Egypt. J. Rad. Sci. Applic., Vol. **24**, No. 1, pp. 185-199 (2011)

Effect of Gamma Irradiation Doses and Micro Elements on Some Physical, Chemical and Crop Parameters of *Vigna sinensis* L.

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THE present work aim to expose *Vigna sinensis* L. (cowpea) seeds to γ- rays at dose levels 40, 80 and 120Gy and to spray the growing plants with micro elements; boron (B) and zinc (Zn) after one month of planting; until harvest date, for increasing crop quality and quantity. Some physical parameters, some chemical analysis, the yield and net percentage of the produced crop were evaluated. The result obtained refer that, the 40Gy dose enhanced most of physical, chemical and yield parameters of cowpea crop. Moreover, the harvested crop was increased and improved in case of those produced from plants sprayed with different concentrations of B or Zn plus 40 Gy dose as compared with the other treatments used followed by the dose of 80Gy. Meanwhile, the dose of 120Gy gave the least enhancement on the quality and quantity of the aforementioned treatments in cowpea crop.

Keyword: *Vigna sinensis*, γ-rays, physical, chemical, yield components.

Cowpea is one of important food legume crop in the tropical areas, particularly in Africa with an average of 24g protein per 100g and about 7g lysine per 100g protein (Joseph, 2006). Total carbohydrate content in cowpea. flour is 62.38g /100g, of starch alone accounts for 51.99g /100g and because of their desirable physical and chemical properties, are known to be suitable for use as thickeners, extenders, stabilizers, gelling agents, dietary calories and texture modifiers in food formulations (Thomas and Atwell, 1997). Many metal ions are utilized in very small amounts as essential nutrients. Both low and excess amounts of micronutrients can suppress growth, cell cycle, development, and survival. As a micronutrient, Zn is required in a large number of enzymes and plays an essential role in DNA transcription. A typical symptom of Zn deficiency is the stunted growth of leaves, commonly known as "little leaf" and is caused by the oxidative degradation of the growth hormone auxin (Paarbhu and Muthuchelian, 2011). Also, B is one of the essential trace elements (Marschner, 1995). It has been purposed that B is involved in many plant metabolisms (Lukaszewski and Blevins, 1996). A limited amount of B is necessary for the normal development of plants; however, a high level of B in soil is generally toxic. B is considered to be involved in nucleic acid metabolism, carbohydrate and protein metabolism, indole acetic acid metabolism, cell wall synthesis, cell wall structure, membrane integrity and function, and phenol metabolism; however, molecular basis of these roles is mostly unknown (Loomis and Durst,1992, Marschner, 1995 and Goldbach *et al.*, 2001).

Gamma irradiation has been used in the biological studies from low doses stimulation to high-doses inhibition (Ribeiro and Machado, 2007). The relatively low doses ionizing radiation on plants as well as *in vitro* studies are manifested as accelerated cell proliferation, cell growth, enzyme activity, stress resistance and mutation induction (Chakravarty and Sen, 2001).

This work aims to study the effect of gamma rays and certain micro-elements for increasing cowpea plants, growth, quality and productivity.

Material and Methods

A cowpea cultivar, Kafr El Sheikh was obtained from Horticulture Research Institute, Agriculture Research Centre, Dokki, Giza, Egypt. Cowpea seeds irradiated at dose levels of (40, 80 and 120 Gy) at NCRRT, Nasr City, Cairo, Egypt. Irradiation facility used was Indian Gamma Cell Research Irradiator (^{60}Co); the dose rate was 1.8 Gy/ Sec. At time of experiment, irradiated and un-irradiated seeds were planted at depth 2-5 cm with space 30 cm, and four replicate from each treatment in complete randomize blocks were cultivated in a wire house at NCRRT. The soil used for cultivation was clay-loamy soil with pH 7.7, after one month from planting date, plants were sprayed by microelements, of Zn (200 and 300 ppm/ L) and B (50 and 100ppm/ L), monthly till harvest date. The treated cowpea seeds samples, from control, 40, 80 and 120Gy; control Zn_1 (200ppm), 40Gy Zn_1, 80Gy Zn_1, 120Gy Zn_1; control Zn_2 (300ppm), 40Gy Zn_2, 80Gy Zn_2, 120Gy Zn_2; control B_1 (50ppm), 40Gy B_1, 80Gy B_1; 120Gy B_1 and control B_2 (100ppm), 40Gy B_2, 80Gy B_2 , 120Gy B_2 were collected and dried in an oven at 60°C for 48 h, then milled to fine powder foe evaluation certain physical parameters, yield components of the plants and moreover, estimation of some chemical characters in harvested seeds of cowpea.

