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Original Research Article

Interactive Effects of Nitrogen and Potash Fertilizers on the Growth and Yield of Kheksa [*Momordica dioica* Roxb. ex Willd.] Under Agro-Climatic Condition of Zone V Prevailing In Giridih District of Jharkhand

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A B S T R A C T

A trial was conducted to study the interactive effects of nitrogen and potash fertilizers on growth and yield of *kheksa* [*Momordica dioica* Roxb. ex Willd.] during *kharif* planting seasons of 2016 and repeated in 2017 at the Krishi Vigyan Kendra, Giridih. The results based on two years mean revealed that out of twelve different treatments, the vines fertilized with 400 kg N ha^{-1} attended the maximum length of main shoot, number of primary branches at last harvest and intermodal length of 3.80 m, 6.44 and 7.80 cm, respectively. The vines fertilized with 400 kg N ha^{-1} showed the maximum number of nodes $plant^{-1}$ of 48.48. Days taken for appearance of first female flower and first harvest were recorded minimum (showing their earliness characteristics) in vines fertilized with 400 kg N ha^{-1} (62.57 and 81.36, respectively). Fruit length and weight and number of fruits $plant^{-1}$ (4.13 cm, 13.08 g and 1375) were recorded maximum from vines fertilized with 400 kg N ha^{-1}. However, maximum fruit diameter was found in vines treated with 400 kg N ha^{-1} (3.03 cm) but it was not superior significantly to other doses of nitrogen application. Vines fertilized with 400 kg N ha^{-1} produced maximum weight of fruits $vine^{-1}$ (18.1 kg) resulting maximum fruit yield of 44.40 q ha^{-1}. Cultivation of *kheksa* at different rates of potassic fertilizer plays significant difference in case of growth parameters and plants fertilized with K @ 150 Kg ha^{-1} attended maximum growth. However, yield attributes and yield of 41.48 q ha^{-1} was recorded maximum from plants fertilized with K @ 150 Kg ha^{-1}. In last, it can be concluded that cultivation of kheksa vines having single lobed leaves planted under fertilizer application of nitrogen @ 400 Kg and potash @ 150 kg ha^{-1} will be attractive and beneficial for farmers of Giridih district and adjoining areas of agro-climatic condition of Zone V of Jharkhand.

Keywords

Nitrogen and potash fertilizers, Kheksa [*Momordica dioica* Roxb. Ex Willd.]

Introduction

Kheksa (*Momordica dioica* Roxb. ex Willd.) also known as kakrol / teale gourd / spine gourd / bristly balsam pear / prickly carolaho / kantola / kakora / padora / carolaho and belongs to family Cucurbitaceae. It is generally a vegetatively propagated dioecious crop. Out of total 80 species, 7 species are available in India and many of the species grow wildly in Bangladesh, Srilanka, Mynamar, Malaya, etc.

In Jharkhand, cultivation by farmers has not been reported yet, except backyard cultivation by farmers that can be counted on fingures. However, fruits collected from

forest areas, the main home of this crop in this region, are being sold at a high price rate in urban areas. It has a great opportunity for its cultivation as irrigated crop under scaffolding or machan system. *Kheksa* can be cultivated here for a period of 7-8 months starting from mid-April to November.

In Jharkhand, commercial method of propagation of *kheksa* may be through seeds. There was a consistent phenotypic variation observed in the seed propagated / segregated plants of *kheksa* which also greatly effecting the yield of vines. As such there is an exigency to find out some broad phenotypic variations in the seed propagated vines and to correlate them with their yield potential.

Nitrogen (N) fertilization favors the development of the aerial parts over roots and consequently the promotion of flowering and fruiting of many crops. *Kheksa* with huge vegetative growth needs high amounts of nitrogen to cover its requirements. Hence, there is a need to standardize the optimum level of nitrogen for getting higher yields.

Potassium (K) is the nutrient having the strongest influence on plant growth, yield and quality attributes that determine fruit marketability (Al-Moshileh, 2003; Lester *et al.*, 2007).

The role of potassium in plant metabolism, growth, and development and its significance in production of marketable fruit and on fruit firmness, quality and visual appearance are published and well known (Al-Moshileh *et al.*, 2005). However, Bashir *et al.*, (1997) have noted that one of the problems facing rural farmers on the fertilizer usage is lack of information on what type of fertilizer and quantity that will suit their crops and soil types. A crop response to fertilizer is higher in soil with low nutrient contents than soil with high nutrient reserve (Tisdale and Nelson, 1975).

