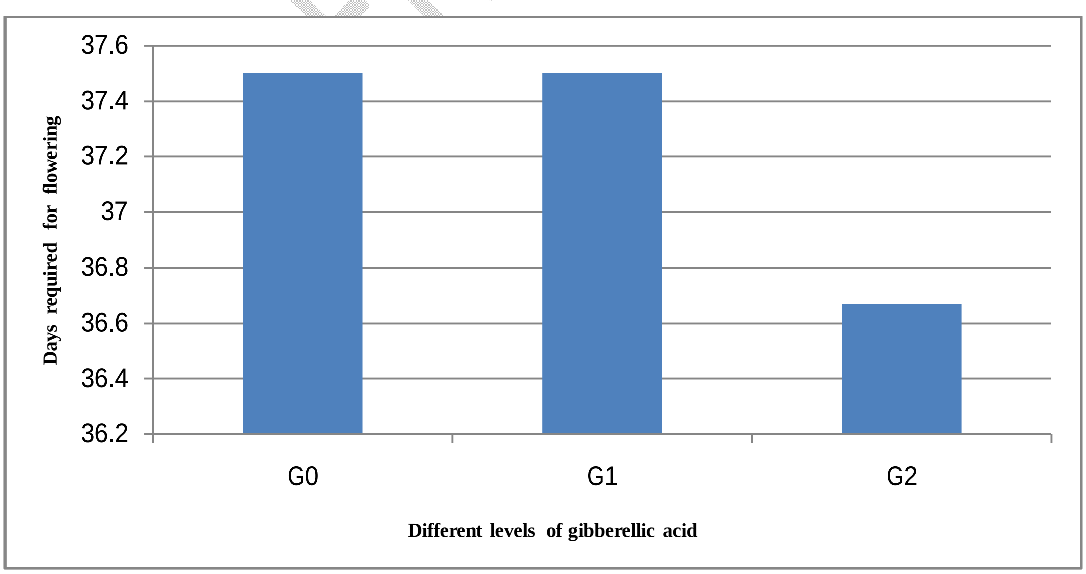
Days required for flowering varied significantly due to response of different levels of potassium (Figure 8). The minimum (36.44) days required for flowering was recorded from K_3, whereas the maximum (37.78) days was from K_1, which was statistically similar (37.67) to K_0.

Application of different levels of gibberellic acid showed significant variation on days required for flowering of okra (Figure 9). Singh stated that GA increased advanced flowering by 3.33 days [16]. The minimum (36.67) days for flowering was found from G_2.On the other hand, the maximum (37.5) days was obtained from G_0, which was statistically identical to (37.5 days) by G_1.



(K_1: 60 kg K_2O/ha, K_2: 90 kg K_2O/ha, K_3: 120 kg K_2O/ha)

Figure 8: Effect of different levels of potassium on days of flowering of okra.



