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PHYSIOLOGICAL RESPONSES OF COWPEA PLANTS TO IAA AND ORGANIC MANURES IN SANDY SOIL

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ABSTRACT

Two field experiments were conducted during two successive seasons in the Nubaria region in Egypt. The soil was supplemented with organic manures, either chicken (CKM) or farmyard (FYM). Foliar application of the cowpea plants with indole acetic acid (IAA) at three concentrations (12.5, 25 & 50 ppm) induced increments of the plants height, fresh and dry weights, number of branches and number of leaves/plant as well as yield components (pods/plant, seeds/pod, weight of pod, weight of seeds/plant and weight of seeds/Feddan). In addition, the same treatments induced a defense mechanism by increasing the accumulation of organic solutes such as sugars, proline and total soluble nitrogen and inorganic solutes (K, Na, Ca, Mg, Zn, Fe and Cu) in the leaves and seeds. Meanwhile the same treatments induced a reduction in the Mn, Pb and Ni contents. The effect of organic fertilizers (CKM and FYM) showed a significant increase in all the mentioned parameters when compared with a control. Meanwhile, the combination of different concentrations of IAA with organic manure induced a highly significant increase in all the above mentioned parameters.

Keywords: Cowpea, chicken manure, farmyard manure, IAA.

INTRODUCTION

Some regions of the world, such as parts of the Sahara Desert of Northern Africa receive an average of 5 mm of rainfall or less per year. This extreme aridity is atypical of the arable land which is used for crops or pastures as in the Nubariya area (near Alexandria) in Egypt. Nonetheless, most of the world's agriculture is subjected to low field capacity. Arid and semi-arid zones are defined as areas in which plant transpiration is about 50% or less than the transpiration that would normally occur, in response to the limited water availability.

In these areas water is the major factor limiting plant growth. This water stress may be alleviated by irrigation whenever possible (Boyer, 1982) or by using certain bioregulators such as IAA (Yadav *et al.*, 1991). Agarwal and Gupta (1995) showed that IAA suppressed the salt stress and in turn its injuries by lowering osmotic potential and maintaining cellular turgidity. In the meantime proline, soluble amino acids, sugars insoluble sugars and proteins were increased by this growth regulator. Moreover, Pustovoitova *et al.* (2000) stated that the higher drought tolerance of the transgenic tobacco plants, *Nicotiana silvestris,* is related to IAA involvement in plant adaptation, that is, in the hormone induced modification of plant hormonal status and the osmoregulation process. Plant hormones have much to offer in improving crops quantitatively and qualitatively. In the meantime, plant hormones are a useful tool in saving irrigation.

The incubation of sand loam soil with either farmyard or chicken organic manures is carried out to improve the physical and chemical properties of soil (Sadovnikova *et al.*, 1996). The organic manures are known to improve the properties of sandy soil by increasing the limited moisture holding capacity (Maynard, 1994). In addition to this effect, it can change the chemical properties of soil through increasing the soil pH, C/N ratio, cation exchange capacity and ion uptake (Bvoungyeul *et al.*, 1996). All these factors are reported to have a positive effect on the growth of groundnut (Hafner *et al.*, 1992), yield of soybean (Ramamurtry and Shivashankar, 1996), the protein quantity of the cowpea seeds produced (Kumer *et al.*, 1993) and the rate of nutrient uptake from the soil by potato, (Sood *et al.*, 1994).The combination of IAA with organic manure is reported to increase the efficiency of the plant to use all the nutrients in soil (Hsich and Hsu , 1993).

The aim of the present study is to assess the effect of IAA and organic manures (CKM or FYM and their combinations) on improving the metabolism, growth and yield of cowpea plants grown in poor sandy soil.

MATERIALS AND METHODS

Two field experiments were carried out during two successive seasons at El-Bostan village, Nubarea area, Tahrir province, Egypt. The data for mechanical and chemical analyses of the experimental field soil are presented in Table 1. According to Jackson (1958) the soil is sandy in texture; having a low level of nutrients and its pH appears to be neutral.

Table 1. Mechanical and chemical analyses of Nubaria soil at the experimental site

Mechanical analysis	
Soil fractions	
Sand %	77.9
Silt %	14.5
Clay %	5-10
Texture class	Sandy
Field capacity %	13– 15
Chemical analysis	
pH	7.45
E.C.	0.730 m S/cm
$CaCO_3$%	1.80
Mg^{++}	1.0 meq/100 g soil
Na^{+}	1.3 meq/100 g soil
K^{+}	0.05 meq/100 g soil
Total nitrogen	150.0 ppm

A split plot design was followed with four replicates. The experimental area was divided into three plots (each 4 x 40 m) two of which were allotted for the manures and the third was left as a control. Two types of manures were used, namely chicken manure (CKM; pH 6.8, Ec 1.8 mmhos/cm^2, N 3.5%, organic matter 49.96%, P 0.9% and K 0.8%) and farmyard manure (FYM; pH 7.5, Ec 2.13 mmhos/cm^2, N 1.2%, organic matter 17.5%, P 0.6% and K 0.34%); one for

each of the designated plots, where the former was applied at 5 m^3/Fed and the latter at 10 m^3/Fed (feddan. = 4200 meter). Each manure was mixed at the depth of 10 – 15 cm in the seed pits after soil preparation. Each plot was divided into four subplots. The plants of each subplot were sprayed twice (30 and 37 days after sowing) with the following IAA concentrations: 0.0, 12.5, 25 and 50 ppm.