With this background the present study was undertaken to assess the interactive effects of nitrogen and potash fertilizers on the growth and yield of *kheksa* under agro-climatic condition of Zone V prevailing in Giridih district of Jharkhand.

Materials and Methods

The present investigation was carried out as on-farm trial at the Krishi Vigyan Kendra, Giridih during *Kharif* planting seasons of 2016 and repeated in 2017 on Kheksa (*Momordica dioica* Roxb. ex Willd.). The vines with single lobed leaves were grown in the main field in pits of 1 x 1' size, arranged at 2 x 2 m spacing. Male plants were also grown as bulk at a ratio of 1:10 to ensure enough pollen for females. The field was irrigated immediately after planting. The crop was fertilized with nitrogen in the form of urea as per the treatment scheduled (100, 200, 300 and 400 kg N ha^{-1}) and potash in the form of murate of potash as per the treatment scheduled (50, 100 and 150 kg K ha^{-1}) at 15, 30 and 45 days after planting in main field. Entire phosphorus is applied as basal dose in the form of single super phosphate @ 125 kg ha^{-1}. Need based manual hand weeding was done and the plots were kept free of weeds. The crop was immediately irrigated after planting to avoid transplanting shock. Subsequent irrigations were given at 3-5 days interval depending upon the moisture condition of experimental plot to maintain uniform soil moisture throughout crop growth period. Staking of plants is done using available wild bushes individually to each plant to ensure individual plant data. Need based plant protection measures were taken up to keep the plot free from pest and diseases and raise

a healthy crop. The plants of *kheksa* were grown under four doses of nitrogen and three doses of potashic fertilizer in the plot size of 8.0 X 8.0 m^2 consisting sixteen plants per plot and laid out in 4 X 3 factorial in Randomized Complete Block Design (RCBD) replicated thrice. Uniform cultural practices were followed for the experiment. The soil of the experimental field was sandy loam in texture with pH 5.8 and organic carbon 0.5 %. Observations on four plant characters viz. length of main shoot (m), number of primary branches at last harvest, intermodal length (cm) and number of nodes $plant^{-1}$, days taken for appearance of first female flower and days taken for first harvest and yield and yield attributes namely fruit length and diameter (cm) and weight (g), number of fruits $plant^{-1}$, fruit weight $vine^{-1}$ (kg) and fruit yield (q ha^{-1}) were recorded. The data on growth parameters and yield attributes were pooled and analyzed statistically as per Gomez and Gomez, 1984 and presented in Table -1 and 2 and Figure 1.

Results and Discussion

Perusal of the data (Table -1) clearly indicated that the significant differences existed in all plant growth characters, flowering and fruiting. Considerable variations in the length of main shoot were observed due to the four rates of nitrogen fertilizer. Application of fertilizers at different levels brought about significant differences in length of the main shoot. The highest length of main shoot (3.80 m) was observed with 400 kg N ha^{-1}. The lowest length of main shoot (2.80 m) was observed with 100 kg N ha^{-1}. Similar increase in kakrol vine length with increased nitrogen was observed by Nek *et al.,* (2000), Prasad *et al.,* (2009), Baset Mia *et al.,* (2011) in case of bitter gourd. The increase in vine length at higher levels of nitrogen might be due to higher uptake of nitrogen as evident from Table 1. There shall be increased auxins, gibberellins, cytokinins and ethylene with increase in carbohydrates and amino acids due to increase in nitrogen levels (Maynard and David, 1987). Length of main shoot of *kheksa* was increased significantly by increasing K levels (Table 1). The highest length of main shoot (3.53 m) was observed at 150 kg K ha^{-1} and lowest (2.89 m) at 50 kg K ha^{-1}.

It is evident from the data that the increase in the number of primary branches at harvest was significant among nitrogen and potash levels. The highest number of primary branches (6.44) was observed in vines fertilized with 400 kg N ha^{-1}, followed by the vines fertilized with 300 kg N ha^{-1} (6.10). Lowest number of primary branches (4.72) was observed in vines fertilized with 100 kg N ha^{-1}. Shariful Islam and Irabangon (1994) also found that the number of branches was highest at 240 kg N ha^{-1} in bitter gourd. Maximum number of primary branches at harvest (6.19) was recorded with the application of 150 kg K ha^{-1} followed by 100 kg K ha^{-1} with 5.66 branches, whereas, the minimum number of primary branches at harvest (5.08) was recorded with the application of 50 kg K ha^{-1}.

