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EFFECT OF NITROGEN AND POTASSIUM FERTILIZATION ON GROWTH, FLOWERING AND YIELD OF PUMPKIN (*CUCURBITA PEPO* L.)

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ABSTRACT

Two field experiments were conducted during the summer seasons of 1995 and 1996 in the Agricultural Experimental Station, at Abies, Alexandria University, to study the effects of four N levels (0,30, 60 and 90 kg N fed.$^{-1}$) and four K levels (0, 36, 72 and 108 kg K_2o fed.$^{-1}$) on vegetative growth, flowering, yield and mineral contents of pumpkin plants. The results, generally, indicated that increasing N applied rate up to Kg N fed.$^{-1}$ promoted vegetative growth characters; i.e main stem length plant^{-1} average branch length, no. of leaves plant^{-1}, average internode length and shoot fresh weight plant^{-1}. Moreover, flowering traits; i.e no. of male and female flowers were increased as a result of increasing N up to 60 kg N fed.$^{-1}$. However, number of nodes below the first five male and /or female flower decreased. The highest fruit set percentage was obtained from the highest N rate (90 kg N fed.$^{-1}$). In addition, application of 60 kg N fed^{-1}. was adequate to produce more number of marketable fruits fed.$^{-1}$, larger fruit size and higher total yield fed.$^{-1}$ leaf's N and K contents, positively and significantly, reflected the amount of N applied level, however, leaf's P content was not affected. The results showed that the intermediate K level of 72 kg K_2O fed.$^{-1}$, greatly improved some vegetative growth characters as well as fruit yield potential, number of marketable fruits fed.$^{-1}$, average fruit weight and total yield fed.$^{-1}$. Increasing K level led to a significant increase in leaf's K and N contents. The interaction effect of N by K was significant on some of the studied traits. Application of 60 kg N fed.$^{-1}$ in combination with 72 kg K_2o fed.$^{-1}$ seemed to be the most efficient and economical combination treatment which assure a better vegetative growth and a higher fruit yield of pumpkin plants.

INTRODUCTION

Pumpkin (*Cucurbita pepo* L.) is considered as a non-traditional vegetable crop. It is cultivated in tropical and subtropical regions. Pumpkin is, really, a good source of carbohydrates, vitamin A and many minerals. More attention was paid to secure high yield and good quality of pumpkin via improvement of the factors affecting its productivity. For instance, fertilization with suitable levels of nitrogen and potassium had a key role for improving the growth, flowering and yield of pumpkin plants (Das and Swain, 1977; Kazuta, 1985; Swiader, 1985; Rhoden and Carver, 1989; Swiader *et al*., 1988). Substantial differences for N and/or K response have been reported. Swiader (1985) indicated that super optimal levels of N may stimulate excessive vine growth, subsequently, delay fruit set and depress overall yield. Excessively low rates of N and K i.e, below 56kg N ha.$^{-1}$ and 112 kg K_2O ha.$^{-1}$, negatively, affected fruit set (Swiader *et al*., 1994). The highest marketable yield, however, occurred with 112 kg N ha.$^{-1}$ in combination with either 112 or 224 kg K_2O ha^{-1}. The increase in yield due to increasing N and K rates was

attributed to a greater number of marketable fruits rather than larger fruit size. Nevertheless, Damarany and Farag (1994) reported that the medium level of NPK i.e., 200 kgN+210 kg P_2o_5+230 kg K_2o fed.$^{-1}$, significantly, brought the highest average fruit weight and yield of marketable fruits, whereas no. of marketable fruits fed.$^{-1}$ increased by the application of 300 kg N+315 kg P_2o_5+354 kg K_2o fed.$^{-1}$. On the other extreme, Reiners and Riggs (1997) found that pumpkin yield was unaffected due to the application of 67, 112, or 157 kg N ha^{-1}. Unfortionately, in Egypt rare information were available regarding N and K requirements for pumpkin (Damarany and Farag, 1994). Hence, this study was conducted to clarify the effect of nitrogen and potassium, as well as, their interactions on vegetative growth, flowering, fruit yield and its components and mineral contents of pumpkin plants cultivated under the environmental conditions of Alexandria.