The plant samples were taken 2 months after sowing and shoot length, number of branches and leaves/plant, and fresh and dry weights were determined. The yield components (number of pods/plant, number of seed/pod, number and weight of seed/plant, weight of pods/plant and the seed yield (Kg/Fadden) were also recorded.

The data of the different treatments were subjected to statistical analysis by using two-way ANOVA (Snedecor and Cochran, 1980).All data are shown as the mean averages of the two seasons

Chemical analysis: The methods of extraction and clarification of carbohydrates were essentially those described by Younis *et al.* (1969). The direct reducing values (D.R.V.) were determined following the procedure described by Bell (1955). The total reducing values (T.R.V.) were estimated by determining the reducing value after hydrolysis by invertase. The sucrose contents was calculated from the difference between T.R.V. and D.R.V. Polysaccharides were determined in the dry residue which was left after the extraction of soluble sugars using the method adopted by Younis *et al.* (1969).

Total-N and total soluble-N were estimated by the conventional micro-kjeldahl method (Pirie, 1955). Subtracting the total soluble-N from the total-N gave the value of protein-N .Cation estimation was carried out according to Chapman and Pratt (1978). Flameemission spectrophotometry was used for determining potassium and sodium while calcium, magnesium, zinc, iron, manganese, copper, lead and nickel were measured by atomic absorption spectrophotometry. Identification and quantitative determination of the amino acid composition of the cowpea protein was carried out by high performance liquid chromatography (HPLC).

RESULTS AND DISCUSSION

Growth measurements. Fig. 1 shows the changes in the following growth criteria:shoot length, number of branches/plant, number of leaves/plant and fresh and dry weights. These parameters were accelerated in comparison to the control as a response to the applied different concentrations of IAA (12.5, 25 and 50 ppm); a positive correlation being apparent with the concentration. Similar results were reported by Stefl (1988) in wheat plants. They found that drought decreased the tryptophan synthase. This reduced the biosynthesis of L-tryptophan and consequently that of IAA; growth being retarded or even stopped. These changes appeared reversible when growing conditions of the plant was improved. Similar results were obtained in the present study when the conditions were reversed by the exogenously applied IAA. Moreover Hathout *et al.* (1993) found that, application of IAA increased growth of tomato plants.

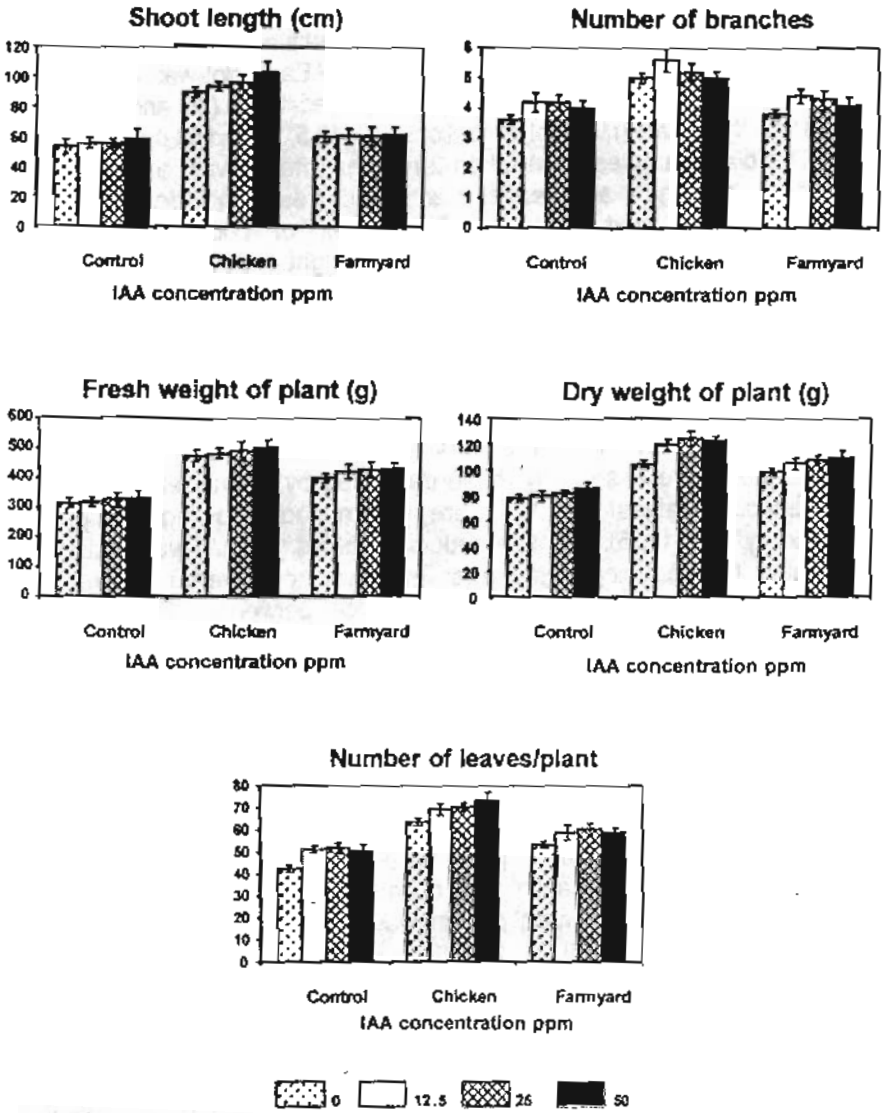

Fig. (1). The effect of the different concentrations of IAA and the different types of manure on growth measurements. Each value is the mean of 10 samples ± S.E

However, the application of organic manures (either CKM or FYM) to poor sandy soil (El-Nubaria), either alone or in combination with IAA, resulted in a significant increase in plant growth compared with the control. These increments are greater with CKM than with FYM. Similar results were obtained by Faiyed *et al.* (1991) who found that shoot dry weight was increased in response to poultry manure application with a slight increase in the case of FYM.