The variation in internodal length among the different doses of fertilizers was found to be significant. Highest internodal length (7.80 cm) was observed with application of 400 kg N ha^{-1} followed by 300 kg N ha^{-1} with 7.43 cm. The lowest internodal length (7.30 cm) was observed with application of 100 kg N ha^{-1}. Variations in vine length due to intermodal length was also observed by Prasad *et al.,* (2009) and Baset Mia *et al.,* (2011) in bitter gourd and by Nek *et al.,* (2000) in bottle gourd due to nitrogen levels. Application of potassium fertilizer to *kheksa* grown in field under acid soil conditions,

and at the rate of 150 kg ha^{-1} level led to the highest intermodal length of vines, and significantly higher than that the intermodal length obtained at the 100 kg K ha^{-1} (Table 1).

The increase in number of nodes per plant at harvest was significant among nitrogen and potash levels. Maximum number of nodes per vine at harvest (48.48) was recorded with the application of 400 kg N ha^{-1} which was followed by with application of 300 kg N ha^{-1} recording 43.50 nodes.

Similar increase in number of nodes and fruits with increased levels of nitrogen was also reported by Suresh and Pappaiah (1991) in bitter gourd which may be due to increased vegetative growth consequent to the increased production of auxins and carbohydrates.

The highest number of nodes per vine (43.41) was observed in plant fertilized with 100 kg K ha^{-1}, followed by vines fertilized with 150 kg K ha^{-1} with 42.83 nodes. Lowest number of nodes per plant (41.80) was observed in vines fertilized with 50 kg K ha^{-1}.

Significant differences were observed among the different nitrogen and potash levels on number of days taken to appearance of first female flower. There was an increase in the days taken for appearance of first female flower with increase in levels of nitrogen.

Early flowering (62.57 days) was observed with application of 400 kg N ha^{-1} and late flowering (68.12 days) was observed with application of 100 kg N ha^{-1}. Prasad *et al.*, (2009) has also reported similar finding with kakrol. Maximum number of days taken to appearance of first female flower (68.34) was observed in vines fertilized with 150 kg K ha^{-1} followed by vines fertilized with 100 kg K ha^{-1} with 66.10 days. The minimum number of days taken to appearance of first female flower (63.43) was observed in vines fertilized with 50 kg K ha^{-1}. This may be due to general tendency of plants towards vegetative phase with increased levels of potash as observed in many crops. The days to first harvest were not significant due to nitrogen and potash application.

The data pertaining to the yield parameters i.e, fruit length (cm), diameter (cm) and weight (g), number of fruits per plant, fruit weight (kg) $vine^{-1}$ and fruit yield (q ha^{-1}), as influenced by different levels of nitrogen and potash application are presented in the Tables 2. The fruit length (cm) was found significant among the phenotypes. The highest fruit length and weight (4.13 cm and 13.08 g) was observed in vines fertilized with 400 kg N ha^{-1} which significantly superior by vines fertilized with 300 kg N ha^{-1} with 4.04 cm and 12.96 g, respectively. Lowest fruit length and weight (3.79 cm and 12.76 g) was observed in vines fertilized with 100 kg N ha^{-1}. Similar differences in fruit size in kakrol strains / cultivars were also reported by Rasul *et al.*, (2004). This may be due to the increase in fruit length and diameter and also due to increased nutrition to the vines with increase in levels of nitrogen and increased synthesis of chlorophyll and amino acids (Dzevelin, 1973).

The highest fruit length and weight (4.11 cm and 13.02 g) was observed in vines fertilized with 150 kg K ha^{-1} which significantly superior by vines fertilized with 100 kg K ha^{-1} with 3.96 cm and 12.92 g, respectively. Lowest fruit length and weight (3.84 cm and 12.79 g) was observed in vines fertilized with 50 kg K ha^{-1}. The diameter of fruit was not found significant due to nitrogen and potash application.

