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EFFECT OF GENOTYPES, PLANT POPULATION AND NITROGEN FERTILIZER LEVEL FOR THE NEW SUPERIOR LINE OF COWPEA

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ABSTRACT

This work was carried out at Sakha Agricultural Research Station, during the summer seasons of 2004 and 2005 on cowpea. The main objective of this research was to evaluate three cultivars (Kaha-1, Kafr El-Sheikh-1 and Dokki-331) and new superior line (A_7) of cowpea under three nitrogen fertilizer levels (15, 30 and 45 kg N fed.$^{-1}$) and two plant populations (60.000 and 120.000 plant fed.$^{-1}$). A split-split plot in a randomized complete blocks design with four replicates was used. Results are summarized as follow:

Dokki-331 cv. surpassed the other genotypes in plant height, number of leaves plant^{-1}, number of branches plant^{-1} and leaf area plant^{-1}. However Kaha-1 cv. produced the lowest values of vegetative traits in both seasons. The Kafr El-Sheikh-1 cv. surpassed in number of peduncle of pods plant^{-1} in both seasons. Moreover, seed yield and its components, i.e., seed yield fed^{-1}, number of pods plant^{-1}, number of seeds per pod and weight of 100-seeds, the lien A_7 surpassed the other genotypes followed by Kafr El-Sheikh-1 cv. However, Dokki-331 cv. produced the lowest seed yield and yield components in both seasons. In addition, the lien A_7 surpassed in leaf's chlorophyll and seed's protein content.

Less plant density improved vegetative growth characters, as well as yield components and increased leaf contents of chlorophyll and seed content of protein. While, seed yield were increased as a sequence of increasing plant population in both seasons.

The results indicated that increasing applied N rate up to 45 kg N fed.$^{-1}$ was accompanied with significant increases in vegetative growth characters, meanwhile, increased number of peduncle of pods plant^{-1} with the application of 30 kg N feddan^{-1}. Moreover, seed yield and its components were increased as a sequence of increasing N level up to 45 kg N fed.$^{-1}$, also, leaf's chlorophyll and seed's protein content positively and significantly reflected.

INTRODUCTION

Cowpea [*Vigna unguiculata* (L.) Walp] is one of the important vegetable legumes due to its high protein content, heat tolerant, low fertilizer requirements and it can gridge easily in the new reclaimed lands. The new cowpea cultivars Kaha-1 and Kafr El-Sheikh-1 are short growth period, an erect and determinate growth habit and resistance to lodging (Metwally *et al.*, 1998a and Masoud, 2002) and A_7 line is similar in these characters (Badr and Masoud, 2004). Therefore, their vegetative growth are bush and small (Metwally *et al.*, 1998a). This character gave the chance for increasing cowpea density and possibility of using fertilization. Nitrogen fertilizer, plant population and cultivar are important factors affecting yield and its quality of cowpea. Application of nitrogen fertilizers increased vegetative growth characters as well as yield and its components of cowpea (El-Waraky, 1996;

Knany *et al.*, 2002 and El-Bably & El-Waraky, 2006). In the semi-arid region, soil is inherently poor in nitrogen due to fast degradation of organic matter and some nitrogen fertilization is usually required. Afifi *et al.*, 1989 and El-Waraky & Kasem, 2007), found that cowpea plants fertilized with 30 kg N fed.$^{-1}$ produced the greatest pod yield, number of pods per plant, seed number per pod and 100-seed weight. Also, increasing nitrogen level up to 40 kg N fed.$^{-1}$, gradually increased cowpea plants growth, yield and its components (El-Bably and El-Waraky, 2006). However, the excessive use of nitrogen fertilizers represents the major cost of crop production and creates pollution of agroecosystem (Fisher and Richter 1984).

Increasing plant population increased seed yield of cowpea (Saleh *et al.*, 1980; Jallow, 1985; El-Zawily *et al.*, 1993; Metwally *et al.*, 1998b and Masoud, 2002). Therefore, the high density of cultivation in such varieties are needed. Thus, the main objective of this research was to evaluate the three cultivars of cowpea, i.e. Kaha-1, Kafr El-Sheikh-1 and Dokki-331 as well as the new superior line (A_7) under three nitrogen fertilizer levels and two plant population to known the suitable cultivar, nitrogen fertilizer level and density for maximum seed yield.

MATERIALS AND METHODS

This work was carried out at Sakha Agricultural Research Station, during the summer seasons of 2004 and 2005. Two field experiments were conduced to clarify the effects of cultivars, under different nitrogen levels and plant populations, on vegetative growth characters, seed production and seed quality of cowpea. The soil in this station has a clay texture (some properties of the experimental soil are presented in Table 1).

Table (1): Some characteristics of the experimental soils.