Physical parameters measurements

Plant height (cm), leaf number, branch number, root length (cm), plant fresh & dry wt (g), horn & seeds number and wt (g) of cowpea were measured from untreated and treated plants with both of γ-rays doses and some micro elements concentrations as the mentioned before.

Cowpea crop parameters

Cowpea seeds productivity under the investigation was estimated by recording horn & seed wt/100 horn and wt of 100 seed. Also, the number and horn & seed wt/Fadden, in addition to the shelling percentage which recorded as follows:

Shelling %= Seed wt of the horns/ Horn wt × 100.

Chemical determination

Elements

Samples digested completely by wet method using concentrated sulfuric acid in presence of percholoric acid, then diluted and measured. K and Na were estimated by inductively coupled plasma-Atomic Emission Spectrometer (ICP-AES, England). Mg, Ca, Zn, B and P determined according to AOAC (1995) by using Atomic Absorption Spectrometer (SOLAR- UNICAM 989, England).

Total protein

Total protein calculated by multiplying the total nitrogen by 6.25. The total nitrogen was determined by kjeldahl method (AOAC, 1984).

Carbohydrates

Total soluble sugars extracted by recommended method of Shannon (1968) and determined by method of Smith *et al.* (1956). Moreover, reducing sugars determined by method of Hosfield *et al.* (1982).

Fatty acids

The method of AOAC (2000) was conducted for lipid extraction from sample using chloroform: methanol (2:1 v/v). The lipid samples were saponified over night with ethanolic KOH (20%) at room temperature according to Vogel (1975). The methyl esters of fatty acids obtained from oil of samples and standard materials were analyzed at NCRRT with Pye Unicam Series 304 gas chromatography equipped with dual flam ionization detector and dual channel recorder. The separation of fatty acid methyl esters was conducted using a coiled glass column (1.5mx 4mm) packed with Diatomite (100-120 mesh) and coated with 10% polyethylene glycol adipate (PEGA) The column oven temperature was programmed at 8°C/ min from 70 to 190°C, then isothermally at 190°C for 25mm with nitrogen at 30ml/ min. The unsaponifiables were also fractionated on a coiled glass column (2.8m x 4 mm) packed with Diatomite (100-120 mesh) and coated with 3% OV-17. The oven temperature was programmed at 10°C/ min from 70°C, then isothermally at 270°C for 25mm and nitrogen flow rate was 30m1/ min. Detector, injector temperatures and hydrogen, air flow rates were generally 300°C, 280°C and 33ml, 330ml/ mm, respectively (PU 4810, Philips).

Statistical analysis

Data obtained were statistically analyzed by using Costat statistical program software (1990) and Duncan's multiple range test (Duncan, 1955) was applied at 5% probability level to compare the differences among estimated parameters.

Results and Discussion

Effect of γ-rays and some microelements on physical parameters

Perusal to the effect of γ-rays and micro elements on physical parameters of cowpea measured and illustrated in Table 1. The results obtained refer that, all treatments used either γ-rays or spraying with micronutrients enhanced vigor in several aspects including plant height, leafiness, root and branch development, fresh and dry wt both in total plants and in seeds. Many investigators are in agreeing with result obtained (Ali *et al.,* 1996, Chakravarty and Sen, 2001 and Mahmoud *et al.,* 2009). Aziz *et al.* (2010) observed that plant growth parameters of *Cymbopogon citrates* significantly increased by Zn application and reported that 200ppm resulted in a great increase in plant height, fresh and dry wt yield.

Also, Kassem *et al.* (2011) found that agrochemicals foliar sprays (2,4-D$^+$ boric acid) at pea or marble stages significantly increased fruit wt in two season (2003, 2004). It was observed that, the best quality and quantity of cowpea were obtained, when plants sprayed by 50ppm concentration of B and produced from seeds irradiated by 120Gy, or untreated control. It must be mentioned her that the heaviest horn dry wt was obtained from plants produced from seeds treated by 40Gy Zn1. Similar results on plant growth were obtained by Orabi (1998), Ribeiro and Machado (2007) and Hussein (2008) upon exposing seeds to different doses of γ-rays, all growth parameters (shoot length, number of pods/ plant, number of seeds/ plant and their wt) increased above control.

TABLE 1. Effect of γ-rays and microelements on physical parameters in *V. Sinensis*.