MATERIALS AND METHODS

Two field experiments were conducted during the summer seasons of 1995 and 1996 at the Agricultural Experimental Station at Abies, Faculty of Agriculture, Alexandria University. Each experiment included 16 treatments which were the combinations of four levels of N (0, 30, 60 and 90 kg N fed.$^{-1}$) and four levels of K (0, 36, 72 and 108 kg K_2O fed.$^{-1}$). Seeds of pumpkin cv. Small Sugar were sown on the 9th and 12th of May in 1995 and 1996, respectively. A split-plot system in a randomized complete block design, with three replications, was used. The four nitrogen treatments were randomly distributed in the main plots, whereas, the four potassium treatments were in the sub-plots. Each sub-plot consisted of 4 ridges, 5 meters long and 2 meters wide, and the inter-row spacing was 50 cm. Nitrogen and potassium fertilization treatments were applied as soil application in the form of ammonium sulphate (20.5%N) and potassium sulphate (48% K_2O), respectively. Nitrogen and potassium fertilizers were applied at three equal portions after 3,5 and 8 weeks of seed sowing. A basal uniform dose of 50 kg P_2O_5 fed.$^{-1}$ as calcium superphosphate (15.5% P_2O5) was broadcasted one week before planting. Guard row was left between each two adjacent experimental units. All other cultural practices were adopted whenever it was necessary and as commonly recommended in the commercial production of pumpkin. Prior to conducting the experiments, soil samples to 25cm depth, were collected and analyzed according to the published procedures (Black, 1965). The results showed that the experimental sites were classified as silty loam soils and having pH 7.9 and 8.1, EC. 3.18 and 3.36 ds m^{-1}, total N content 0.11% and 0.13% and K content 0.068 and 0.073 MeqL^{-1} in 1995 and 1996, orderly. In each sub-plot, plants of the outer two ridges were allocated to measure the vegetative growth characters, flowering traits and mineral contents. Plants of the inner two ridges were assigned to determine yield and its components. The following data were recorded:

I. Vegetative growth:

Seventy days after seeding, random sample of five plants from each sub-plot was taken, to measure average lengths of the internode, lateral

branch and main stem plant^{-1} (cm). Moreover, number of leaves and branches as well as shoot fresh weight plant^{-1} were recorded.

II. Flowering:

Five plants randomly chosen in each sub-plot were labeled to record number of male and female flowers and fruit set; with the appearance of the 1st flower, all newly emerged flowers were marked with designated coloured plastic flags inserted behined each flower in the soil and number of male and female flowers were counted. Fruit-set was calculated as % by dividing number of set fruits by number of female flowers throughout the entire flowering period. Flowering time defined as average number of nodes below the first five male and/or female flowers on 25% of the plants in each sub-plot.

III. Fruit yield and its components:

Fruits were harvested by hand when they reached the consumptive maturity, as indicated by changing 75% of the external fruit colour from green to tan. Number of marketable fruits fed.$^{-1}$ and total yield fed.$^{-1}$ were recorded. Average fruit weight was also calculated.

V.Leaf's mineral contents:

seventy days after seed sowing, random samples taken from the fully expanded leaves, nearest to growing tip, were collected from five plants in each sub-plot for N, P and K mineral analysis; according the methods described in A.O.A.C. (1992).

All obtained data were statistically analyzed using MSTAT software (1985), and the Revised L.S.D. test was used to compare the differences between treatment means as illustrated by El-Rawy and Khalf-Allah (1980).

RESULTS AND DISCUSSION

I. Vegetative growth:

Application of nitrogen at the rates of 30, 60 and 90 Kg N fed.$^{-1}$, significantly, increased main stem, lateral branch and internode lengths, number of leaves plant^{-1}, and shoot fresh weight plant^{-1} in comparison with the control treatment in both seasons (Table 1). However, number of branches plant^{-1} was not significantly affected. It was noticed that the rate of 90 kg N fed.$^{-1}$, significantly, gave the highest mean values for most of the previously mentioned traits. Both the rates of 60 and 90 kg N fed.$^{-1}$ did not, significantly, differ with respect to shoot fresh weight. The positive effect of N on most of the tested vegetative growth characters may be attributed to the presence of a relatively low amount of N available to pumpkin plants in the soil as indicated by the results of soil analysis for experimental sites, in both seasons. Such finding regarding the effect of N on vegetative growth could be interpreted on the basis of the physiological fact that N is known as an essential element for proteins , nucleic acids and chlorophyll formation

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pigments. Moreover, it stimulates the merstimic activity which in turn results in more new tissues and organs (Marschner, 1986). These results match well with those reported by Swaider (1985) and Rhoden and Carver (1989).