Season	Mechanical analysis			Texture	pH*	EC** dSm^{-1}	OM %	Available elements ppm		
	Sand %	Silt %	Clay %					N	P	K
1st	21.65	25.14	53.21	Clay	8.05	2.1	1.70	22	6.1	280
2nd	24.72	26.11	49.17	Clay	8.21	2.4	1.60	19	5.8	214

*** 1: 2.5 soil: water suspension.**
**** Soil past extract**

Two plant populations, 60.000 plants fed.$^{-1}$ (sowing on one side of ridge with 20 cm between hills this making 15 plants m^{2-1}) and 120.000 plants fed.$^{-1}$ (sowing on two side of ridge with 20 cm between hills this making 30 plants m^{2-1}). Each hill was allowed to have two plants. Three nitrogen levels 15, 30 and 45 kg N fed.$^{-1}$. Nitrogen fertilizer, in the form of ammonium sulphate (20.5% N), was applied to the soil as one dose before the first irrigation (21 days after sowing) according to soil analysis the experimental soil had enough values of phosphorus (6.1 and 5.8 ppm) thus no phosphorus fertilizer was added. Four genotypes of cowpea (3 cultivars and one mutant) were used. The cultivars were Kaha-1, Kafr El-Sheikh-1 and Dokki-331 and

one mutant was A_7. The A_7 mutant was the superior mutant of the fifth generation (M5) after exposing to gamma-radiation. This inbred line was selected in Horticulture Department Faculty of Agriculture at Kafr El-Sheikh. All genotypes of cowpea belong to *Vigna unguiculata* (L.) Walp. In all treatment cowpea seeds were inoculated by an effective strain of *Rhizobium* bacteria just before sowing. The sowing dates were 5 and 10 of May in the first and second seasons, respectively.

The experiments were conducted using split-split plot system in a randomized complete block design, with four replications. The two plant populations were assigned for the main plots. The three nitrogen fertilizer levels were used in the sub-plots, whereas the four genotypes of cowpea were in the sub-sub plots. Therefore, this experiment included 24 treatments which were the combinations of two plant populations, three nitrogen fertilizer treatments and four genotypes of cowpea. The experimental plot contained 4 ridges, 6 m in long and 0.6 m in width, comprising an area of 14.4 m^2. The other recommended agricultural practices were used.

After 45 days from sowing the following data were recorded:

1. Chlorophyll content of leaves measured by the SPAD-501, a portable leaf chlorophyll meter (Minolta) (Marquard and Timpton, 1987) on the recently fully expanded leaf.
2. Vegetative traits, i.e., plant height, number of leaves per plant, number of branches per plant, leaf area per plant and peduncle of pods per plant.
3. After harvest seed yield and its components, i.e., seed yield kg per fed., number of pods per plant, number of seeds per pod, pod length, seed index (weight of 100 seeds) and protein were determined.

Data were subjected to the combined analysis as described by Snedecor and Cochran (1980). The treatment means were compared according to Duncan's multiple range test (Duncan, 1955).

Samples were oven dried, crashed and digested using sulphuric + perchloric acid methods according to Cottenie *et al.* (1982). Nitrogen in the digested seeds was determined by micro-kjeldahl method according to Jackson (1958), also nitrogen content of cowpea seeds was multiplied by a factor of 6.25 to calculate the crude protein content. Soil samples were collected before sowing air dried, finely ground for chemical and mechanical analysis according to Jackson (1958).

RESULTS AND DISCUSSION

I. Vegetative growth characters:

a.Effect of genotypes:

Data presented in Table (2) and Fig. (1) show that Dokki-331 cv. produced the highest values of plant height, number of leaves $plant^{-1}$, number of branches $plant^{-1}$ and leaf area $plant^{-1}$ followed by Kafr El-Sheikh-1 cv. While Kaha-1 cv. produced the lowest values, and the differences were highly significant in both seasons. On the other hand, mutant A_7 produced the

highest values of chlorophyll content and number of peduncle of pods plant^{-1} in both seasons. However, Dokki-331 cv. produced the lowest values. The differences between values were significant in both seasons.

In this respect, Remison (1980), Morsy (1986), Metwally *et al.* (1998a), El-Kassas and Metwally (1999) and Masoud (2002), the found, on cowpea, that plant height, number of leaves and branches plant^{-1} and leaf area plant^{-1} were mainly different due to genotypes.

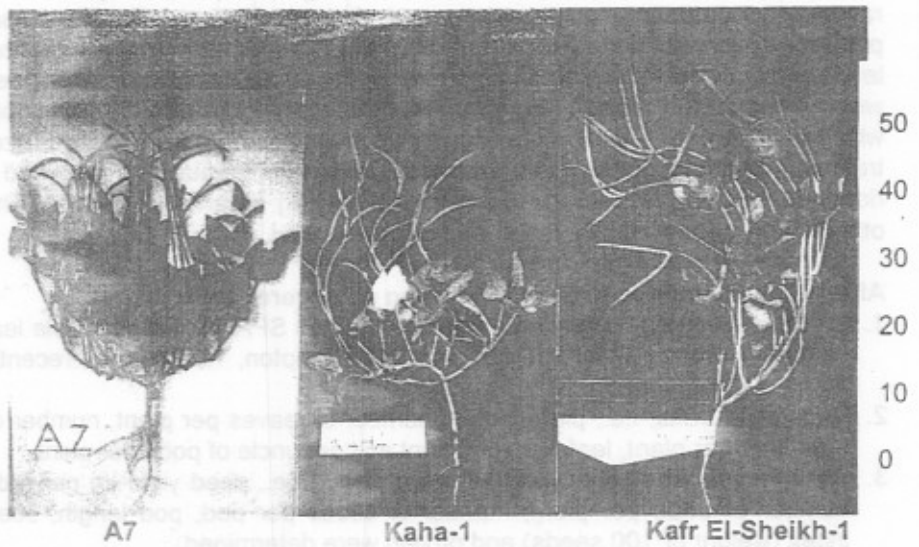

Fig. (1):Plant growth habit for studied genotypes.