Dose/Gy	**Plant height** cm	**Leaf No.**	**Root length** cm	**Branch No.**	**Plant fresh wt** g	**Plant dry wt** g	**Horn No.**	**Horn dry wt** g
Con	32.1^{c}	14.8^{e}	14.6^{cde}	3^{f}	62.9^{f}	17.68^{g}	18.5^{efg}	19.7^{bc}
40	31.7^{c}	35.1^{bcde}	19^{bc}	5.2^{bcdef}	374.6^{b}	56.95^{c}	36.8^{abc}	21.1^{ab}
80	42.8^{c}	40.5^{abc}	16.8^{bc}	5.65^{bcde}	305^{bcd}	48.6^{cd}	28.5^{bcde}	23.8^{ab}
120	70^{b}	41^{abc}	19.5^{b}	8.5^{a}	220.2^{cde}	42.4^{cdef}	22.3^{def}	14.9^{fg}
Con Zn_1	82.6^{a}	38.8^{bcde}	19.5^{b}	4^{def}	290^{bcde}	50.03^{cd}	33.5^{abcd}	16.7^{fg}
40 Zn_1	35^{c}	36^{bcde}	19.5^{b}	4^{def}	289.2^{bcde}	42.9^{cdef}	21^{ef}	27.7^{ab}
80 Zn_1	37^{c}	38.5^{bcde}	11.5^{ef}	5.75^{bcde}	198.5^{cde}	33.9^{defg}	20.8^{ef}	13.3^{de}
120 Zn_1	36^{c}	32^{bcde}	15.3^{bcde}	7.25^{ab}	312.9^{bc}	49^{cd}	38.3^{ab}	15.2^{fg}
Con Zn_2	35.3^{c}	27^{cde}	16.4^{bcd}	6.25^{bcd}	197.3^{cde}	32.9^{defg}	20.5^{ef}	12.9^{g}
40 Zn_2	31^{c}	39^{abcd}	19.5^{b}	6^{bcd}	273.3^{bcde}	48.5^{cd}	25^{cdef}	13.7^{fg}
80 Zn_2	42.3^{c}	28.8^{cde}	12.3^{def}	7^{abc}	155.7^{ef}	22.7^{g}	15.3^{fg}	13.2^{de}
120 Zn_2	32.8^{c}	21^{de}	9.5^{f}	8.75^{a}	168.1^{def}	23.9^{g}	15.5^{fg}	17.2^{fg}
Con. B_1	35.8^{c}	32.3^{abcde}	16^{bcd}	5.3^{bcdef}	566^{a}	94.6^{a}	43.3^{a}	23.5^{ab}
40 B_1	22.3^{c}	26.5^{cde}	24.5^{a}	6.25^{bcd}	259.5^{bcde}	51.9^{c}	38^{ab}	21.5^{ab}
80 B_1	27.5^{c}	50.3^{a}	17^{bc}	5^{bcdef}	211.5^{cde}	95.9^{a}	35.8^{abc}	19.4^{ef}
120 B_1	36.5^{c}	37^{abcd}	25.5^{a}	4^{def}	387.1^{b}	74.7^{b}	43.3^{a}	19.1^{ef}
Con B_2	39.8^{c}	37^{abcd}	25.5^{a}	4^{def}	227.2^{cde}	43.8^{cdef}	17.3^{efg}	26.9^{a}
40 B_2	47.4^{c}	25^{cde}	19.3^{b}	4.25^{def}	202.3^{cde}	29^{efg}	8^{g}	18.8^{efg}
80 B_2	37^{c}	47^{ab}	15.3^{bcde}	4.75^{cdef}	326.9^{bc}	45.3^{cde}	25.8^{cdef}	15.7^{fg}
120 B_2	31.5^{c}	34.3^{bcde}	15.3^{bcde}	3.5^{ef}	198.1^{cde}	27.2^{fg}	23^{def}	15.5^{cd}
$L.S.D_{0.05}$	22.5	15.3	3.77	1.99	114.9	15.19	10.5	5.19

Con: control. Zn_1: 200ppm. Zn_2: 300ppm. B_1: 50ppm. B_2: 100ppm.

Hassan *et al.* (2000) examined the effect of 20, 40, 60 and 80Gy gamma irradiation doses on growth of cowpea. Irradiation treatments caused decrease in shoot dry wt with the increase of gamma dose. On the other hand, Nassar *et al.* (2004) found that gamma irradiation enhanced plant height and shoot. Abdul Majeed *et al.* (2010) reported that the growth parameters showed declining tendency with increasing doses of gamma irradiation.

Effect of γ-rays and some micro-elements on chemical parameters

Elements components

When cowpea plants treated by Zn_1, Zn_2, B_1 and B_2, it was noticed that P and Ca values were close to normal seeds with some exception. The harvested cowpea seeds irradiated as seeds before planting contain P increasing in seed samples treated with 40 Gy and Ca increased at 40 and 120.