Application of K fertilizer at the rates of 72 and 108 kg K_2O fed.$^{-1}$, significantly, increased main stem length, average branch length, number of leaves plant^{-1} and shoot fresh weight plant^{-1} compared with the control. The reverse was true with average internode length. However, number of branches plant^{-1}was not affected. It was noticed that fertilizing with potassium at the rate of 72 kg K_2O fed^{-1} showed the highest mean values for main stem length and no. of leaves plant^{-1}. Moreoever, the heaviest shoot fresh weight plant^{-1} was obtained from the highest rate of K i.e., 108 kg K_2O fed.$^{-1}$. The favorable effects of K on vegetative growth, in our study, agree with those outlined by Swiader *et al*. (1994).

The interaction effects between N and K on main stem length, number of leaves plant^{-1} and shoot fresh weight plant^{-1} were significant in both seasons. However, average branch length, number of branches plant^{-1} and average internode length did not appear to be significantly affected. The combined treatment of 90kg N+72kg K_2o fed.$^{-1}$ recorded the highest mean values of the main stem length and number of leaves plant, whereas shoot fresh weight plant^{-1} attained the peak with 60kg N+108 kg K_2O fed.$^{-1}$. Similar trends were reported by Swiader *et al*. (1994) who found that stem elongation increased as N rate increased, with a relatively little effect of K.

II. Flowering:

Data in Table (2) reflected significant differences in pumpkin flower production due to N fertilization, in both years. Increasing N applied rate up to 60 kg N fed.$^{-1}$, significantly, increased number of male and female flowers. Raising N level to 90 kg N fed^{-1}., however, did not reflect any significant positive effect, but negatively, decreased flower production whether was male or female. It was noticed that the N rate of 90 kg N fed^{-1}, significantly, achieved the highest fruit set percentage in both years. Number of nodes below the first male flower or female flower decreased as N rate increased. However, the difference between the two N rates of 60 and 90 kg N fed.$^{-1}$ was not significant with the exception in 1996 season, where the N level of 90 kg N fed.$^{-1}$, significantly, gave lower number of nodes below the first male than 60 kg N fed.$^{-1}$. These results could be explained on the basis that

flowering is associated with the moderate level of N (60 kg N fed.$^{-1}$), meanwhile, the excessive amount of N i.e. 90 kg N fed.$^{-1}$ may affect the carbohydrate/nitrogen ratio so that the N available to plants have fallen below an inhibitory level, subsequently, the highest N rate probably less flowered and fruitful (Janick *et al*., 1974). Similar conclusions were reported by Das and Swain (1977) and Swiader *et al*. (1994).

The effect of various K levels on all the studied flowering characters, except of fruit set, was significant in both seasons (Table, 2). Application of K at 36, 72 and 108 kg K_2O fed.$^{-1}$, significantly, increased number of male and female flowers plant^{-1}. However, there were no significant differences among 36, 72 and 108 kg K_2O fed.$^{-1}$ in the first season and between 36 and 72 kg K_2O fed.$^{-1}$ in the second one with respect to no. of female flowers plant^{-1}. It was apparent that number of nodes below the first male or female flower was the lowest with the highest K rate (108 kg K_2O fed.$^{-1}$), in both years. Similar trends were documented by Swiader (1985) and Swiader *et al*. (1994).

The results in Table (2) showed that the interaction effect of N by Klevel on number of male and female flowers was significant in 1995 and 1996 seasons. Generally, at any N level , increasing K applied rate increased number of male flowers plant^{-1}. The combination treatment of 60kg N and 108 kg K_2O fed.$^{-1}$ gave the highest mean value for number of male flowers plant^{-1}. Meanwhile, number of female flowers plant^{-1} was the highest with the combined treatment of 60 kg N+36 kg K_2O fed.$^{-1}$. Similar findings were obtained by Swiader *et al*. (1994).