b.Effect of plant population:

Data presented in Table (2) show that all vegetative traits, i.e. plant height, number of leaves plant^{-1}, number of branches plant^{-1}, leaf area plant^{-1}, chlorophyll content and number of peduncle of pods plant^{-1} were affected by plant density. Plants grown under low density (60.000 plants fed.$^{-1}$) were bigger than those grown under high density (120.000 plants fed.$^{-1}$). The differences were significant in both seasons. The results may reasonably be explained as the higher than planting density the more competition between plants for nutrients, light and water. Lower density for plant gave the chance for more branching and correspondingly more leaves can be born by the increased number of branches plant^{-1}. This results are agree with those obtained by Abd El-Rahman *et al.*, 1983; Morsy, 1986 and Masoud, 2002.

C.Effect of nitrogen levels:

Data presented in Table (2) showed that in all growth parameters were significantly affected by increasing rate of nitrogen fertilization in both growing seasons, the highest nitrogen fertilization rate gave the tallest plants, the highest number of leaves plant^{-1}, branches plant^{-1}, leaf area plant^{-1} as well as the higher chlorophyll content.

Table (2): Effect of genotypes, plant population and nitrogen fertilizer levels on cowpea vegetative growth characters in 2004 and 2005 seasons.

Treatments	Plant height (cm)		No. of leaves plant^{-1}		No. of branches plant^{-1}		Leaf area plant^{-1} (dm^2)		Chlorophyll content SPAD unit		No. of peduncle of pods plant^{-1}	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Genotypes (G)												
A_7	49.9 c	44.0 c	21.0 c	19.5 c	2.8 c	2.2 c	1238.8 b	1148.4 c	52.1 a	50.8 a	8.9 b	7.5 a
Kaha-1	45.2 d	40.3 d	19.7 d	17.5 d	2.6 d	1.9 d	1184.4 c	1077.9 d	51.1 b	50.0 b	8.4 c	6.9 b
Kafr El-Sheikh-1	65.3 b	57.7 b	25.5 b	22.0 b	3.0 b	2.5 b	1349.3 a	1204.0 b	50.9 b	49.5 bc	9.3 a	7.5 a
Dokki-331	68.2 a	62.7 a	27.7 a	23.9 a	3.3 a	2.7 a	1348.8 a	1220.6 a	49.8 c	48.8 c	7.7 d	6.1 c
F-test	**	**	**	**	**	**	**	**	**	**	**	**
Plant population (plant fed.$^{-1}$) (P)												
60.000	54.6 b	49.1 b	24.9 a	22.1 a	3.3 a	2.5 a	1365.7 a	1194.0 a	52.7 a	51.5 a	10.1 a	7.5 a
120.000	59.7 a	53.3 a	22.1 b	19.4 b	2.6 b	2.1 b	1194.9 b	1131.5 b	49.3 b	48.1 b	7.1 b	6.5 b
F-test	**	**	**	**	**	**	**	**	**	**	**	**
N levels (kg N fed.$^{-1}$) (F)												
15	51.6 c	46.3 c	20.9 c	18.5 c	2.5 c	2.0 c	1184.8 c	1106.0 c	49.5 c	48.4 c	7.2 c	6.5 c
30	57.6 b	51.1 b	23.6 b	21.0 b	3.0 b	2.3 b	1257.8 b	1163.0 b	51.0 b	49.7 b	9.6 a	7.5 a
45	62.3 a	56.1 a	25.9 a	22.8 a	3.3 a	2.6 a	1398.4 a	1219.2 a	52.6 a	51.3 a	8.9 b	7.0 b
F-test	**	**	**	**	**	**	**	**	**	**	**	**
Interactions												
G x P	N.S	*	N.S	N.S	N.S	N.S	**	**	N.S	N.S	**	**
G x F	N.S	**	**	N.S	N.S	N.S	**	N.S	**	N.S	**	N.S
P x F	N.S	N.S	N.S	N.S	*	N.S	**	N.S	N.S	N.S	**	**
G x P x F	N.S	N.S	N.S	N.S	N.S	N.S	**	N.S	*	N.S	**	N.S

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

While, the highest mean values of number of peduncle of pods were obtained from the application of 30 kg N fed.$^{-1}$, whereas 15 kg nitrogen rate produce the lowest value of each character. The positive results of the added N effects could be related to the important role of nitrogen and its vital contribution to several biochemical processes in the plant, related to growth (Marscher, 1986) and to its role in assimilating the photosynthetic reaction. Furthermore, plants with high nitrogen contents had higher levels of indigenous auxin and high gibberellin activity (Rajagopal and Rao, 1974). The present results matched well with those obtained by Knany *et al.* (2002), El-Bably and El-Waraky (2006), and El-Waraky and Kasem (2007) on cowpea; Shiboob (2000) on bean and Bin Ishaq (2002) on pea.