TABLE 2. Elements (mg/ g) in *V. Sinensis* as affected by γ-rays and microelements.

Dose/Gy	Concentration elements mg/ g dry wt						
	P	Na	K	B	Zn	Ca	Mg
Con	0.0706	1.504 x10^{-7}	1.158 x10^{-4}	2.766 x10^{-4}	0.06	0.676	0.972
40	0.1088	1.503 x10^{-7}	9.769 x10^{-5}	2.765 x10^{-4}	0.04	0.74	0.349
80	0.0669	1.439 x10^{-7}	9.939 x10^{-5}	2.763 x10^{-4}	0.013	0.692	0.38
120	0.0395	1.545 x10^{-7}	1.020 x10^{-4}	2.761 x10^{-4}	0.037	0.913	0.726
Con Zn_1	0.0646	1.421 x10^{-7}	1.045 x10^{-4}	2.765 x10^{-4}	0.035	0.49	0.349
40 Zn_1	0.0741	1.430 x10^{-7}	1.017 x10^{-4}	2.759 x10^{-4}	0.029	0.931	0.325
80 Zn_1	0.0085	1.432 x10^{-7}	8.919 x10^{-5}	2.761 x10^{-4}	0.011	0.552	0.313
120 Zn_1	0.0729	1.459 x10^{-7}	1.066 x10^{-4}	2.754 x10^{-4}	0.018	0.904	0.328
Con Zn_2	0.0515	1.441 x10^{-7}	9.989 x10^{-5}	2.765 x10^{-4}	0.017	0.648	0.358
40 Zn_2	0.0765	1.376 x10^{-7}	1.088 x10^{-4}	2.759 x10^{-4}	0.027	0.712	0.353
80 Zn_2	0.0777	1.339 x10^{-7}	1.004 x10^{-4}	2.762 x10^{-4}	0.007	0.776	0.429
120 Zn_2	0.0801	1.414 x10^{-7}	1.070 x10^{-4}	2.765 x10^{-4}	0.022	0.473	0.324
Con. B_1	0.0753	1.405 x10^{-7}	1.032 x10^{-4}	2.760 x10^{-4}	0.008	0.853	0.303
40 B_1	0.0825	1.373 x10^{-7}	1.106 x10^{-4}	2.763 x10^{-4}	0	0.547	0.373
80 B_1	0.0861	1.431 x10^{-7}	1.059 x10^{-4}	2.760 x10^{-4}	0.008	0.506	0.306
120 B_1	0.0598	1.370 x10^{-7}	1.020 x10^{-4}	2.765 x10^{-4}	0.009	0.47	0.415
Con B_2	0.092	1.478 x10^{-7}	1.058 x10^{-4}	2.761 x10^{-4}	0.008	0.547	0.315
40 B_2	0.0896	1.460 x10^{-7}	1.126 x10^{-4}	2.762 x10^{-4}	0.004	0.541	0.306
80 B_2	0.1052	1.349 x10^{-7}	1.041 x10^{-4}	2.759 x10^{-4}	0.07	0.724	0.303
120 B_2	0.0813	1.346 x10^{-7}	9.889 x10^{-5}	2.760 x10^{-4}	0.001	0.485	0.288

Con: control. Zn_1: 200ppm. Zn_2: 300ppm. B_1: 50ppm. B_2: 100ppm.

Ca concentration increased especially in the control group, and in Zn_1 and Zn_2, except 120Gy Zn_2. While B_1 and B_2 treatments decrease its concentration. Phosphorus had similar trend as in Ca, where its concentrations in Zn_1 and Zn_2 increased and decreased in B_1 and B_2 except the 120 B_1, 40 B_2 and 120 B_2 specimens Table 2. Panjie and Jegadees (1959) think that the simulative effect of γ-rays on P absorption may be due to an interactive of these γ-rays with hormonal biosynthesis. The increase in the absorption of NO_3, K and P were stimulated by application of γ-rays. This increase might be due to the effect of such γ-rays on accelerating the transpiration rate through increasing the stomata aperture. Regarding to sodium, no tangible change noticed in their concentrations absorbed by cowpea plants affected by γ-rays, microelement and interaction between both of them where their values ranged between ($1.4x\ 10^{-7}$ to $1.5x10^{-7}$mg/ g dry wt). As a result of aforementioned treatments, K concentration was increased. The harvested seeds contain $1.16x10^{-4}$ mg/ g dry wt changed in those produced from plants sprayed with Zn_1, Zn_2, B_1 or B_2 to $1.03x10^{-4}$, $1.05x10^{-4}$, $1.06x10^{-4}$, and $9.989\ x10^{-5}$ mg/g dry wt. Also, a little increase in seeds that harvested from plants sprayed by microelements with some exception observed. B behaves the same trends like K. Moreover, all treatments applied decreased Mg concentration in seeds (treated or untreated) that produced from plants sprayed by microelements or not sprayed. The results obtained refer to 80 $Zn_{2,}$ and B_2 group that gained high Mg concentration when compared by its corresponding control. We must refer to group of plants that sprayed by B_1 where it gained high Mg concentration than its corresponding control (0.303), in addition to 80 Zn_2, but all of them still less than main control.