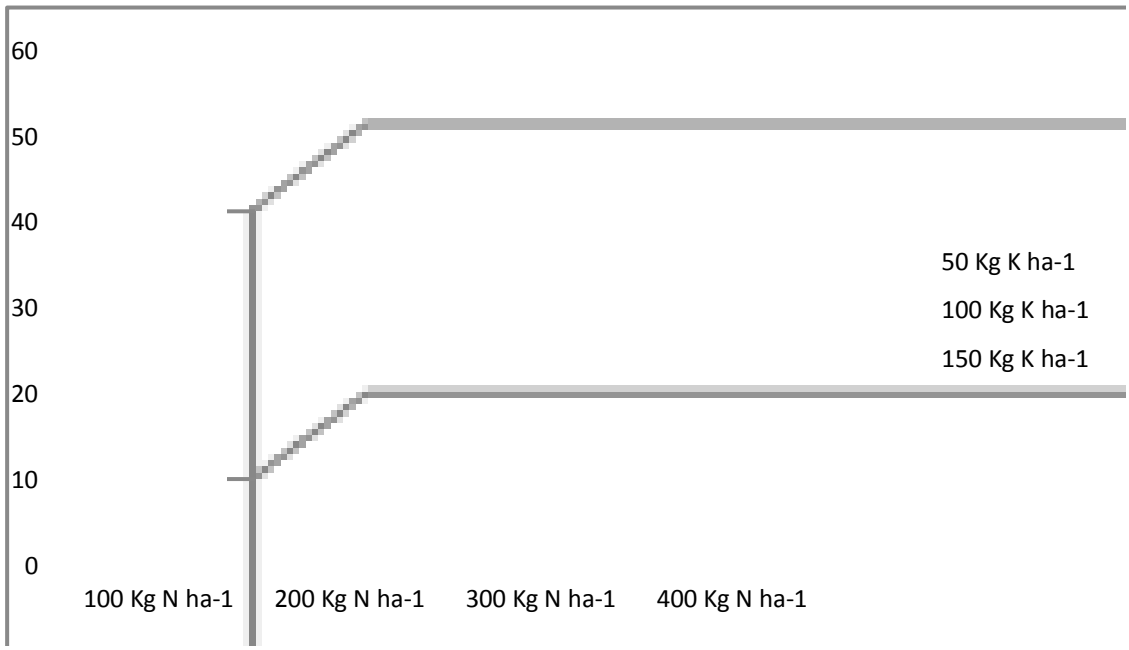
Table.1 Growth parameters, flowering and fruiting of *kheksa* [*Momordica dioica* Roxb. ex Willd.] as influenced by nitrogen and potash fertilizers

Treatments	Length of main shoot (m)	No. of primary branches at last harvest	Internodal length (cm)	No. of nodes plant^{-1} at last harvest	Days taken for appearance of first female flower	Days taken for first harvest
Nitrogen						
100 Kg ha^{-1}	2.80	4.72	7.30	38.42	68.12	84.55
200 Kg ha^{-1}	2.96	5.31	7.37	40.31	68.67	85.23
300 Kg ha^{-1}	3.24	6.10	7.43	43.50	64.55	82.77
400 Kg ha^{-1}	3.80	6.44	7.80	48.48	62.57	81.36
CD $_{0.05}$	0.27	0.30	0.33	0.43	1.33	NS
Potash						
50 Kg ha^{-1}	2.89	5.08	6.90	41.80	63.43	82.54
100 Kg ha^{-1}	3.18	5.66	7.31	43.41	66.10	86.82
150 Kg ha^{-1}	3.53	6.19	8.21	42.83	68.34	81.08
CD $_{0.05}$	0.33	0.36	0.44	0.55	1.67	NS

Table.2 Yield and yield attributes of fruits of *kheksa* [*Momordica dioica* Roxb. ex Willd.] as influenced by nitrogen and potash fertilizers

Treatments	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	No. of fruits plant^{-1}	Fruit weight vine^{-1} (kg)	Fruit yield (q ha^{-1})
Nitrogen						
100 Kg ha^{-1}	3.79	3.02	12.76	1108	14.2	29.89
200 Kg ha^{-1}	3.93	6.06	12.85	1186	15.4	31.77
300 Kg ha^{-1}	4.04	3.09	12.96	1268	16.6	43.27
400 Kg ha^{-1}	4.13	3.13	13.08	1375	18.1	44.40
CD $_{0.05}$	0.08	NS	0.09	20.2	0.6	0.18
Potash						
50 Kg ha^{-1}	3.84	3.01	12.79	1164	15.0	33.18
100 Kg ha^{-1}	3.96	3.08	12.92	1229	16.0	37.35
150 Kg ha^{-1}	4.11	3.13	13.02	1311	17.2	41.48
CD $_{0.05}$	0.11	NS	0.10	30.2	0.8	0.25

Fig.1 Interactive effect of nitrogen and potash on Fruit Yield of *kheksa* (q ha^{-1}) [*Momordica dioica* Roxb. ex Willd.]