In general, the improvement of plant growth in response to the application of organic manures was due to the increase of soil organic compounds and consequently its fertility (Cassman *et al.*, 1992). In addition, the stimulating influence of organic manures on cowpea grown in sandy soil might be attributed to the improved microbial activity in the soil which probably improves the viability of the nutrients (Hannaa, 1994)

Carbohydrate contents of the leaves: It is clear from figure 2 that IAA significantly increased the glucose and total soluble sugar contents of the cowpea leaves, but these increments were higher in response to IAA at the lowest concentration (12.5 ppm) than at the higher ones (25 and 50 ppm). In addition, 12.5 and 25 ppm IAA induced a highly significant increase in sucrose contents.These results appeared to be similar to those obtained by Dogra *et al.* (1994), who stated that IAA increased the water soluble and acid soluble sugar contents of wheat.

Concerning the effect of IAA on polysaccharides and total carbohydrate values of cowpea leaves, significant increases were apparent. The maximum increase was achieved at the highest concentration (50 ppm IAA). These results indicate that IAA induced a stimulatory effect on carbohydrate synthesis. Similar results were obtained by Hathout *et al.* (1993). Furthermore, the pronounced accumulation of carbohydrates and protein due to IAA treatments in sorghum plants was attributed to the obvious increase in green area, which consequently leads to an increase in photosynthetic activity and consequently in plant productivity and dry production (Azooz *et al.*, 2004).

With regard to the plants grown in soil mixed with each type of organic manures, (either farmyard or chicken), total carbohydrate production was enhanced in the cowpea plants. This increase was mainly due to an increase in glucose and total soluble sugars in FYM and to an increase in polysaccharides in CKM.This effect could be mainly due to the increase of soil C/N ratio. The decomposition of organic matter seems also to benefit plant nutrition by increasing the percentage of ambient carbon dioxide, some of which escapes into the atmosphere and is absorbed by plants through the stomata as a source of carbon (Othieno, 1973).

The mixed application of different IAA concentrations and different types of organic manure induced variable increases in the total carbohydrates in cowpea leaves. This parameter reached the highest values in response to IAA (12.5 and 25 ppm) in the presence of CKM. This result was due to the increase in glucose, sucrose and total soluble sugars. Meanwhile, the polysaccharides were increased in response to 12.5 ppm IAA only and were still more or less constant at 25 and 50 ppm IAA. However, FYM induced a significant increase in total carbohydrates with increasing concentrations of IAA which was mainly due to the increase in polysaccharides and sucrose. Meanwhile, a reverse situation was observed for glucose and total soluble sugars.

Nitrogenous constituents in leaves: The results, as is clear in figure 3, indicate that the amounts of total soluble nitrogen, total nitrogen and protein nitrogen were significantly increased with increasing IAA concentrations. The increase in total soluble nitrogen may be due to the increase in amino acids as recorded by Shukry *et al.* (1990). The protein contents were increased by IAA treatments. These increments could be due to the direct increase of mRNA and

protein synthesis (Singh *et al.*, 1987). Moreover, Hathout *et al.* (1993) and Azooz *et al.* (2004) found that the protein content of tomato and sorghum plants, respectively were increased significantly subsequent to foliar spray with IAA.