Total nitrogen and total protein

It was noticed that total nitrogen percentage in harvested cowpea seeds were 2.048%. But, N% increase with the increase in radiation dose, or spraying by microelements or their interaction. Also, the same trends were obtained in total protein in cowpea seeds. Where, the total protein content increased with the increase in dose of radiation, especially at dose of 40 Gy that increased its content to (21.656g/ 100g dry wt) as compared by the control (15.505g/ 100g dry wt). Also, the highest increase in total proteins observed when seeds irradiated with 40Gy and sprayed by microelements of B_1, B_2, Zn_2 and Zn_1 after planting. Their values were 25.069, 24.5, 22.313 and 21.07g/ 100g dry wt respectively, Table 3. Similar findings were obtained on Lupine and cowpea (Khodary, 2004 and Vasconcelos *et al.*, 2010).

Abou El-Yazied (2011) refer that yield per Fadden was significantly correlated with total protein percent. Changes in protein fractions may be related to some cross linking or aggregation of proteins as a result of gamma irradiation which could affect nitrogen solubility (Ciesta *et al*., 2000).

Total carbohydrate and reducing sugars

The foliar treatments by micronutrients considered an effective treatment for increasing total carbohydrates in harvested crop of cowpea. As showed in Table 3. It was noticed that, growing control plants sprayed with B_2 and B_1 have the maximum carbohydrates values (77.2 and 74.0g/ 100g dry wt) as well as the treatment of 40Gy Zn_1 (77.1g/ 100g dry wt) comparing with normal seeds (59.9g/ 100g dry wt). On the contrary, treatments of 80Gy B_1, 80Gy B_2, 120Gy B_1 and 120Gy B_2 had the total carbohydrates values less than the normal seeds, to reach 41.1, 41.4, 40.5 and 39g/ 100g dry wt, respectively. Abou El-Yazied (2011) refer that yield per Fadden was significantly correlated with total sugars.

TABLE 3. Total Nitrogen, protein and carbohydrates g/ 100g dry wt in *V. Sinensis* shoots as affected by γ-rays and micro-element treatments.

Dose/Gy	Total nitrogen	Total proteins	Total carbohydrates	Reducing sugar
Con	2.481 ^{b}	15.505 ^{b}	59.9 ^{ef}	11. 7 ^{cde}
40	3.465 ^{a}	21.656 ^{a}	69.2 ^{b}	17.1 ^{a}
80	3.136 ^{a}	19.6 ^{a}	64.1 ^{cde}	13.5 ^{bc}
120	3.237 ^{a}	20.23 ^{a}	53.6 ^{gh}	10.4 ^{efg}
Con Zn_1	3.297 ^{a}	20.606 ^{a}	67.4 ^{bc}	14.4 ^{b}
40 Zn_1	3.371 ^{a}	21.07 ^{a}	77.1 ^{a}	13.2 ^{bcd}
80 Zn_1	3.157 ^{a}	19.731 ^{a}	60.6 ^{def}	11.3 ^{de}
120 Zn_1	3.332 ^{a}	20.825 ^{a}	57.5 ^{fg}	8.7 ^{fgh}
Con Zn_2	3.396 ^{ab}	21.227 ^{ab}	64 ^{cde}	13.4 ^{bc}
40 Zn_2	3.57 ^{a}	22.313 ^{a}	49.6 ^{hi}	12 ^{cde}
80 Zn_2	2.786 ^{a}	17.413 ^{a}	47.8 ^{i}	11.2 ^{e}
120 Zn_2	3.427 ^{ab}	21.42 ^{ab}	40.7 ^{j}	9.9 ^{efg}
Con. B_1	3.648 ^{ab}	22.803 ^{ab}	74.0 ^{a}	14.8 ^{b}
40 B_1	4.01 ^{a}	25.069 ^{a}	65.5 ^{bcd}	10.4 ^{efg}
80 B_1	3.659 ^{ab}	22.867 ^{ab}	41.1 ^{j}	11.1 ^{e}
120 B_1	3.22 ^{b}	20.125 ^{b}	41.5 ^{j}	15.0 ^{gh}
Con B_2	3.528 ^{a}	22.05 ^{a}	77.2 ^{a}	10.5 ^{b}
40 B_2	3.92 ^{a}	24.5 ^{a}	61.6 ^{def}	8.4 ^{ef}
80 B_2	3.388 ^{a}	21.175 ^{a}	40.5 ^{j}	7.7 ^{h}
120 B_2	3.423 ^{a}	21.394 ^{a}	39.0 ^{j}	7.6 ^{h}
$L.S.D_{0.05}$	0.6369	0.6369	4.674	1.756