d.Effect of genotypes and plant population interaction:

Data presented in Table (3) show that the interaction between cowpea genotypes and plant population significantly affected plant height in the second season and high significantly affected leaf area plant^{-1} and number of peduncle of pods plant^{-1} in both seasons. Dokki-331 cv. and Kafr El-Sheikh-1 cv. had the higher values of plant height and leaf area plant^{1} and low density (60.00 plants fed.$^{-1}$). Also, it had high significant effect on number of peduncle of pods plant^{-1} where the highest values of 11.9 and 8.5 were obtained with Kafr El-Sheikh-1 as cowpea cultivar and low density (60.000 plants fed.$^{-1}$). These results are agree with those obtained by Masoud (2002).

e.Effect of genotypes and nitrogen fertilizer levels interaction:

Data tabulated in Table (4) show that the interaction between genotypes and nitrogen rates high significantly affected plant height in the second season and high significantly affected number of leaves plant^{-1}, leaf area plant^{-1}, chlorophyll content and number of peduncle of pods plant^{-1} in the first seasons. Dokki-331 cv. had the higher values of plant height, number of leaves plant^{-1} and leaf area plant^{-1} and 45 kg N fed.$^{-1}$ followed by Kafr El-Sheikh-1 cv. On the other hand, mutant A_7 produced the highest values of chlorophyll content with 45 kg N/ fed.$^{-1}$ followed by Kaha-1 cv. Concerning the number of peduncle of pods plant^{-1} Kafr El-Sheikh-1 cv. and mutant A_7 produced the largest number of peduncle of pods plant^{-1} and 30 kg N fed.$^{-1}$, while, Dokki-331 cv. produced the lowest value of number of peduncle of pods plant^{-1}. These results are in agreement with those obtained by Knany *et al.* (2002)

f.Effect of plant population and nitrogen fertilizer levels interaction:

Data of Table (5) show that plant density and nitrogen rates interaction significantly affected number of branches plant^{-1} and leaf area plant^{-1} in the first season and high significantly affected number of peduncle of pods plant^{-1} in both seasons. Plants grown under low density (60.000 plant fed.$^{-1}$) had the higher values of number of branches plant^{-1} and leaf area plant^{-1} and 45 kg N fed.$^{-1}$. The highest values of number of peduncle of pods plant^{-1} of 12.2 and 8.1 were obtained with low density (60.000 plant fed.$^{-1}$) and 30 kg N fed.$^{-1}$ in the first and second seasons, respectively.

Table (3): Effect of genotypes and plant population interaction on cowpea vegetative growth characters in 2004 and 2005 seasons.

Genotypes	60.000 plant fed.$^{-1}$						120.000 plant fed.$^{-1}$					
	Plant height (cm)		Leaf area plant^{-1} (dm^2)		No. of peduncle plant^{-1}		Plant height (cm)		Leaf area plant^{-1} (dm^2)		No. of peduncle plant^{-1}	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
A_7	46.7	42.1 e	1306.2 c	1175.1 bc	9.9 b	8.1 b	53.0	46.0 d	1171.4 e	1121.7 d	7.9 e	6.9 cd
Kaha-1	43.0	38.9 f	1238.9 d	1098.9 e	9.5 c	7.1 c	47.5	41.7 e	1129.9 f	1057.0 f	7.4 f	6.7 de
Kafr El-Sheikh-1	63.2	55.4 c	1460.2 b	1245.8 a	11.9 a	8.5 g	67.4	60.0 b	1238.4 d	1162.2 c	6.8 g	6.5 ef
Dokki-331	65.5	59.8 b	1457.3 a	1256.0 a	9.1 d	6.4 f	70.8	65.6 a	1240.2 d	1185.2 b	6.2 h	5.9 g
F-test	N.S	*	**	**	**	**	N.S	*	**	**	**	**

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

Table (4): Effect of genotypes and nitrogen fertilizer levels interaction on cowpea vegetative growth characters in 2004 and 2005 seasons.

Genotypes	N levels kg N fed.$^{-1}$	Plant height (cm)		No. of leaves plant^{-1}		Leaf area plant^{-1} (dm^2)		Chlorophyll content SPAD unit		No. of peduncle of pods plant^{-1}	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
A_7	15	43.6	38.9 g	19.1 g	17.5	1161.1 d	1083.4	50.1 e	49.3	7.4 de	6.9
	30	49.6	43.6 f	21.2 f	19.5	1228.7 c	1146.7	51.7 cd	51.0	9.8 b	8.1
	45	56.3	49.7 e	22.7 e	21.7	1326.6 b	1215.1	54.5 a	52.2	9.6 b	7.6
Kaha-1	15	40.2	36.6 h	17.9 h	15.6	1112.5 e	1020.3	49.7 e	48.3	7.0 ef	6.4
	30	45.4	40.4 g	19.9 g	18.0	1188.0 d	1082.6	51.2 d	50.0	9.5 b	7.4
	45	50.2	44.0 f	21.4 f	19.0	1252.7 c	1131.0	52.5 b	51.8	8.8 c	6.9
Kafr El-Sheikh-1	15	59.4	53.5 d	22.3 ef	19.8	1233.3 c	1153.8	49.6 e	48.1	7.8 d	7.1
	30	66.8	57.6 c	25.5 c	22.4	1313.7 b	1203.8	51.3 d	49.4	10.4 a	8.0
	45	69.7	62.1 b	28.6 b	24.0	1500.9 a	1254.6	52.1 bc	51.2	9.9 b	7.6
Dokki-331	15	63.1	56.5 c	24.3 d	21.2	1232.5 e	1166.5	48.5 f	48.0	6.7 f	5.8
	30	68.4	62.8 b	27.9 b	24.0	1300.6 b	1219.1	49.7 e	48.7	8.6 c	6.5
	45	72.9	68.9 a	30.9 a	26.7	1513.2 a	1276.2	51.3 d	50.0	7.7 d	6.1
F-test		N.s	**	**	N.S	**	N.S	**	N.S	**	N.S