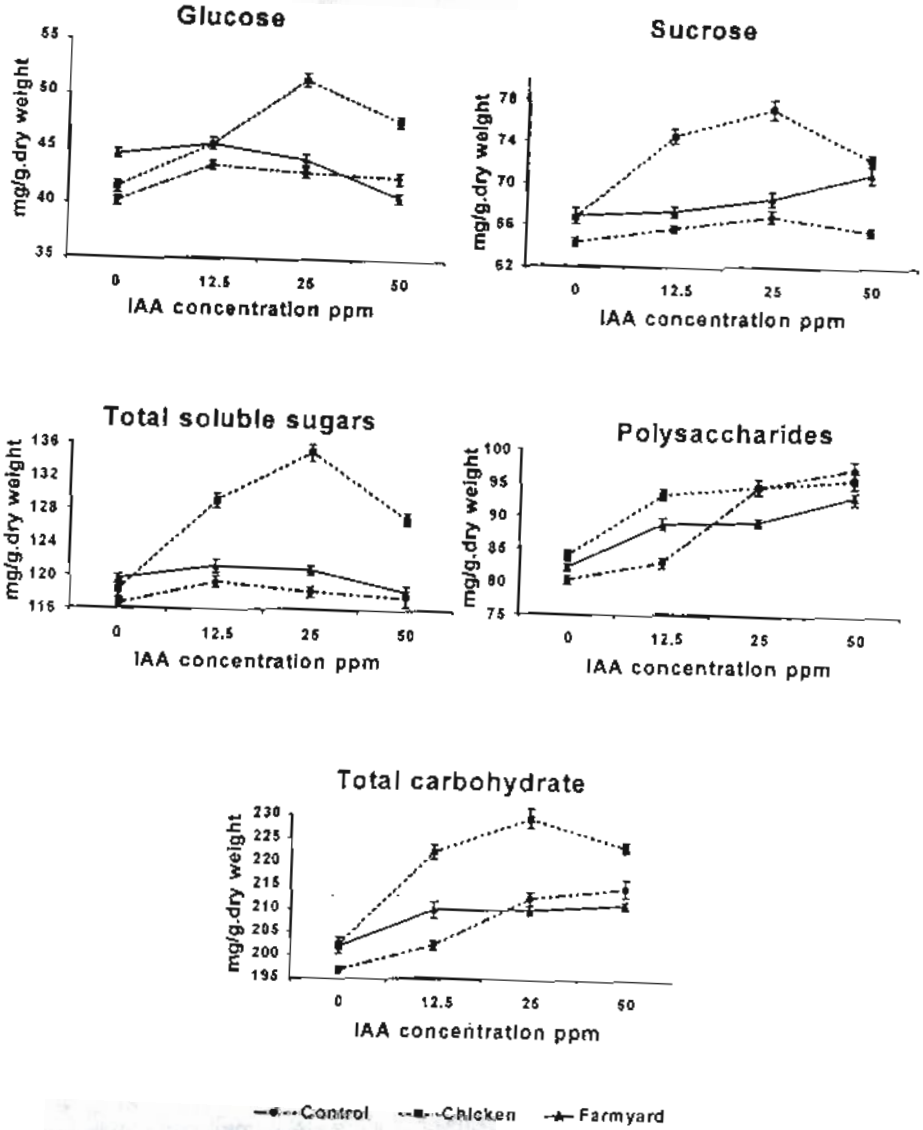

Fig. (2): The effect of the different concentrations of IAA and the different types of manure on the carbohydrate contents of cowpea leaves. Each value is the mean of 4 samples ± S.E.

Supplemental application of FYM or CKM to the soil showed higher values of total soluble nitrogen, protein nitrogen and total nitrogen in cowpea leaves. These increases were due to the high values of the nitrogenous components of the organic manure, which was added to the soil as recommended by Kumar *et al.* (1993); Maynard (1994) and Bvoungyeul *et al.* (1996). In

consequence an increase in nitrogen uptake in expected as observed in maize plant (Grignani *et al.*, 1994). In addition, it is clear in Fig. 3 that there were further significant increases in the nitrogenous constituents with increasing IAA concentrations used in combination with the organic manures.

Mineral contents: As presented in Fig. 4, K, Na and Ca showed increases in the leaves of cowpea in response to IAA treatments. These increases are in parallel with IAA concentrations. The results reflect the role of IAA in increasing the uptake and the translocation of the element solutes in the tissues of the leaves. Similar results were shown by Hathout *et al.* (1993) on tomato plants.

The growing of plants in a soil supplemented by organic manures (in absence of IAA) increased the ionic contents of leaves from K, Na and Ca. These results are in accordance with those obtained by Bvoungyeul *et al.* (1996), who found that, organic composts increased CEC (cation exchange capacity) of the soil. Bagavathimmal and Muthiath (1995) found that FYM increases K uptake by rice plants. The combined treatments of different concentrations of IAA and FYM or CKM generally induced a greater increase of K, Na and Ca contents than that increase maintained with each of these treatments when used alone. In Table 2, the increase in the amounts of Mg in cowpea leaves appeared, to be a function of the concentration of IAA.

The combination of FYM or CKM with IAA concentrations significantly increased Mg contents in cowpea leaves, particularly with12.5 ppm IAA plus FYM and 25 ppm plus CKM. The same trend was recorded in the case of Zn and Fe. However, Mn, Pb and Ni were decreased with increasing IAA concentrations, either alone or combined with organic manure. Ni was not detected in leaves in the presence of FYM at 50 ppm IAA and in the presence of CKM at all concentrations of IAA and Pb was not detected in response to 50 ppm IAA alone. Meanwhile, Cu concentrations were increased significantly in response to all concentrations of IAA. It is stated that the increase of Cu in the leaves was accompanied by an increase in K (Vardaka *et al.*, 1997). In general, our results are in accordance with those obtained by Warman *et al.* (1993) and Suwara *et al.* (1994).

Yield and yield attributes: The results as presented in figure 5 show an increase in the number of pods/plant, number of seeds/pod, number of seeds/plant, weight of pod/plant, weight of seeds/plant and weight of seeds/Feddan; the maintained increases run in parallel with an increase in IAA concentration. This pattern of results was confirmed by several investigators, thus Raghuranula *et al.* (1990) found that spraying robusta coffee plants with 8 ppm IAA increased fruit retention due to the reduction in endogenous level of ABA. Similar results were obtained by Yadav *et al.* (1991), who showed an increase in the number of seeds in *Brassica juncea* and *Brassica tournefortii* plants sprayed by IAA. Moreover, Omer *et al.* (1997) found that foliar application of IAA increased seed yield of *Cumin cymumun* plants grown in sandy soil.

The present results also show that using different organic manures (CKM or FYM) induced a highly significant increase in the yield and yield attributes of cowpea plants as compared with the control. The results Wonprasaid *et al.* (1996) using rice and Ramamurthy and Shivashankar

threonine, valine, methionine, leucine, isoleucine , phenylalanine and lysine) to the non essential amino acids (aspartic, glutamic, serine, glycine, alanine, proline, tyrosine and cystiene) of the yielded seeds of cowpea plants.