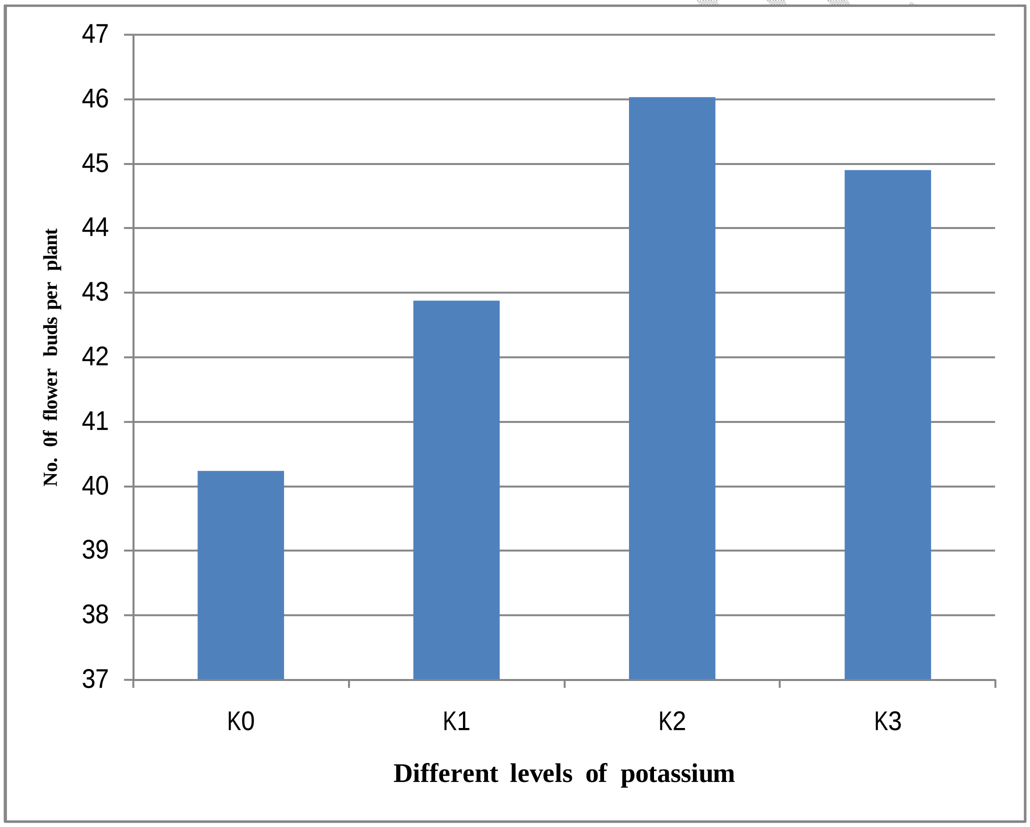
(G_0:0ppm GA_3, G_1:60ppm GA_3, G_2:90ppm GA_3)

Figure 9: Effect of different levels of gibberellic acid on days of flowering of okra.

Number of flower buds per plant

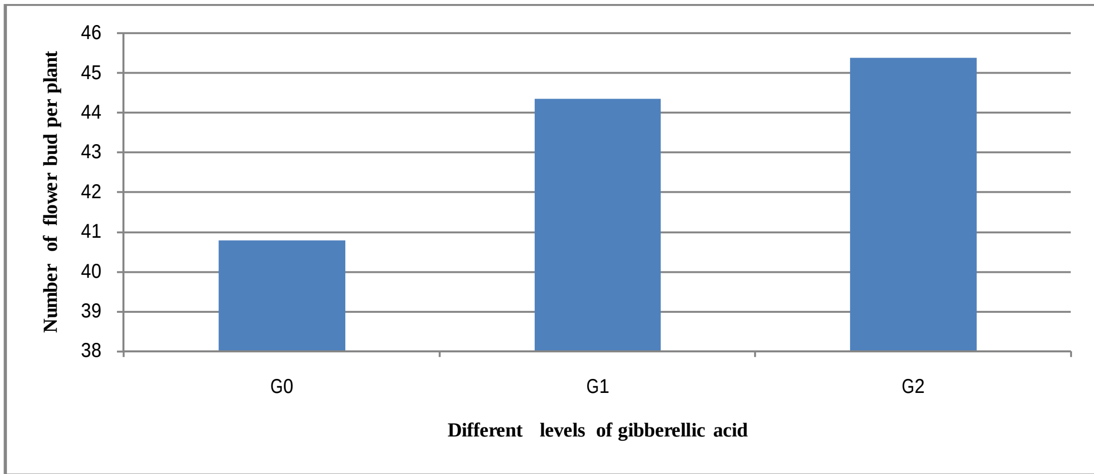
Significant variation was found due to application of different leaves of potassium on number of flower buds per plant (Figure 10). The maximum number of flower buds per plant (46.03) was counted from K_2 which was statistically similar and with K_3 (44.90), whereas the minimum (40.23) was obtained from K_0.

Due to application of different levels of gibberellic acid number of flower buds per plant varied significantly (Figure 11). The maximum number of flower buds per plant (45.38) was observed in G_2, which was statistically similar (44.35) to G_1 and the minimum (40.79) was recorded from G_0.