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

II.Seed yield and its components:

a.Effect of genotypes:

Data in Table (6) generally indicated that mutant A_7, significantly, increased seed yield fed.$^{-1}$, number of pods plant^{-1}, number of seeds per pod, weight of 100-seeds and seed crude protein content, in both seasons, as compared with Kaha-1 cv., Kafr El-Sheikh-1 c.v and Dokki-331 cv. The differences were highly significant in both seasons. Concerning, the pod length Kafr El-Sheikh-1 cv. produced the highest value of pod length, while, Kaha-1 c.v. produced the lowest value of pod length. On the other hand, Dokki-331 c.v produced the lowest seed yield and yield components in both seasons. Seed yield in cowpea is determined by three major yield components; i.e., number of pods plant^{-1}, number of seeds pod^{-1} and average seed weight. The superiority of the mutant A_7 compared with the other genotypes is due to their higher number of pods plant^{-1}, higher number of seed pod^{-1} and higher weight of 100-seed compared with other genotypes. In this concern, Afolabi (1980), on cowpea, found that seed yield was strongly affected by number of pods plant which was carried due to variety. These results are in harmony with those of Morsy (1986), Metwally *et al.* (1998 a,b), El-Kassas and Metwally (1999) and Masoud (2002) working on different varieties of cowpea. They reported that seed yield component were fairly stable with cultivar specially.

b.Effect of plant population:

Data presented in Table (6) show that cowpea plants grown at high plant density (120.000 plants fed.$^{-1}$) produced the highest seed yield, *i.e.*, 1657 and 1423 kg fed.$^{-1}$ in the first and second seasons, respectively. On the other hand, cowpea plants grown at low plant density (60.000 plants fed.$^{-1}$) produced the highest values of number of pods plant^{-1}, number of seeds pod^{-1}, pod length, weight of 100-seeds and seed crude protein content while, cowpea plants grown under high plant density produced the lowest values. The differences were significant in both seasons In this respect, many investigators reported that seed yield per feddan significantly increased as plant density increased. Saleh *et al.* (1980), on cowpea, found that less crowded plants led to higher seed yield per plant but lower seed yield per feddan. Morsy (1986), Metwally *et al.*(1998b) and Masoud (2002), on cowpea, reported that the higher seed yield were obtained from high plant population per feddan.

c.Effect of nitrogen levels:

Data in Table (6) generally indicated that nitrogen fertilization with 30 and 45 kg N fed.$^{-1}$, significantly, increased seed yield fed.$^{-1}$, number of pods plant^{-1}, number of seeds pod^{-1}, weight of 100-seeds and seed crude protein content, in the both seasons, as compared with 15 kg N fed.$^{-1}$, whereas 30 and 45 kg N levels had approximately the same effect, this due to the soil contain 22 and 19 kg available N fed.$^{-1}$ in the first and second seasons, respectively that complete the needed values of N required to cowpea with 30 kg N, while this values with 45 kg N was increase than the needed (Table 1).

Table (5): Effect of plant population and nitrogen fertilizer levels interaction on cowpea vegetative growth characters in 2004 and 2005 seasons.

N levels (kg N/fed.$^{-1}$)	60.000 plant fed.$^{-1}$						120.000 plant fed.$^{-1}$					
	No. of branches plant^{-1}		Leaf area plant^{-1} (dm^2)		No. of peduncle of pods plant^{-1}		No. of branches plant^{-1}		Leaf area plant^{-1} (dm^2)		No. of peduncle of pods plant^{-1}	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
15	2.8 d	2.2	1227.5 d	1134.4	8.2 c	6.9 c	2.5 e	1.8	1142.1 f	1077.6	6.2 e	6.2 e
30	3.4 b	2.5	1332.1 b	1194.4	12.2 a	8.1 a	2.5 e	2.1	1183.4 e	1131.7	7.0 d	6.8 c
45	3.6 a	2.8	1537.4 a	1253.2	10.0 b	7.6 b	3.0 c	2.5	1259.4 c	1185.3	8.0 c	6.5 d
F-test	*	N.S	**	N.S	**	**	*	NS	**	N.S	**	**

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

Table (6): Effect of genotypes, plant population and nitrogen fertilizer levels on seed yield and its components of cowpea plants in 2004 and 2005 seasons.