(1996) using soybean confirmed our illustrated pattern of results. Concerning

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الأستجابة الفسيولوجية لنبات اللوبيا لأندول حمض الخليك و المخصبات العضوية في الأراضى الرملية

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*** المركز القومي للبحوث – الدقي – الجيزة – مصر.**

**** قسم النبات – كلية العلوم – جامعة المنصورة – المنصورة – مصر.**

تم زراعة نبات اللوبيا في موسمين متتاليين في منطقة النوبارية وقد عوملت مجموعة من هذه النباتات بمخصبات عضوية (مخلفات الماشية أو مخلفات الدجاج) ورشت مجموعة ثانية بإندول حمض الخليك [ثلاثة تركيزات (١٢,٥ ، ٢٥ ، ٥٠ جزء في المليون)] بينما تم معاملة مجموعة ثالثة بكل من المخصبات العضوية وأندول حمض الخليك وتركت مجموعة أخرى دون أي معاملات (كنترول). وقد أوضحت النتائج أن مجموعة النباتات المرشوشة بإندول حمض الخليك دون إضافة مخصبات عضوية أظهرت زيادة في معايير النمو (الطول والوزن الغض والوزن الجاف وعدد الأفرع وعدد الأوراق/نبات) بالإضافة إلى زيادة في إنتاجية المحصول (عدد القرون/نبات وعدد البذور/نبات ووزن القرون/نبات ووزن البذور/نبات ووزن البذور/فدان) وذلك مقارنة بالنباتات غير المعاملة. وقد عزى ذلك إلى التأثير الفعال لإندول حمض الخليك في زيادة تراكم المواد العضوية (المواد السكرية – البرولين – المواد النيتروجينية) و المواد غير العضوية (مثل عنصر البوتاسيوم – الكالسيوم – الصوديوم – الماغنسيوم – الزنك – الحديد – النحاس) في كل من أوراق وبذور نبات اللوبيا. كما أوضحت النتائج أيضا نقصا في تركيز عناصر المنجنيز والرصاص والنيكل. وقد أدى استخدام الأسمدة العضوية منفردة إلى زيادة كبيرة في قياسات المعايير السابق ذكرها مقارنة بالنباتات الغير معاملة (الكنترول) بل وبالمقارنة أيضا بالنباتات المرشوشة بإندول حمض الخليك.

كما أظهرت النتائج المتحصل عليها أن معاملة نبات اللوبيا بالمخصبات العضوية مصحوبة بالرش بإندول حمض الخليك أدى إلى تفوق واضح في معايير النمو وإنتاجية النبات مقارنة بأي معاملة أخرى.

Regarding the effects of FYM treatment, Anamika and Singh (1996) found that FYM gave higher yields of both seeds and sprouts than did inorganic fertilizers. Moreover, Kumar *et al.* (1993) found that seed yield in cowpea was increased with the application of FYM. Of particular interest, Zeidan and El Kramany (2001) found that the application of organic manures increased the yield and yield components of the wheat plants grown in sandy soil. With respect to IAA treatments in the presence of CKM or FYM, higher increases in cowpea yield and yield attributes were generally induced by the combined application over & above the increase maintained by single treatments.

Chemical analysis of seeds: IAA treatments significantly increased the carbohydrate contents of the yielded seeds (Fig. 6), which appeared in parallel with the increase in IAA concentration, either alone or in combination with CKM or FYM. This increase may be due to the increased rate of translocation of carbohydrate from pump leaves to sink seeds (Ray and Choudhuri, 1981).

The protein content of seeds was significantly increased at 12.5 ppm and then decreased at 25 and 50 ppm IAA either alone or in combination with CKM. Meanwhile in FYM, there were significant increases at 12.5 and 25 ppm IAA and a decrease at 50 ppm (Fig. 6). These results support those obtained by Kumar *et al.* (1993) and Wonprasaid *et al.* (1996) who found that the nitrogen content of seeds was increased in the presence FYM. In general, seeds of farmyard manure have a good quality with respect to either carbohydrate or protein maintained in particular at 25 ppm IAA. The ionic contents of seeds are shown in Fig 6 and Table 3. K, Na and Ca showed a significant increase at all IAA treatments either alone or in combination with CKM or FYM. The trend was similar to that recorded in leaves. This may be due to the translocation of these elements &their deposition in seeds.

In general, IAA at all concentrations increased all trace elements in the seeds. This trend differed upon combination of IAA with CKM or FYM; thus Ni was not detected in seeds of CKM and FYM in combination with 25 and 50 ppm IAA. Also Pb was not detected in seeds in FYM at 25 and 50 ppm IAA and in CKM at 50 ppm IAA. These trace elements that were not detected in leaves or in seeds might have been accumulated and retained by the roots. However, Khadr *et al.* (1988) found that in the soil treated with chicken manure, increases in N, P, K, Fe, Zn and Mn contents in wheat grain were observed.

Amino acids In seeds: The data presented in Table 4 show the effect of the used treatments on the total amino acid and on the essential and non essential amino acids.

Regarding IAA effects, it is clear that its lowest concentration (12.5 ppm) increased the total amino acids while the reverse was shown in response to 50 ppm IAA. Meanwhile, the addition of FYM alone decreased the amino acid contents but when combined with 12.5 and 25 ppm IAA a noticeable increase was induced. However, upon application of CKM with or without IAA , no changes in the amino acid contents were observed in comparison to the control. The data in Table 4 show that, in general, IAA treatment increased the ratio of the essential amino acids (histidins, arginine, threonine, valine, methionine, leucine, isoleucine , phenylalanine and lysine) to the non essential amino acids (aspartic, glutamic, serine, glycine, alanine, proline, tyrosine and cystiene) of the yielded seeds of cowpea plants.