K_0: 0 kg K_2O/ha (control), K_1: 60 kg K_2O/ha, K_2: 90 kg K_2O/ha, K_3: 120 kg K_2O/ha)

Figure 10: Effect of different levels of potassium on number of flower buds per plant of okra.



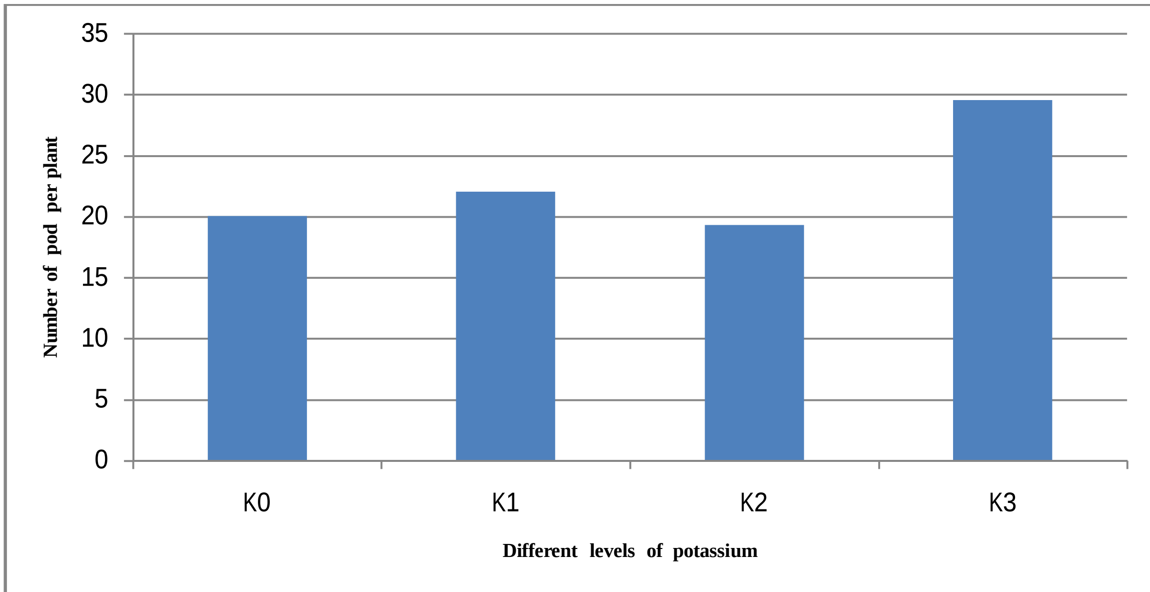
(G_0:0ppm GA_3, G_1:60ppm GA_3, G_2:90ppm GA_3)

Figure 11: Effect of different levels of gibberellic acid on number of flower buds per plant of okra.

Number of pods per plant

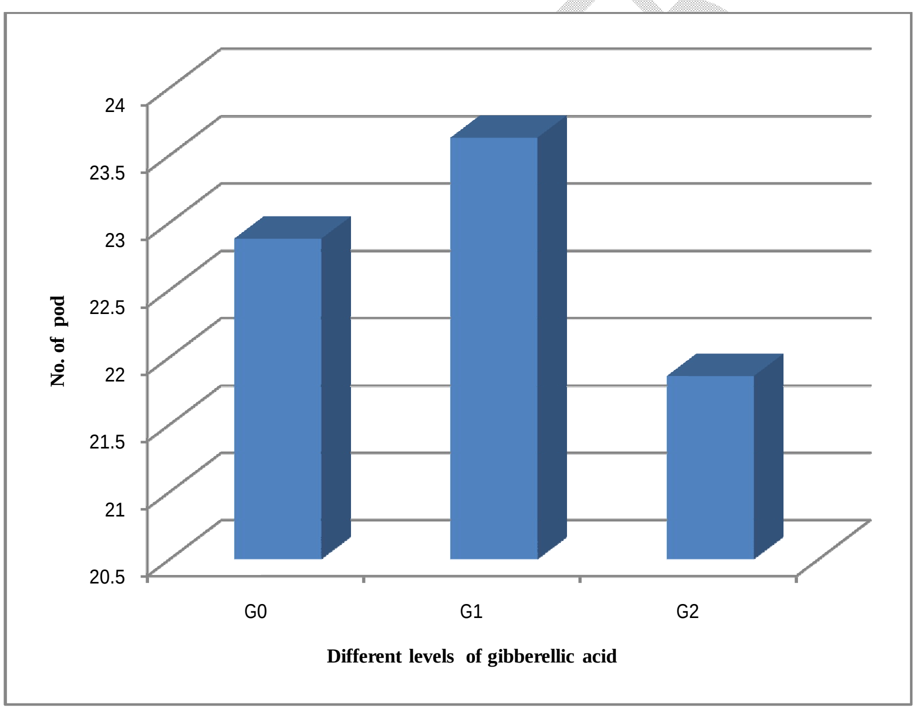
Number of pods per plant of okra varied significantly due to response of different levels of potassium (Figure 12). Misra and Pandeyreported that K significantly increasd the number of fruits/plant. The maximum number of pods per plant (29.54) was observed in K_3 and the minimum (20.06) was counted from K_0 [17].