Fruit yield and its components:

Data in Table (3) clarified that application of N, irrespective of the level used, significantly, increased no. of marketable fruits fed.$^{-1}$, average fruit weight and total yield fed.$^{-1}$ relative to the control treatment, in both seasons. Application of 60 kg N fed.$^{-1}$ out-yielded the low N level 30 kg N fed.$^{-1}$. Raising N applied level above 60 kg N fed.$^{-1}$, however, did not reflect any significant increases in fruit yield and its components but, reversely and significantly reduced all the studied traits of the yield and its components. The enhancing effects of N on the yield and its components could be related to the potentiality of N; particularly, the moderate N level (60 kg N fed.$^{-1}$) to assure adequate and balanced N requirement which were resulted in suitable vegetative growth and flowering potential and in turn probably achieved more fruit yield. Similar trends were obtained by Das and Sawin (1977), Kazuta (1985). Swiader *et al.* (1988) reported that higher rates of N had a greater effect on yield of pumpkin plants.

Table (3) shows that addition of K had significant effects on fruit yield and its components during both seasons. Application of K at 36, 72 and 108 kg K_2O fed.$^{-1}$, significantly, increased no. of marketable fruits fed.$^{-1}$, average fruit weight and total yield fed.$^{-1}$ over the control in both years. The exception was that ; difference between the control and 36 kg K_2O fed.$^{-1}$ for average fruit weight in 1996 and total fruit yield in both years was not significant. The maximum yield potential was obtained from plants received the moderate level of K i.e., 72 kg K_2O fed.$^{-1}$, indicating that such a treatment provides adequate nutrition for pumpkin plants which being sufficient to reach their full

potential. Additional K rate over 72 kg K_2O fed.$^{-1}$ was not warranted by higher yield potential. Similar findings were documented by Swiader *et al*. (1994).

The comparisons among the means of the various treatment combinations of N-K, listed in Table (3), reflected significant differences, indicating the presence of some interactions affecting the performances of fruit yield and its components. Generally, it was noticed that the highest no. of marketable fruits[1] and total yield fed.$^{-1}$ were obtained from the plants fertilized with 60 + 72 kg of N and K_2O fed.$^{-1}$, respectively. In 1995 season, the heaviest fruit weight was gained with the application of 90 Kg N fed.$^{-1}$ and 72 kg K_2o fed.$^{-1}$ together . In 1996 season, the combination treatment of 60 kg N + 108 kg K_2o fed.$^{-1}$ recorded the highest average fruit weight . These results indicated that the increase in total yield was attributed to the increment in number of marketable fruits, rather than fruit size. Similar results were reported by Das and Swain (1977), Rhoden and Carver (1989), Swiader *et al*. (1994).

Damarany and Farag (1994) indicated that fertilizing pumpkin plants with medium level of NPK, significantly, increased yield of marketable fruits fed.$^{-1}$

Leaf's mineral contents:

The effect of N and K levels on leaf's mineral contents during the summer seasons of 1995 and 1996 are shown in Table (4). Results revealed that increasing N level, increased N and K contents in leaves of pumpkin plants. However, P content was not affected in both seasons. The fertilization with 90 kg N fed.$^{-1}$ showed significantly the highest mean values of N and K contents. Similar conclusions were reported by Swiader *et al.* (1994).

Data presented in Table (4) indicted that the effect of N and K levels on leaf's N and K contents was significant , in both years . However, leaf's P content was not affected . Increasing K applied level up to 72 and 36 Kg K_2o fed.$^{-1}$ in 1995 and 1996 , orderly led to a significant increase in leaf's N content .Raising N applied rate over 60and 30 kg N fed.$^{-1}$ in the first and the second season , consecutively, did not enhance leaf's N content . Leaf's K content was significantly the highest when K applied rate was 108 Kg K_2o fed.$^{-1}$. Similar conclusions were reported by Kazuta (1985).

The effect of the interactions between N and K levels was not found significant for leaf's N, P and K contents. Therefore, Table (4) shows only the main effects of the two studied factors.

The results indicated the effectiveness of N-K fertilization for pumpkin production at moderate rates of N and K. The combined treatment of 60kg N fed.$^{-1}$ in conjunction with 72 kg K_2O fed.$^{-1}$ was suggested under prevailing conditions of the present study.