Con: control. Zn_1: 200ppm. Zn_2: 300ppm. B_1: 50ppm. B_2: 100ppm.

The reducing sugars value of normal seeds was 11.7g/ 100g dry wt as in Table 3 as well as the treatments of 40Gy Zn_2, 80Gy Zn_1, 80Gy Zn_2 and 80Gy

B_1 (11.9, 11.3, 11.2 & 11.1g/ 100g dry wt, respectively). That values increased to 13.2, 13.4, 13.5, 14.4, 14.8, 15 and 17.1g/ 100g dry wt by the treatments of 40Gy Zn_1, control Zn_2, 80Gy, control Zn_1, control B_1, control B_2 and 40Gy that considered gave the highly increased from the reducing sugars, respectively. The other treatments had reducing sugars decreased than the value of the normal seeds. Lima *et al.* (2011) resulted that no significant differences in content for irradiated samples (0.5, 1.0, 2.5, 5.0 and 10.0kGy). Those values increased to 13.2, 13.4, 13.5, 14.4, 14.8, 15 and 17.1g/ 100g dry wt by the treatments of 40Gy Zn_1, control Zn_2, 80Gy and control Zn_1, control B_1, control B_2 and 40Gy that considered gave the highly increased from the reducing sugars, respectively. The other treatments had reducing sugars decreased than the value of the normal seeds.

Fatty acids

Fatty acids of Eicosenioc, Linolenic, Linoleic and Stearic were mostly decreased in samples produced from irradiated seeds (40, 80, and 120) and sprayed by (Zn_2) as compared by control in Table 4. and at vice versa, Oleic, Palmitic and Myristic fatty acids were increased in irradiated samples compared with un-radiated. Margaric acid was disappeared in the control and irradiated and sprayed samples by Zn_1 or B_2. While it found in sample irradiated by 40Gy the irradiated samples treated by B_1, cause an increase in fatty acids, Palmitic and Myristic. The fatty acid of Margaric was disappeared in normal irradiated samples by 80 and 120Gy. Also, Stearic acid disappeared in irradiated samples by dose of 80Gy, and these fatty acids may be refer to transform to hydrocarbons and small portion compounds; the latest, probably degradation by γ-irradiation to CO_2, H_2O_2, H_2O. The same trend happened when the irradiated seeds treated by B_2. So, when the cowpea seeds irradiated by doses of 40, 80 and 120Gy before planting, most fatty acids increased compared with control. When, the growing cowpea seeds sprayed by microelements after planting, most of fatty acids in harvested seeds increased especially with Zn_1, followed by Zn_2 and B_1.

On the other hand, treated by B_2 had destructive in the most of fatty acids. Rahimi and Bahrani (2011) results showed that the highest Canola oil percent (48.3%) of linolenic acid and (12.7%) of linoleic acid obtained in 100Gy and 200Gy treatment, respectively. While the lowest oil percent were (11.5%) and (7.6%) obtained in that of 500Gy.

TABLE 4. Fatty acids in *V. Sinensis* as affected by γ-rays and some microelements.