Table (2). Effect of IAA and organic manures on the ionic contents of cowpea leaves grown in Nubaria region. The values listed are presented as mM/g^{-1} D. Wt x 10^{-6}. Two-way analyses of variance were carried out.

Treatment		Mg	Zn	Fe	Mn	Cu	Pb	Ni
Manure	IAA (ppm)							
0	0.0	250.990 ± 0.58	74.600 ± 0.58	16.300 ± 0.58	5.110 ± 0.58	0.415 ± 0.029	2.280 ± 0.03	4.468 ± 0.03
	12.5	359.900 ± 0.58	76.700 ± 0.58	91.020± 0.58	4.180 ± 0.58	0.448 ± 0.029	1.900 ± 0.03	3.908 ± 0.03
	25.0	350.880 ± 0.58	96.300 ± 0.58	87.600 ± 0.58	4.200 ± 0.58	2.300 ± 0.029	1.780 ± 0.03	2.500 ± 0.03
	50.0	340.120 ± 0.58	154.000 ± 0.58	50.740 ± 0.58	4.000 ± 0.58	19.510 ± 0.029	-	2.550 ± 0.03
F-Test		1.000	1.000	1.000	1.000	1.3129	0.9036	1.5429
P-Value		0.000	0.000	0.000	N.S.	0.000	0.000	0.000
CKM	0.0	297.430 ± 0.58	123.100 ± 0.58	30.410 ± 0.58	12.472 ± 0.58	2.210 ± 0.50	3.341 ± 0.01	4.672 ± 0.00
	12.5	408.950 ± 0.58	120.400 ± 0.58	198.100± 0.58	7.506 ± 0.58	3.490 ± 0.50	1.265 ± 0.01	-
	25.0	998.110 ± 0.58	143.900 ± 0.58	223.500 ± 0.58	4.333 ± 0.58	4.640 ± 0.50	1.110 ± 0.01	-
	50.0	345.800 ± 0.58	132.900 ± 0.58	54.980 ± 0.58	3.988 ± 0.58	3.820 ± 0.50	0.332 ± 0.01	-
F-Test		1.000	1.000	1.000	2.000	11.8581	0.4030	2.4545
P-Value		0.000	0.000	0.000	0.000	0.0034	0.000	0.000
FYM	0.0	310.730 ± 0.58	366.8 ± 0.58	43.590 ± 1.13	18.750 ± 0.58	5.810 ± 0.29	3.574 ± 0.01	3.130 ± 0.01
	12.5	409.330 ± 0.58	271.100 ± 0.58	199.500 ±1.13	16.298 ± 0.58	1.080 ± 0.29	2.310 ± 0.01	3.440 ± 0.01
	25.0	381.530 ± 0.58	143.100 ± 0.58	135.850 ±1.13	10.243 ± 0.58	3.890 ± 0.29	1.740 ± 0.01	6.097 ± 0.01
	50.0	368.850 ± 0.58	161.300 ± 0.58	92.870 ± 1.13	13.136 ± 0.58	4.310 ± 0.29	1.561 ± 0.01	-
F-Test		1.000	0.000	0.7538	1.000	0.6085	0.6364	0.2727
P-Value		0.000	0.000	0.000	0.0002	0.0002	0.000	0.000

N.S. : Non significant   C.K.M.: Chicken manure   F.Y.M.: Farmyard manure

Table (3). Effect of IAA and organic manures on the ionic contents of cowpea seeds grown in Nubaria region. The values listed are presented as mM/g^{-1} D. Wt x 10^{-6}. Two-way analyses of variance were carried out.

Treatment		Mg	Zn	Fe	Mn	Cu	Pb	Ni
Manure	IAA (ppm)							
0	0.0	195.60 ± 0.14	15.30 ± 1.53	6.181 ±.0.06	0.224 ±.0.04	0.815 ±.0.03	0.372 ±.0.01	1.165 ±.0.01
	12.5	200.84 ± 0.14	23.03 ± 1.53	6.55 ±.0.06	1.697 ±.0.04	0.91 ±.0.03	0.753 ±.0.01	1.92 ±.0.01
	25.0	226.39 ± 0.14	35.30 ± 1.53	7.169 ±.0.06	1.243 ±.0.04	1.10 ±.0.03	0.433 ±.0.01	1.811 ±.0.01
	50.0	293.99 ± 0.14	13.20 ± 1.53	11.37 ±.0.06	0.923 ±.0.04	0.48 ±.0.03	0.333 ±.0.01	1.743 ±.0.01
F-Test		2.0768	1.1887	1.000	2.3595	1.5429	0.333	0.000
P-Value		0.000	0.0001	0.000	0.000	0.000	0.000	0.0013
CKM	0.0	224.71 ± 0.06	33.00 ±.0.06	6.37 ±.0.06	2.234 ±.0.05	0.730 ±.0.03	0.332 ±.0.01	0.93 ±.0.01
	12.5	290.72 ± 0.06	17.50 ±.0.06	10.49 ±.0.06	1.823 ±.0.05	0.531 ±.0.03	0.194 ±.0.01	0.677 ±.0.01
	25.0	348.50 ± 0.06	23.78 ±.0.06	14.23 ±.0.06	1.138 ±.0.05	1.854 ±.0.03	0.129 ±.0.01	-
	50.0	825.45 ± 0.06	14.40 ±.0 06	26.81 ±.0.06	0.991 ±.0.05	0.278 ±.0.03	-	-
F-Test		4.500	3.500	1.000	6.9504	2.5789	9.000	2.4545
P-Value		0.000	0.000	0.000	0.000	0.000	0.000	0.000
FYM	0.0	242.05 ± 0.06	13.00 ±.0.06	8.61±.0.06	1.549 ±.0.04	0.669 ±.0.01	0.370 ±.0.01	0.723 ±.0.01
	12.5	299.90 ± 0.06	13.50 ±.0.06	11.43 ±.0.06	1.254 ±.0.04	0.489 ±.0.01	0.300 ±.0.01	1.165 ±.0.01
	25.0	458.74 ± 0.06	31.70 ±.0.06	15.92 ±.0.06	1.891 ±.0.04	0.716 ±.0.01	-	-
	50.0	519.46 ± 0.06	12.20 ±.0.06	20.74 ±.0.06	1.124 ±.0.04	0.323 ±.0.01	-	-
F-Test		0.000	1.000	2.333	1.6328	1.4211	2.4545	0.000
P-Value		0.000	0.000	0.000	0.000	0.000	0.000	0.000