Table (4): Effect of nitrogen and potassium levels on Leaf's mineral contents (% of dry weight) of pumpkin plants in 1995 and 1996 seasons

Treatment		Leaf's mineral contents (% of dry weight)					
N level (Kg N fed.$^{-1}$)	K level (Kg K_2O fed.$^{-1}$)	N%	K%	P%	N%	K%	P%
		1995 season			1996 season		
0		2.19 C*	2.36 C	0.37 A	2.06 C	2.25 C	0.33 A
30		2.58 B	2.81 B	0.32 A	2.51 B	2.64 B	0.35 A
60		2.97 B	2.78 B	0.38 A	2.71 B	2.81 B	0.31 A
90		3.61 A	3.05 A	0.31 A	3.55 A	2.97 A	0.36 A
	0	2.11 C	2.46 C	0.38 A	2.07 B	2.29 C	0.33 A
	36	2.16 B	2.99 B	0.36 A	2.22 A	2.86 B	0.29 A
	72	2.56 A	3.17 B	0.34 A	2.41 A	2.97 B	0.32 A
	108	2.74 A	3.65 A	0.35 A	2.67 A	3.57 A	0.34 A

***Values marked with the same alphabetical letter (s), with in a comparable group of means, are not significantly different at P=0.05, (revised L.S.D test).**

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تأثير التسميد النيتروجيني والبوتاسي على النمو والإزهار والمحصول فى القرع العسلى.

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أجريت دراسة حقلية لمدة عامين خلال الموسم الصيفى لعامى 1995،1996 بالمزرعة التجريبية لكلية الزراعة بأبيس –جامعة الإسكندرية لدراسة تأثيرات أربعة مستويات من النيتروجين (صفر ،30،60،90 كجم ن /فدان) وأربعة مستويات من البوتاسيوم (صفر ، 36، 72، 108 كجم بو2 أ /فدان) على النمو و الإزهار ومحصول الثمار و محتويات العناصر لنباتات القرع العسلى.

دلت النتائج على أن زيادة معدل النتروجين المضاف حتى 90 كجم ن/ فدان قد شجع النمو الخضرى معبرا عنه بطول الساق الرئيسية ومتوسط طول الفرع وعدد الاوراق للنبات و متوسط طول السلامية والوزن الطازج للمجموع الخضرى للنبات، وعلاوة على ذلك فان صفات الإزهار متمثلة فى عدد الازهار المذكرة والمؤنثة قد استجاب بالزيادة كنتيجة لزيادة مستوى النيتروجين حتى 60 كجم ن/فدان ، الا أنه ادى الى تقليل عدد العقد التى تسبق ظهور أول زهرة مذكرة أو مؤنثة ، ولقد تم الحصول على أعلى نسبة مئوية لعقد الثمار من اضافة اعلى معدل نيتروجين(90كجم ن/فدان)، وبالإضافة الى ذلك فان اضافة 60كجم ن/فدان كان كافيا لانتاج عدد اكبر من الثمار القابلة للتسويق وثمار اكبر حجما ومحصول كلى للفدان اعلى ولقد عكست كميات النتروجين المضافة بصور إيجابية و معنوية الزيادة فى محتوى الأوراق من النيتروجين والبوتاسيوم، فى حين لم يتأثر محتوى الاوراق من الفوسفور .

ولقد اوضحت النتائج ان المستوى المتوسط من البوتاسيوم 72 كجم بو2ا / فدان قد أدى الى تحسين بعض صفات النمو الخضرى بالاضافة الى الجهد المحصولى للثمار معبرا عنه بعدد الثمار الصالحة للتسويق ومتوسط وزن الثمرة والمحصول الكلى للفدان . ولقد ادت زيادة مستوى البوتاسيوم الى زيادة معنوية فى محتوى الاوراق من البوتاسيوم والنتروجين 0ولقد كان تأثير التداخل بين النيتروجين و البوتاسيوم معنويا على بعض الصفات المدروسة .أوضحت النتائج إن إضافة 60كجم ن مع 72كجم بو2 أ للفدان يعد اكثر المعاملات كفاءة حيث انها تكفل نمو خضرى جيد ومحصول ثمار اعلى لنباتات القرع العسلى تحت ظروف بيئية مشابه للدراسة الحالية

Table (2): Effect of nitrogen and potassium levels on flowering characters of pumpkin plants in 1995 and 1996 seasons.