Treatments	Seed yield fed.$^{-1}$ (kg)		No. of pods plant^{-1}		No. of seeds pod^{-1}		Pod length (cm)		100-seed weight (g)		Crude protein (%)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Genotypes (G)												
A_7	1713.5 a	1491.5 a	13.3 a	13.0 a	10.2 a	9.7 b	12.9 c	12.6 b	14.9 a	14.3 a	18.4 a	17.8 a
Kaha-1	1515.3 c	1295.5 c	13.0 b	12.2 b	10.1 a	9.6 b	12.6 d	12.6 b	13.8 d	13.0 d	17.8 b	17.4 b
Kafr El-Sheikh-1	1632.5 b	1377.5 b	13.3 a	12.0 b	10.2 a	9.9 a	14.4 a	13.7 a	14.5 b	14.0 b	18.2 a	17.5 b
Dokki-331	1101.5 d	897.0 d	10.8 c	10.0 c	8.7 b	8.0 c	13.9 b	12.9 b	13.9 c	13.3 c	17.5 c	17.2 c
F-test	**	**	**	**	**	**	**	**	**	**	**	**
Plant population (plant fed.$^{-1}$) (P)												
60.000	1324.1 b	1107.0 b	14.6 a	13.3 a	10.4 a	9.9 a	13.7 a	13.1 a	14.4 a	13.8 a	18.8 a	18.1 a
120.000	1657.3 a	1423.8 a	10.6 b	10.0 b	9.2b	8.7 b	13.2 b	12.8 b	14.0 b	13.4 b	17.1 b	16.8 b
F-test	**	**	**	**	**	**	**	**	*	**	**	**
N levels (kg N fed.$^{-1}$) (F)												
15	1332.4 b	1109.8 c	11.7 c	10.9 c	9.5 b	9.0 b	13.1 b	12.7 c	14.1	13.4 b	17.1 c	17.0 b
30	1591.7 a	1315.5 b	13.4 a	12.2 a	9.9 a	9.4 ab	13.6 a	13.0 b	14.3	13.7 a	17.9 b	17.4 b
45	1548.0 a	1370.8 a	12.7 b	11.9 b	9.9 a	9.6 a	13.7 a	13.2 a	14.3	13.9 a	18.9 a	18.0 a
F-test	**	**	**	**	**	**	**	**	N.S	**	**	**
Interactions												
G x P	**	**	**	**	**	**	N.S	**	**	*	N.S	*
G x F	N.S	N.S	N.S	N.S	*	N.S	N.S	**	N.S	N.S	N.S	*
P x F	**	**	**	**	*	*	N.S	N.S	N.S	N.S	**	**
G x P x F	N.S	N.S	N.S	N.S	N.S	N.S	N.S	**	N.S	N.S	N.S	*

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

The obtained increments in the seed yield as a result of N application might be directly attributed to the increase of pod number per plant, number of seeds per pod and weight of 100-seed. These results seemed to be in accordance with those reported by Edij *et al.* (1975), who found that seed yield of bean and its components were significantly increased with increasing nitrogen rates from 40 to 200 kg N ha^{-1}. Also, Nassar and El-Masry (1989) observed significant increases in seed yield with nitrogen application up to 160 kg $fed.^{-1}$, meanwhile, Bin Ishag (2002) found that the soil application of N at the rate of 40 or 60 kg $fed.^{-1}$ gave the highest mean values of pea dry seed yield. The later reported that the increase in seed yield to be related to the increments on number of pods $plant^{-1}$ rather than to increase in weight of seeds pod^{-1}. Lau and Stephenson (1993) explained the increase in seed yield, as a result of N fertilization, on the basis that the pollen produced by plants in high nitrogen treatment sired significantly more seeds than the pollen from low nitrogen plants. Similar results on cowpea were recorded by Morsy (1986), Knany *et al.* (2002), El-Bably and El-Waraky, 2006 and El-Waraky and Kasem (2007).

d.Effect of genotypes and plant population interaction:

Data presented in Table (7) show that the productivity of different genotypes of cowpea plants were affected by plant density in both seasons. It is clear that mutant A_7 produced the highest seed yield $fed.^{-1}$ under high plant density (120.000 plants $fed.^{-1}$), while Kafr El-Sheikh-1 cv. produced the highest seed yield $fed.^{-1}$ under low plant density (60.000 plants $fed.^{-1}$). On the other hand, the Dokki-331 cv. which was grown under low or high plant density produced the lowest seed yield, in both seasons. In this respect, Jallow (1985), Metwally *et al.* (1998b) and Masoud (2002) reported that there was a significant cultivar x density interaction effect on seed yield of cowpea.