Dose/Gy	Fatty acids							
	Cis-11-Eicosenioc	Lionlenic	Linoleic	Oleic	Stearic	Margaric	Palmitic	Myristic
	C 20:1	C 18:3	C 18:2	C18:1	C18:0	C 17:0	C 16:0	C 14:0
Con	1.530	23.520	26.096	17.774	0.483	0.217	26.294	0.332
40	1.588	24.200	26.827	17.129	0.428	0.205	25.642	0.298
80	1.608	28.846	30.496	8.716	1.019	0.218	24.058	0.246
120	1.898	27.309	30.342	9.429	1.451	0.238	24.056	0.259
Con Zn_1	0.748	28.196	29.931	8.904	1.229	0.244	24.476	0.287
40 Zn_1	1.645	25.974	28.961	13.217	1.160	-	25.312	0.308
80 Zn_1	1.699	27.914	30.229	10.768	1.614	-	24.077	-
120 Zn_1	1.532	26.522	30.359	10.063	1.519	0.255	25.469	0.305
Con Zn_2	1.875	26.678	29.498	10.059	1.323	-	22.725	0.238
40 Zn_2	0.537	22.469	25.425	18.698	0.924	0.194	25.859	0.330
80 Zn_2	1.739	26.916	28.335	12.574	0.695	-	24.458	0.269
120 Zn_2	1.632	26.185	29.172	12.823	1.246	-	24.965	0.274
Con. B_1	1.863	28.727	32.157	7.164	1.374	-	24.514	0.243
40 B_1	1.739	23.128	26.093	17.981	0.861	-	25.226	0.291
80 B_1	1.545	27.506	31.956	9.983	-	-	25.105	0.253
120 B_1	1.541	26.071	30.108	11.731	1.109	0.220	26.176	0.246
Con B_2	0.633	26.082	28.384	8.251	1.493	0.238	23.334	0.203
40 B_2	1.348	21.619	24.869	16.169	0.976	0.233	26.613	0.325
80 B_2	1.189	19.132	24.445	17.360	0.874	-	25.505	0.276
120 B_2	2.082	22.861	27.429	14.516	1.215	-	27.307	0.359

Con: control. Zn_1: 200ppm. Zn_2: 300ppm. B_1: 50ppm. B_2: 100ppm.

Effect of γ-rays and some microelements on the crop parameters

Perusal to the effect of γ-rays and micro-elements on crop parameters of cowpea, shown in Table 5, the result obtained revealed that, all treatments used improve crop productivity. It was observed that, the best cowpea quantity and quality obtained, when plants produced from seeds irradiated by 40Gy and sprayed by different concentrations of B (50 and 100ppm/ L). Growth, biochemical constituents and yield of snap bean cv. Bonco investigated by Abou El-Yazied (2011) revealed that 30 up to 80Gy produced the highest seedling emergence percentage growth, *i.e.*, plant height, leaf number, leaf area and plant dry wt at 50 days after planting recorded significantly the highest values. And, near harvested given the highest values of pod number and pod yield per plant and Fadden and marketable yield per Fadden; also, the highest fruit set percentage. Yield per Fadden was significantly correlated with seedling emergence percent, seedling emergence rate, plant height, leaf number, leaf area, dry wt, fruit set, total pod number.

TABLE 5. Effect of γ-rays and **microelements on crop parameters of *V. Sinensis*.**

Dose/Gy	100 horn wt g	seed wt/ 100 horn g	100 seed wt g	Total crop/ Fadden Horn No.	Horn wt g	Seed wt g	Seed shelling %
Con	120.7^{g}	88.97^{f}	14.47^{e}	33552^{g}	41832^{bc}	23119.2^{ef}	73.73^{d}
40	156.5^{ab}	121.2^{b}	34.9^{d}	64800^{cd}	97149.6^{bc}	33652.8^{ef}	77.44^{cd}
80	120.8^{f}	89.1^{f}	15.88^{e}	44352^{efg}	55886.4^{bc}	28490.4^{ef}	76.81^{cd}
120	121.3^{f}	91.8^{ef}	15.47^{e}	37656^{fg}	29332.8^{c}	24343.6^{ef}	75.68^{d}
Con Zn_1	142.9^{c}	111.2^{c}	15.2^{e}	38232^{fg}	52696.8^{bc}	28562.4^{ef}	77.82^{cd}
40 Zn_1	155.2^{ab}	122.1^{b}	54.02^{b}	75072^{bc}	99856.4^{a}	81385.6^{d}	81.50^{c}
80 Zn_1	122.2^{f}	89.67^{f}	14.7^{e}	60192^{cde}	48585.6^{bc}	26820^{ef}	75.02^{d}
120 Zn_1	120.3^{f}	93.5^{ef}	15.27^{e}	34848^{g}	35712^{bc}	20728.8^{ef}	73.28^{d}
Con Zn_2	121.7^{f}	91.3^{ef}	14.87^{e}	29304^{g}	39352.2^{bc}	22932^{ef}	76.92^{cd}
40 Zn_2	133.3^{e}	125^{b}	43.73^{c}	82672^{ab}	225207^{abc}	198768^{c}	88.26^{b}
80 Zn_2	140.23^{cd}	99.9^{de}	14.5^{e}	57312^{cde}	69588^{bc}	40903.2^{e}	76.22^{cd}
120 Zn_2	125.8^{f}	96.1^{f}	14.72^{e}	66384^{bcd}	67075.2^{bc}	40838.4^{e}	74.35^{d}
Con. B_1	122.8^{f}	89.76^{def}	16.1^{e}	62424^{cd}	72648^{bc}	40579.2^{e}	74.70^{d}
40 B_1	158.7^{a}	119.5^{b}	58.9^{b}	90328^{a}	267982^{ab}	241594^{b}	90.15^{ab}
80 B_1	123.4^{f}	95.3^{ef}	15.7^{e}	34776^{g}	47131.2^{bc}	23025.6^{ef}	77.23^{cd}
120 B_1	151.1^{b}	93.95^{ef}	14.88^{e}	1507^{h}	23401^{c}	10231^{f}	62.18^{e}
Con B_2	121.3^{f}	93.83^{ef}	15.5^{e}	33048^{g}	40240.8^{bc}	22744.8^{ef}	75.32^{d}
40 B_2	157.4^{ab}	139.9^{a}	98.5^{a}	92980^{a}	370927^{a}	346951^{a}	93.54^{a}
80 B_2	123.6^{f}	97.03^{def}	16.13^{e}	32976^{g}	37706.4^{bc}	22255.2^{ef}	74.35^{d}
120 B_2	135.5^{de}	103.6^{d}	14.58^{e}	54720^{def}	67132.8^{bc}	15192^{f}	76.42^{cd}
$L.S.D_{0.05}$	6.383	7.147	6.052	16322.4	195176.4	20624.2	4.787