N.S. : Non significant C.K.M.: Chicken manure F.Y.M.: Farmyard manure

Table (4). Effect of different concentrations of IAA and different types of manures on the amino acid contents (g amino acid/100 gm protein) of Cowpea seeds.

Amino acid	Without manure				Chicken manure				Farmyerd manure			
	0	12.5 ppm IAA	25 ppm IAA	50 ppm IAA	0	12.5 ppm IAA	25 ppm IAA	50 ppm IAA	0	12.5 ppm IAA	25 ppm IAA	50 ppm IAA
Aspartic	2.87	2.69	2.90	2.09	2.91	1.70	1.91	1.46	1.19	1.94	1.86	0.12
Glutamic	6.52	3.89	4.10	1.73	5.61	3.29	3.95	2.37	0.98	2.40	2.28	0.11
Serine	0.68	0.21	0.20	0.21	0.75	0.10	0.14	0.70	0.31	0.26	0.24	0.13
Glycine	1.06	0.78	0.46	1.22	0.25	0.53	0.53	1.33	0.92	0.86	0.62	1.01
*Histidin	0.80	2.90	1.20	2.98	1.20	0.65	0.78	3.95	4.68	4.34	2.22	1.73
*Arginine	0.85	0.60	0.60	0.64	1.03	2.15	2.43	1.40	0.01	0.54	2.02	2.81
*Threonine	3.01	3.32	3.86	3.81	3.80	2.02	2.14	1.87	4.49	4.00	2.47	3.08
Alanine	0.62	1.02	0.97	0.83	0.21	0.20	0.41	0.31	0.76	1.16	0.45	0.46
Proline	1.17	1.64	1.58	1.59	1.97	3.10	3.17	1.83	2.48	2.39	4.85	6.80
Tyrosine	0.89	0.42	0.95	2.23	0.83	0.36	0.34	3.23	1.02	0.74	0.75	0.59
*Valine	1.65	1.10	1.12	0.38	1.33	0.80	0.80	0.10	1.38	1.20	1.52	1.92
*Methionine	1.02	0.75	0.66	1.89	0.68	2.13	0.88	2.39	0.10	2.15	1.71	1.01
Cystiene	0.51	0.47	0.40	0.34	2.08	1.24	1.30	1.01	0.23	0.25	0.35	Nil
*Isoleucine	0.81	2.03	2.08	1.57	1.45	5.58	1.62	1.26	1.88	1.71	1.85	2.66
*Leucine	1.68	1.87	1.88	1.09	0.82	1.42	2.80	0.99	1.11	1.16	1.01	1.11
*Phenylalanine	0.60	2.31	2.37	1.72	1.37	0.82	2.80	0.72	2.13	1.61	2.03	1.06
*Lysine	1.54	1.29	1.33	0.60	0.39	0.58	0.40	1.25	0.98	0.78	1.10	1.49
*Essential	11.96	16 17	14.6	14.68	12.07	16.15	14.65	13.93	16.76	17.49	15.93	16.87
Non-essential	14.32	11.12	11.56	10.23	14.61	10.52	11.75	12.24	7.89	10	11.4	9.22
Total	26.328	27.29	26.16	24.91	26.68	26.67	26.40	26.17	24.65	27.49	27.33	26.09
Esse/Non-ess.	0.835	1.454	1.263	1.435	0.826	1.535	1.245	1.138	2.124	1.749	1.397	1.83
Proline/Total a.a.	0.044	0.06	0.060	0.963	0.074	0.1162	0.120	0.070	0.1006	0.087	0.184	0.26

In this respect Narkumaraja *et al.* (1997) concluded that IAA induced changes in aminocylation levels and isoacceptor in ragi (*Eleusine corocane*) coleoptiles. Overall amino acid acceptance was elevated following IAA treatments. In particular the relative acceptance activities for isoleucine, leucine, lysine, phenylalanine, serine and tyrosine in IAA treated plants.