Concerning, the number of pods $plant^{-1}$, number of seeds pod^{-1}, pod length Kafr El-Sheikh-1 cv. produced the largest values of this characters under low plant density, in both seasons. While, high significant effect on number of pods $plant^{-1}$, number of seeds pod^{-1} and weight of 100-seeds were obtained with mutant A_7 and low density. Also, mutant A_7 produced the highest value of seed index with values of 15.0 and 14.6, 14.8 and 14.0 g 100 $seeds^{-1}$ either low or high plant density, in the first and second seasons, respectively.

e.Effect of genotypes and nitrogen fertilizer interaction:

Data presented in Table (8) show that the number of seeds pod^{-1} of cowpea plants was significantly affected by the interaction between genotypes and nitrogen fertilizer levels in the first season, while pod length and seed crude protein content were significantly affected in the second season. In the first season, mutant A_7 and Kafr El-Sheikh-1 cv. fertilized with the high N level produced the highest number of seeds pod^{-1}, while Dokki-331 cv. showed the lowest number of seeds pod^{-1}. In the second season, Kafr El-Sheikh-1 cv. had high significant effect on pod length with the high N level. On the other hand, mutant A_7 and Kafr El-Sheikh-1 cv. were fertilized with the high N level produced the highest seed crude protein content.

Table (7): Effect of genotypes and plant population interaction on seed yield and its components of cowpea plants in 2004 and 2005 seasons.

Genotypes	Plant population (plant fed.$^{-1}$)	Seed yield fed.$^{-1}$ (kg)		No. of pods plant^{-1}		No. of seeds pod^{-1}		Pod length (cm)		100-seed weight (g)		Crude protein (%)	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
A_7	60.000	1492.0 c	1259.0 d	15.2 ab	13.9 a	10.9 ab	10.3 b	13.1	12.7 cd	15.0 a	14.6 a	19.3	18.6 a
	120.000	1935.0 a	1724.0 a	11.3 d	11.2 d	9.5 c	9.2 c	12.8	12.5 d	14.8 a	14.0 c	17.4	16.9 d
Kakha-1	60.000	1276.5 d	1076.0 e	14.7 b	13.5 b	10.7 b	10.1 b	12.9	12.9 bc	13.5 d	13.1 f	18.5	18.0 b
	120.000	1754.0 b	1515.0 b	11.3 d	10.8 e	9.5 c	9.0 c	12.3	12.2 e	13.6 cd	12.9 g	17.0	16.7 de
Kafr El-Sheikh-1	60.000	1571.0 c	1299.0 d	15.8 a	14.2 a	11.1 a	10.7 a	14.6	13.7 a	15.0 a	14.2 b	19.1	18.2 b
	120.000	1694.0 b	1456.0 c	10.8 d	9.7 f	9.3 c	9.0 c	14.1	13.6 a	14.0 b	13.8 d	17.2	16.8 de
Dokki-331	60.000	957.0 e	794.0 g	12.6 c	11.8 c	9.0 d	8.4 d	14.4	13.0 b	13.9 bc	13.4 e	18.2	17.7 c
	120.000	1246.0d	1000.0 f	9.1 e	8.2 g	8.3 e	7.7 e	13.6	12.9 bc	13.8bcd	13.2 f	16.8	16.6 e
F-test		**	**	**	**	**	**	N.S	**	**	*	N.S	*

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

Table (8): Effect of genotypes and nitrogen fertilizer levels interaction on number of seed pod^{-1}, pod length and crude protein of cowpea plants in 2004 and 2005 seasons.

Genotypes	N levels kg N fed.$^{-1}$	No. of seeds pod^{-1}		Pod length (cm)		Crude protein (%)	
Season		1st	2nd	1st	2nd	1st	2nd
A_7	15	9.9 c	9.3	12.6	12.4 fg	17.4	17.0 gh
	30	10.3 ab	9.9	13.2	12.7 ef	18.3	17.7 cd
	45	10.5 a	10.1	13.0	12.8 de	19.5	18.6 a
Kaha-1	15	9.9 c	9.3	12.2	12.2 g	17.0	17.0 gh
	30	10.2 abc	9.6	12.8	12.4 fg	17.6	17.3 efg
	45	10.2 abc	9.9	12.8	13.3 bc	18.7	17.8 c
Kafr El-Sheikh-1	15	10.0 bc	9.7	14.1	13.6 ab	17.2	17.1 fg
	30	10.2 abc	9.9	14.4	13.6 ab	18.1	17.4 def
	45	10.4 a	10.1	14.6	13.8 a	19.1	18.1 b
Dokki-331	15	8.1 e	7.7	13.5	12.7 ef	16.8	16.7 h
	30	9.1 d	8.2	14.0	13.0 cde	17.3	17.1 g
	45	8.9 d	8.3	14.4	13.1 cd	18.2	17.6 cde
F-test		*	N.S	N.S	**	N.S	*

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

f.Effect of plant population and nitrogen fertilizer levels interaction:

Data presented in Table (9) show that seed yield fed.$^{-1}$, number of pods plant^{-1}, number of seeds pod^{-1} and seed crude protein content were affected by the interaction between the plant density and nitrogen fertilizer levels in both seasons. Plants grown under high density with high N fertilizer level produced the highest seed yield (1797 and 1612 kg fed.$^{-1}$) in the first and second seasons, respectively, followed by plants grown under high density with medium N fertilizer level (30 kg N fed.$^{-1}$). While, plants grown under low density with low N fertilizer level produced the lowest seed yield (1186 and 988 kg fed.$^{-1}$) in the first and second seasons, respectively.