Treatments		No. of male flowers plant^{-1}	No. of female flowers plant^{-1}	Fruit set (%)	No. of node to first male flower	No. of node to first female flower	No. of male flowers plant^{-1}	No. of female flowers plant^{-1}	Fruit set (%)	No. of node to first male flower	No. of node to first female flower
N level Kg N fed.$^{-1}$	K level kg K2O fed.$^{-1}$	1995 season					1996 season				
0		20.4 C*	2.56 C	44.08 B	6.86 A	14.92 A	20.1 C	2.40 C	46.65 B	6.55 A	15.92 A
30		23.8 AB	2.87 B	41.46 B	6.65 A	14.34 B	24.8 B	2.81 B	46.29 B	7.33 A	15.34 B
60		24.9 A	3.05 A	44.53 B	6.30 B	13.84 C	26.3 A	3.31 A	41.69 B	6.83 B	14.08 C
90		24.4 A	2.30 C	57.10 A	6.03 B	13.75 C	23.3 B	2.46 C	52.40A	6.13 C	13.67C
	0	20.4 D	2.56 B	46.03 A	6.56 A	15.33 A	20.3 D	2.59 B	47.70 A	7.33 A	15.09 A
	36	23.4 C	2.76 A	47.22 A	6.68 A	14.17 B	23.7 C	2.89 A	44.68 A	7.0 B	14.92 A
	72	24.4 B	2.72 A	48.78 A	6.43 A	14.09 B	25.3 B	2.93 A	45.10 A	6.93 B	14.75 A
	108	25.3 A	2.74 A	45.14 A	6.18 B	13.00 C	26.2 A	2.56 B	49.56 A	6.58 C	1 4.25 B
0	0	17.3 bc	1.97 c	48.22 a	7.15 a	16.33 a	13.9 c	1.77 c	57.49 a	7.60 a	16.00 a
	36	19.5 ab	2.45 b	45.56 a	7.00 a	14.67 a	20.3 ab	2.33 b	47.05 a	7.40 b	16.00 a
	72	21.7 a	2.83 a	40.28 a	6.80 a	15.33 a	22.7 a	2.97 a	37.58 a	7.70 a	15.67 a
	108	22.9 a	2.99 a	42.26 a	6.51 a	13.33 a	23.5 a	2.51 b	44.47 a	7.50 a	16.00 a
30	0	19.6 b	2.73 ab	44.37 a	6.70 a	16.00 a	20.2 b	2.67 c	47.06 a	7.80 a	15.67 a
	36	24.4 a	2.73 ab	47.16 a	6.90 a	14.00 a	25.5 a	2.95 b	42.67 a	7.10 a	15.00 a
	72	24.9 a	2.89 a	45.20 a	6.60 a	13.67 a	26.1 a	3.21 a	41.14 a	7.20 a	15.67 a
	108	26.1 a	3.10 a	29.10 a	6.40 a	13.67 a	27.3 a	2.41 d	54.30 a	7.20 a	15.00 a
60	0	20.7 c	3.31 a	38.86 a	6.30 a	14.67 a	21.1 c	3.59 a	35.06 a	7.10 a	14.67 a
	36	25.3 ab	3.45 a	38.55 a	6.50 a	14.00 a	26.9 ab	3.76 a	37.90 a	7.00 a	14.33 a
	72	26.5 a	2.76 b	52.49 a	6.30 a	13.67 a	27.7 a	2.92 b	47.98 a	6.70 a	14.00 a
	108	27.3 a	2.66 b	48.21 a	6.10 a	13.00 a	29.5 a	2.91 b	45.83 a	6.50 a	13.33 a
90	0	23.8 a	2.21 a	52.66 a	6.10 a	14.33 a	21.9 b	2.32 ab	51.19 a	6.80 a	14.00 a
	36	24.3 a	2.35 a	57.61 a	6.30 a	14.00 a	22.1 b	2.51 a	51.10 a	6.50 a	14.33 a
	72	24.4 a	2.41 a	57.16 a	6.00 a	13.67 a	24.5 a	2.61 a	53.69 a	6.10 a	13.67 a
	108	24.9 a	2.22 a	60.98 a	5.70 a	13.00a	24.5 a	2.41 a	53.62 a	5.10 a	12.67 a