Maximum number of fruits per plant (1375) was recorded with the application of 400 kg N ha^{-1} followed by 300 kg N ha^{-1} bearing 1268 fruits, whereas, the minimum number of fruits per plant (1108) was recorded with the application of 100 kg N ha^{-1}. Maximum number of fruits per plant (1311) due to application of potash was observed in vines fertilized 150 kg ha^{-1} followed by vines fertilized with 100 kg K ha^{-1} with 1229 fruits. The minimum number of fruits per plant (1164) was observed in vines fertilized with 50 kg K ha^{-1}. Similar findings were reported by Kiranpatro and Mallareddy (2007) where higher number of fruits per vine was obtained from 240:160:75 kg NPK ha^{-1}. On the other hand the increase in number of fruits was also due to increase in number of nodes on account of increased number of primary and secondary branches either due to increased nitrogen or potash. It was also reported by Parmar *et al.,* (2011) in bitter gourd. The higher number of branches and nodes per plant could be also attributed to the higher fruit number. Maximum fruit yield per vine (18.1 kg) was recorded with the application of 400 kg ha^{-1} followed by 300 kg N ha^{-1} bearing 16.6 kg fruits. Whereas, the minimum fruit yield per vine (14.2 kg) was recorded with the application of 100 kg N ha^{-1}. Maximum fruit yield per vine (17.2 kg) due to potash application was observed in vines fertilized with 150 kg ha^{-1} followed by vines fertilized with 100 kg K ha^{-1} with 16.0 kg. The minimum fruit yield per vine (15.0 kg) was observed in vines fertilized with 50 kg K ha^{-1}.

Marketable yield at the 400 kg ha^{-1} rate was the highest compared to all the other rates. Though the highest fruit yield was obtained in vine fertilized with 400 kg ha^{-1} (44.40 q ha^{-1}) that produced maximum number of fruits plant^{-1} to a tune of 1375 and fruit weight (13.08 g) and production of fruits vine^{-1} with respect of weight (18.1 kg). Poor yield (29.89 q ha^{-1}) was recorded in vines fertilized with 100 kg ha^{-1}, a plant having

poor vegetative growth, might be due to lower number and weight of fruits plant^{-1}. Maximum fruit yield (41.48 q ha^{-1}) was recorded with the application of 150 kg K ha^{-1} followed by 100 kg K ha^{-1} producing 37.35 q ha^{-1} fruits. Whereas, the minimum fruit yield (33.18 q ha^{-1}) was recorded with the application of 50 kg K ha^{-1}. Working with tomato and cucumber grown in greenhouses under arid conditions of Al-Qassium region (latitude 26-27 N, longitude 44-45 E, altitude 725 m above sea level), in Kingdom of Saudi Arabia, Al-Moshileh *et al.,* (2017) also found that application of potassium fertilizer at the 250 ppm level led to the highest marketable yield.

Application of NPK fertilizer to the soil was necessary due to its low fertility in order to increase the crop growth and productivity which was in agreement with the results obtained by Shiyam *et al.,* (2007) and Mare and Modi (2009) in case of taro. A crop response to fertilizer is higher in soil with low nutrient contents than soil with high nutrient reserve (Tisdale and Nelson, 1975). Significant effect on the growth parameters and total yield of the cultivar (Table – 1 & 2) could be attributed to the maximum ecological factors which triggered high photosynthetic activities to produce enough photosynthates deposited in the economic yield character - fruit. This agreed with the result obtained by Ahmed and Badr (2009) and Orji *et al.,* (2016) found in case of taro. It is evident from studied figure reveal that both application of N and K fertilizer had an significant effect on the fruit yield of *kheksa*. But application of nitrogen was found to be more responsive to yield than that of application of K fertilizer (Fig. 1). However, with the interaction of nitrogen – potash fertilizer at increased rates significantly increased the studied parameter of yield at increased levels. The highest yield of *kheksa* plants fertilized with 400 kg N ha^{-1} was obtained 51.55 q ha^{-1} closely followed by vines fertilized with 300 kg N ha^{-1} shown under application of potash fertilizer @ 150 Kg ha^{-1} and significantly differed over other treatment combinations of nitrogen and potash fertilizer.

In last, it can be concluded that cultivation of kheksa vines having single lobed leaves planted under fertilizer application of nitrogen @ 400 Kg and potash @ 150 kg ha^{-1} will be attractive and beneficial for *kheksa* [*Momordica dioica* Roxb. ex Willd.] cultivation by the farmers of Giridih district and adjoining areas of agro-climatic condition of Zone V of Jharkhand and will be able to uplift the socio-economic conditions of population of the area.

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