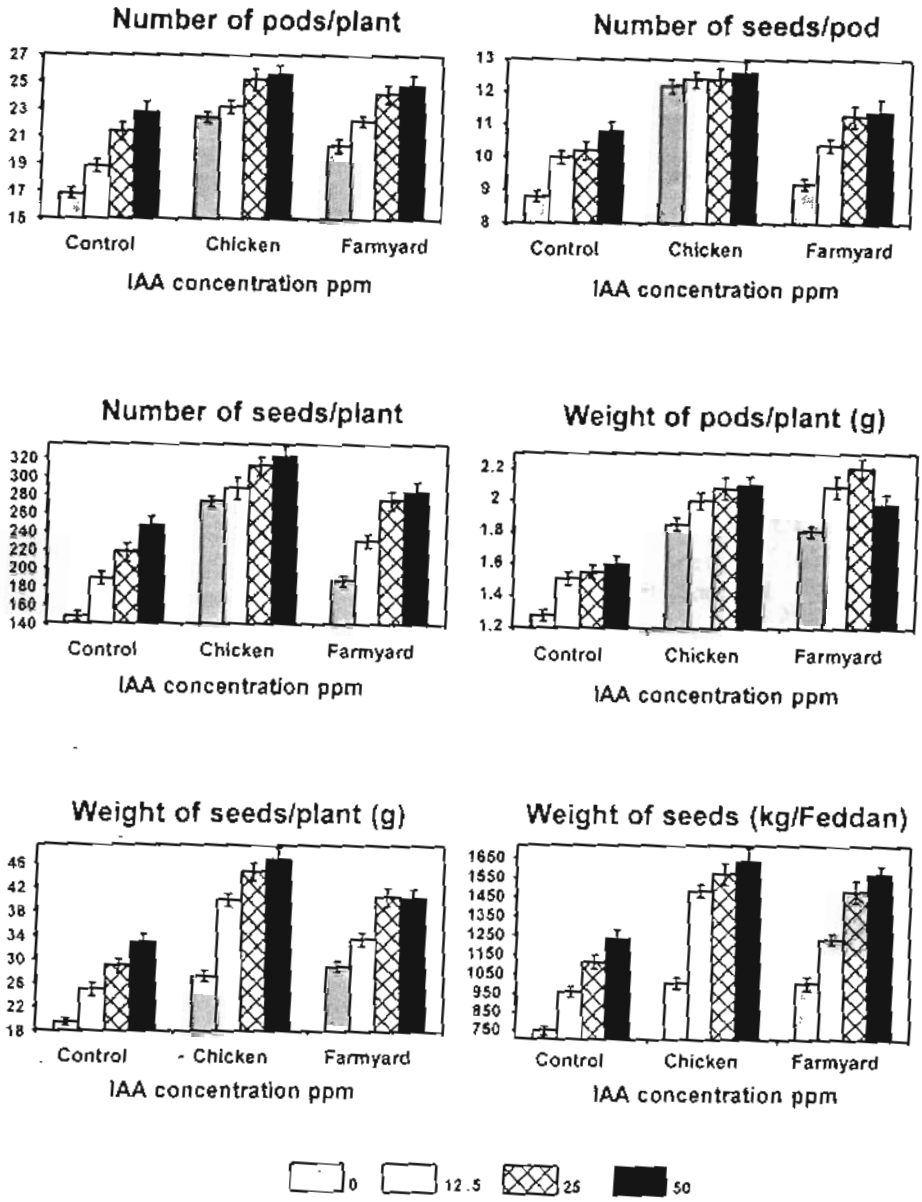

Fig. (5). The effect of the different concentrations of IAA and the different types of manure on yield components. Each value is the mean of 10 samples ± S.E

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الأستجابة الفسيولوجية لنبات اللوبيا لأندول حمض الخليك و المخصبات العضوية فى الأراضى الرملية

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تم زراعة نبات اللوبيا في موسمين متتاليين في منطقة النوبارية وقد عوملت مجموعة من هذه النباتات بمخصبات عضوية (مخلفات الماشية أو مخلفات الدجاج) ورشت مجموعة ثانية بإندول حمض الخليك [ثلاثة تركيزات (١٢,٥ ، ٢٥ ، ٥٠ جزء في المليون)] بينما تم معاملة مجموعة ثالثة بكل من المخصبات العضوية وأندول حمض الخليك وتركت مجموعة أخرى دون أي معاملات (كنترول). وقد أوضحت النتائج أن مجموعة النباتات المرشوشة بإندول حمض الخليك دون إضافة مخصبات عضوية أظهرت زيادة في معايير النمو (الطول والوزن الغض والوزن الجاف وعدد الأفرع وعدد الأوراق/نبات) بالإضافة إلى زيادة في إنتاجية المحصول (عدد القرون/نبات وعدد البذور/نبات ووزن القرون/نبات ووزن البذور/نبات ووزن البذور/فدان) وذلك مقارنة بالنباتات غير المعاملة. وقد عزى ذلك إلى التأثير الفعال لإندول حمض الخليك في زيادة تراكم المواد العضوية (المواد السكرية – البروتين – المواد النيتروجينية) و المواد غير العضوية (مثل عنصر البوتاسيوم – الكالسيوم – الصوديوم – الماغنسيوم – الزنك – الحديد – النحاس) في كل من أوراق وبذور نبات اللوبيا. كما أوضحت النتائج أيضاً نقصاً في تركيز عناصر المنجنيز والرصاص والنيكل. وقد أدى استخدام الأسمدة العضوية منفردة إلى زيادة كبيرة في قياسات المعايير السابق ذكرها مقارنة بالنباتات الغير معاملة (الكنترول) بل وبالمقارنة أيضاً بالنباتات المرشوشة بإندول حمض الخليك.

كما أظهرت النتائج المتحصل عليها أن معاملة نبات اللوبيا بالمخصبات العضوية مصحوبة بالرش بإندول حمض الخليك أدى إلى تفوق واضح في معايير النمو وإنتاجية النبات مقارنة بأي معاملة أخرى.