***Values marked with the same alphabetical letter (s), within a comparable group of means, are not significantly different (revised L.S.D. test) .**

Table (3): Effect of nitrogen and potassium levels on fruit yield and its components of pumpkin plants in 1995 and 1996 seasons

Treatment		No. of Marketable fruits fed.$^{-1}$	Average fruit weight (gm)	Total yield fed.$^{-1}$ (ton)	No. of marketable fruits fed.$^{-1}$	Average fruit weight (gm)	Total yield fed.$^{-1}$ (ton)
N level kg N fed.$^{-1}$	K level kg K2O fed.$^{-1}$	1995 season			1996 season		
0		4441.3 D	2.565 D	10.928 D	4393.8 C	2.805 C	11.379 D
30		5035.8 C	3.108 C	15.571 C	5154.0 B	3.410 B	16.597 C
60		5347.5 A	3.910 A	20.972A	5442.5 A	4.178 A	21.048 A
90		5248.8 B	3.780 B	18.742 B	5163.5 B	3.827 A	18.718 B
	0	4611.3 C	3.155 C	15.346 C	4720.3 C	3.425 B	15.892 C
	36	5106.3 B	3.273 B	16.140 C	5062.5 B	3.490 B	16.693 BC
	72	5272.5 A	3.567 A	17.863 A	5272.5 A	3.625 A	18.172 A
	108	5083.3 B	3.380 B	16.865 B	5098.5 B	3.680 A	16.985 B
0	0	3800 c	2.650 a	8.933 c	4070 b	2.980 a	9.787 c
	36	4465 b	2.320 ab	10.547 ab	4385 a	2.550 b	11.500 b
	72	4560 b	2.740 a	12.827 a	4465 a	2.850 a	12.830 a
	108	4940 a	2.550 a	11.403 a	4655 a	2.840 a	11.400 b
30	0	4845 b	2.870 c	13.873 c	5026 ab	3.020 b	15.490 ab
	36	5225 a	3.050 b	14.963 b	5035 ab	3.450 a	16.220 a
	72	5225 a	3.110 a	16.817 a	5320 a	3.500 a	17.290 a
	108	4848 b	3.400 a	16.630 a	5235 a	3.670 a	17.390 a
60	0	5145 b	3.740 b	20.997 a	5035 c	4.060 b	21.190 a
	36	5320 b	4.170 a	20.617 a	5700 a	3.960 b	19.670 c
	72	5795 a	3.920 a	21.663 a	5700 a	4.080 b	22.330 a
	108	5130 b	3.860 b	20.617 a	5335 b	4.610 a	21.000 ab
90	0	4655 b	3.360 bc	17.580 a	4750 c	3.640 b	17.100 bc
	36	5415 a	3.550 b	18.433 ab	5130 b	4.000 a	19.380 a
	72	5510 a	4.500 a	20.143 a	5605 a	4.690 a	20.240 a
	108	5415 a	3.710 b	18.813 a	5169 b	3.600 b	18.150 ab

***Values marked with the same alphabetical letter (s), within a comparable group of means, are not significantly different (revised L.S.D. test) .**

Table (1): Effect of nitrogen and potassium levels on vegetative growth characters of pumpkin plants in 1995 and 1996 seasons.