Table (9): Effect of plant population and nitrogen fertilizer levels interaction on seed yield and its components of cowpea plants in 2004 and 2005 seasons.

Plant population	N levels	Seed yield fed.$^{-1}$ (kg)		No. of pods plant^{-1}		No. of seeds pod^{-1}		Crude protein (%)	
(plant fed.$^{-1}$) Season	kg N fed.$^{-1}$	1st	2nd	1st	2nd	1st	2nd	1st	2nd
60.000	15	1186.5 e	988.1 e	13.3 c	12.6 c	10.2 b	9.6 b	17.6 c	17.5 c
	30	1487.6 c	1203.8 c	16.1 a.	14.3 a	10.6 a	10.0 a	18.6 b	18.0 b
	45	1298.3 d	1129.1 d	14.3 b	13.2 b	10.5 a	10.0 a	20.1 a	18.9 a
120.000	15	1478.3 c	1231.1 c	10.0 e	9.2 f	8.7 e	8.4 e	16.6 e	16.4 f
	30	1695.8 b	1427.3 b	10.7 d	10.0 e	9.2 d	8.7 d	17.1 d	16.8 e
	45	1797.8 a	1612.5 a	11.1 d	10.7 d	9.5 c	9.1 c	17.7 c	17.1 d
F-test		**	**	**	**	**	**	**	**

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

On the other hand, plants grown under low density with medium N fertilizer level produced the highest seed yield (1487 and 1203 kg fed.$^{-1}$) in the first and second seasons. Concerning, the number of pods plant^{-1} number

of seeds pod^{-1} and seed crude protein content plants grown under low density with medium N fertilizer level produced the highest values of this characters. In this respect, Metwally *et al.* (1998b), on cowpea, found that there were significant interactions between plant density and nitrogen on seed yield.

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تأثير التراكيب الوراثية والكثافة النباتية ومستوى التسميد النيتروجينى على سلالة متفوقة من اللوبيا تُعد لتسجل كصنف جديد

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أجريت التجربة على محصول اللوبيا خلال العروة الصيفية لعامى ٢٠٠٤ ، ٢٠٠٥م فى مزرعة محطة البحوث الزراعية بسخا ، وكان الهدف الرئيسى للبحث هو تقييم بعض أصناف وسلالة من اللوبيا تحت ثلاثة مستويات من التسميد النيتروجينى (١٥ ، ٣٠ ، ٤٥كجم ن/فدان) ، والأصناف المستخدمة هى: قها-١ ، كفرالشيخ-١ ، ودقى-٣٣١ والسلالة هى: أ-٧. وكان التصميم المستخدم هو نظام القطع المنشقة مرتين فى أربع مكررات حيث وزعت معاملات الكثافة النباتية عشوائيا على القطع الرئيسية بينما وزعت المعاملات السمادية داخل القطع المنشقة وكذلك وزعت التراكيب الوراثية للأصناف والسلالة داخل القطع المنشقة مرتين.

وتتلخص أهم النتائج المتحصل عليها فى الآتى:

تفوق الصنف دقى-٣٣١ عن باقى التراكيب الوراثية فى ارتفاع النبات وعدد الأوراق وعدد الأفرع الجانبية للنبات والمساحة الورقية للنبات ، بينما أعطى الصنف قها-١ أقل القيم فى النمو الخضرى وذلك فى الموسمين ، وقد تفوق الصنف كفرالشيخ-١ فى عدد الأفرع الثمرية للنبات. وعلاوةعلى ذلك فإن محصول البذور ومكوناته معبرا عنه بالمحصول الكلى للفدان وعدد القرون للنبات وعدد البذور للقرون ووزن ١٠٠ بذرة فقد تفوقت السلالة أ-٧ عن باقى التراكيب الوراثية يليه الصنف كفرالشيخ-١ ، بينما أعطى الصنف دقى-٣٣١ أقل القيم فى محصول البذور ومكوناته وذلك فى الموسمين. وبالإضافة إلى ذلك تفوقت السلالة أ-٧ فى محتوى الأوراق من الكلوروفيل ومحتوى البذور من البروتين.

بينت النتائج أن قلة الكثافة النباتية قد أدى إلى تحسين صفات النمو الخضرى ومكونات المحصول ، علاوة على زيادة محتوى الأوراق من الكلوروفيل ومحتوى البذور من البروتين ، بينما محصول البذور قد استجاب بالزيادة كنتيجة لزيادة الكثافة النباتية.

أوضحت النتائج أن زيادة معدل التسميد النيتروجينى المضاف حتى ٤٥ كجم/فدان صاحبه زيادة معنوية فى صفات النمو الخضرى ، بينما زادت عدد الأفرع الثمرية للنبات وعدد القرون للنبات عند التسميد بـ ٣٠كجم ن/فدان ، وعلاوة على ذلك فإن محصول البذور ومكوناته قد استجاب بالزيادة كنتيجة لزيادة مستوى النيتروجين المضاف حتى ٤٥كجم ن/فدان ، وأيضا زيادة معنوية فى محتوى الأوراق من الكلوروفيل ومحتوى البذور من البروتين.