Con: control. Zn_1: 200ppm. Zn_2: 300ppm. B_1: 50ppm. B_2: 100ppm.

Generally, γ-rays of 40, 80 and 120Gy doses increased the cowpea crop qualitatively and quantitatively when seeds exposed to γ-radiation before planting, especially with dose of 40Gy that improved most physical, chemical and yields parameters. That dose (40Gy) caused a characteristics enhancement when the irradiated seeds sprayed with micro elements of B_1, B_2, Zn_1 and Zn_2 after one month of planting. Thus, it can be classified the effect of the agrochemical foliar sprays and γ-rays used on cowpea for increasing crop quality and quantity as follows: the dose 40Gy either sprayed by Zn or Br gained the highest growth and yield parameters and chemical composition followed by 80Gy sprayed or not and the last one was 120Gy. The increase in crop parameters might be due to the fulfillment of Zn or B deficiency. Similar findings were obtained by Mehmood *et al.* (2009).

Acknowledgment

Meaning participated the work raved the deceased Dr. Mohammed Ibrahim Abdullah gives us good example devotion in the work; optimistically performer, work ethics and continue immortal our hearts.

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(Received: 09 /10/2011;

accepted: 28/12/2011)

تأثير جرعات أشعة جاما وبعض العناصر الصغرى على قياسات النمو والمحصول والتغيرات الكيميائية فى اللوبيا *Vigna sinensis L.*

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قسم بحوث المنتجات الطبيعية ، المركز القومى لبحوث وتكنولوجيا الإشعاع ، ص. ب. ٢٩ مدينة نصر ، مصر.

يهدف البحث إلى تعريض بذور اللوبيا *Vigna sinensis* L. (cowpea) لجرعات أشعة جاما (٤٠ ، ٨٠، ١٢٠ جراى). ورش النباتات النامية بعد شهر من تاريخ الزراعة بعنصرينً من العناصر الدقيقة هما البورون والزنك حتى تاريخ الحصاد، وذلك بهدف زيادة جودة المحصول من الناحية الوصفية والكمية. كما تم قياس بعض التغيرات الطبيعية فى نمو النبات، و تقدير بعض التحليلات الكيميائية فى محصول البذور. بالإضافة الى قياس بعض صفات الجودة لمحصول اللوبيا والنسبة المئوية لصافى ناتج المحصول. وقد أظهرت النتائج المتحصل عليها أن معاملة البذور بالجرعة ٤٠ جراى أدت الى تحسين معظم قياسات النبات وبعض التحاليل الكيميائية والمحصول الناتج.

وقد لوحظ أيضاً أزدياد التحسن فى معاملات الجرعة ٤٠ جراى المرشوشة بتركيزات مختلفة من الزنك أو البورون بالمقارنة بالمعاملات الأخرى، يليها فى ذلك معاملات ٨٠ جراى. وكانت الجرعة ١٢٠ جراى هى الأقل تحسناً من الناحية الوصفية والكمية للمحصول بالمقارنة بالمعاملات السالفة الذكر.