Treatments		Main stem length (cm)	Average branch length (cm)	No. of branches plant^{-1}	No. of leaves. plant^{-1}	Average internode length (cm)	Shoot fresh weight plant^{-1} (g)	Main stem length (cm)	Average branch length (cm)	No. of ranches plant^{-1}	No. of Leaves Plant^{-1}	Average nternode length (cm).	Shoot fresh weight plant^{-1} (g)
N level kg N fed.$^{-1}$	K level kg K_2O fed.$^{-1}$	1995 season							1996 season				
0		233.2 C*	131.9 C	2.6 A	29.3 D	16.70 D	1315.1 C	211.1 C	84.01 C	2.3 A	28.2 D	15.04 C	1292.5 C
30		259.4 B	147.2 B	2.4 A	36.6 C	17.75 C	1654.1 B	256.0 B	107.3 B	2.2 A	35.8 C	17.35 B	1638.8 B
60		284.4 B	156.2 B	2.4 A	43.5 B	19.50 B	2223.0 A	255.8 B	126.4 B	2.2 A	43.8 B	18.61 B	2298.6 A
90		365.1 A	231.0 A	2.8 A	58.1 A	20.98 A	2172.8 A	352.5 A	153.1 A	2.7 A	57.8 A	20.21 A	2311.3 A
	0	275.9 B	143.3 C	2.6 A	37.6 B	21.29 A	1617.7 B	241.9 B	97.4 D	2.3 A	36.0 B	20.15A	1476.7 C
	36	281.3 B	154.0 C	2.4 A	34.1 B	19.08 B	1657.3 B	257.2 B	111.2 C	2.3 A	34.8 B	17.96 B	1755.4 B
	72	292.9 A	175.2 B	2.2 A	51.3 A	17.06 C	1657.6 B	294.3 A	124.9 B	2.2 A	49.7 A	16.73 C	1953.0 B
	108	292.0 A	193.8 A	2.7 A	44.5 A	17.05 C	2432.4 A	282.0 A	137.3 A	2.4 A	45.2 A	16.35 C	2356.0 A
0	0	230.3 a	125.0 a	2.0 a	26.7b	17.44 a	1156.2 c	189.0 c	74.6 a	2.0 a	25.0 b	16.33 a	1094.1 bc
	36	229.7 a	126.7 a	2.8 a	25.0 b	17.02 a	1065.3 d	187.7 c	80.7 a	2.0 a	25.0 b	14.87 a	1163.3 b
	72	239.7 a	160.0 a	3.6 a	26.7 b	16.30 a	1354.6 b	212.7 b	84.3 a	3.0 a	24.7 b	14.32 a	1336.4 b
	108	233.0 a	115.7a	2.0 a	38.7 a	16.05 a	1684.4 a	255.0 a	96.6 a	2.0 a	38.0 a	14.63 a	1576.2 a
30	0	246.3 bc	135.0 a	2.5 a	34.3 b	19.35 a	1657.1 a	205.7 d	93.3 a	2.0 a	32.0 a	18.35 a	1411.3 bc
	36	262.3 b	125.7 a	2.0 a	32.0 bc	18.78 a	1725.2 a	253.0 c	108.7 a	2.0 a	34.3 a	17.74 a	1611.2 ab
	72	274.0 a	160.0 a	2.5 a	41.3 a	15.27 a	1410.3 b	295.3 a	111.0 a	2.3 a	38.0 a	16.32 a	1700.4 a
	108	255.0 b	168.0 a	2.5 a	38.7 a	17.58 a	1823.6 a	270.0 b	116.3 a	2.3 a	39.3 a	16.97 a	1832.1 a
60	0	292.3 b	124.3 a	2.5 a	34.3 b	24.81 a	1746.5 b	218.0 d	106.4 a	2.3 a	35.0 b	22.35 a	1639.2 d
	36	254.7 d	161.7 a	2.0 a	38.0 b	17.14 a	1760.1 b	232.0 c	112.6 a	2.0 a	38.0 b	18.25 a	1903.6 c
	72	275.7 c	170.7 a	2.5 a	63.3 a	16.69 a	1662.3 b	303.0 a	138.9 a	1.7 a	63.0 a	17.32 a	2190.1 b
	108	315.0 a	168.0 a	2.5 a	38.7 b	17.58 a	3723.2 a	270.0 b	147.7 a	2.3 a	39.3 b	16.51 a	3461.3 a
90	0	335.0 c	188.7 a	3.2 a	55.0 c	23.55 a	1911.1 d	355.0 c	115.3 a	3.0 a	52.0 c	23.55 a	1762.1 c
	36	3783 a	202.0 a	3.0 a	41.3 d	23.38 a	2078.4 c	356.0 b	142.7 a	3.3 a	42.0 d	21.01 a	2343.5 b
	72	382.0 a	210.0 a	2.0 a	74.0 a	19.99 a	2203.3 b	366.3 a	165.6 a	1.7 a	73.0 a	18.97 a	2585.2 a
	108	365.0 b	323.3 a	3.0 a	62.0 b	17.00 a	2498.2 a	332.7 d	188.7 a	2.7 a	64.0 b	17.31 a	2554.3 a

***Values marked with the same alphabetical letter (s), within a comparable group of means, are not significantly different (revised L.S.D. test) .**