Different levels of gibberellic acid showed significant variation on number of pods per plant of okra (Figure 13).Singh reported that GA_3 increase pod yield by 30% [16]. The maximum number of pods per plant (22.88) was found from G_2, which was statistically identical (23.63) with G_1, whereas the minimum (21.68) was observed from G_0.



(K_1: 60 kg K_2O/ha, K_2: 90 kg K_2O/ha, K_3: 120 kg K_2O/ha)

Figure12: Effect of different levels of potassium on number of pod per plant of okra.



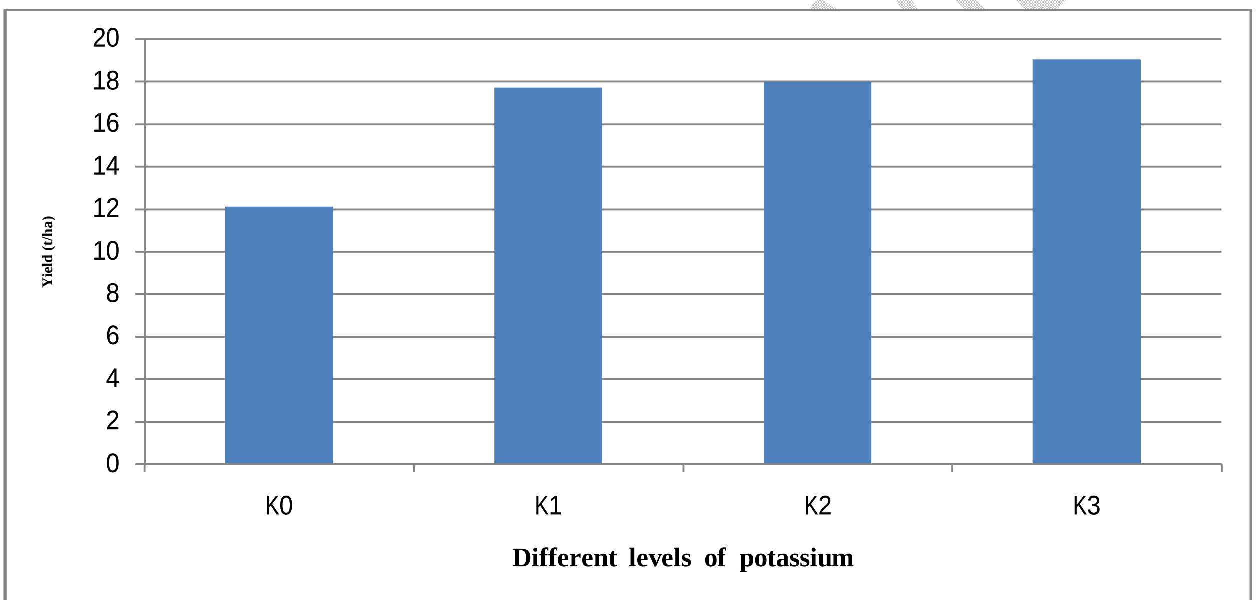
(G_0:0ppm GA_3, G_1:60ppm GA_3, G_2:90ppm GA_3)

Figure 13: Effect of different levels of gibberellic acid on number of pod per plant of okra

Yield per hectare

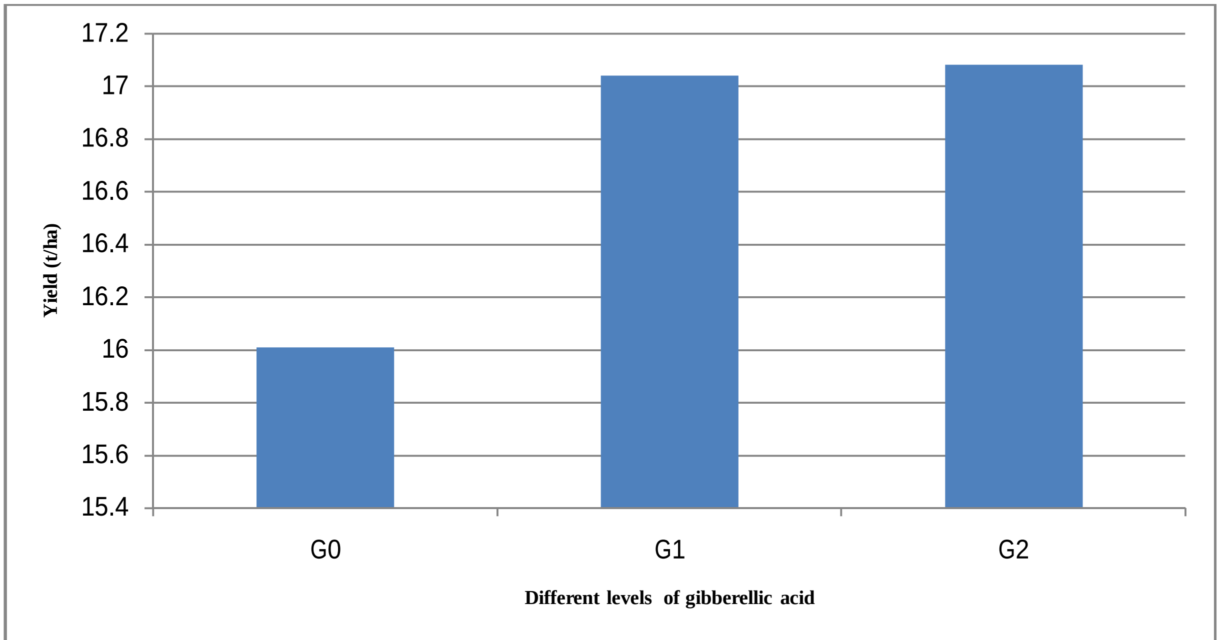
Statistically significant variation was recorded on yield/hectare (ton) of okra due to the application of different levels of potassium under the present trial (Figure 14). The highest yield per hectare (19.04) was recorded from K3, while the lowest yield per hectare (12.11) from K0.

Different levels of gibberellic acid showed significant variation on yield per hectare of okra (Figure 15). The highest yield per hectare (17.08) was observed in G2. On the other hand, the lowest yield per hectare (16.01) was found from G0.



(K_0: 0 kg K_2O/ha (control), K_1: 60 kg K_2O/ha, K_2: 90 kg K_2O/ha, K_3: 120 kg K_2O/ha)

Figure 14: Effect of different levels of potassium on yield of okra.



(G_0:0ppm GA_3, G_1:60ppm GA_3, G_2:90ppm GA_3).

Figure 15: Effect of different levels of gibberellic acid on yield of okra.

Conclusion

It was discovered that plant growth development enhanced up to a certain point in response to increases in potassium and gibberellic acid. Reducing the potassium and gibberellic acid, the opposite happens. From the results and discussion, it is found that, the crop yield also depends on the slight increase in the amount of potassium and gibberellic acid.

[DISCLAIMER: (ARTIFICIAL INTELLIGENCE)Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts**].**

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