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GAMMA RADIATION EFFECTS ON SHOOTS PRODUCED FROM CALLUS AND PLANTLETS OF TWO POTATO (*SOLANUM TUBEROSUM* L.) CULTIVARS IN *IN VITRO* CONDITION

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Abstract

The study was carried out at Biotechnology Center, Agricultural Directorate, Ministry of Science and Technology laboratories during the period of1/8/2017 – 12/5/2018 using tissue culture and mutation technique to evaluate the response of field performance of regenerated plants produced from irradiated callus of two potato cultivars Arizona and Labera class Elite . The Results showed that:Labera cultivar was superior significantly in related to plant height, and total yield characteristic reached (33.07 cm and 113.6 g. plant^{-1}) respectively as compare with Arizona cultivar which significantly superior in number of mini tubers, which reached 7.42 tuber. Plant^{-1} . Further more, the dose 20 Gy affected significantly on dry weight of vegetative growth, chlorophyll contain and number of mini tubers which reached (6.35 g, 126.48 mg. m^{-1} and 10.5 mini tuber. Plant^{-1} respectively, while 10 Gy dose affected significantly on total yield of mini tuber which reached 135.9 g. plant^{-1} .

Key words : Gamma, potato, callus, plantlets, yield.

Introduction

Many people around the world eat potato (S*olanum tuberosum* L.) as a major food as a good source of energy , it is a rich in carbohydrates, starch and provides the human with about 76 calories added to contain many vitamins and salts. Each 100 g of fresh tubers contains 1-2 g protein, 17.1 g carbohydrate, 7 mg calcium, 53 mg phosphorus, 0.6 mg iron, 3 mg sodium, 4.7 mg potassium, 0.1 mg thiamine, 0.4 mg riboflavin, 20 mg vitamin C He added that it and vitamin B (Zamotaeva, 1997; Taher, 2016). Iraq suffers from the problem of salinity, especially in the central and southern regions, knowing that 75% of the areas where the cultivation of potato crop affected by salt, and there have been many attempts to improve the quality of potatoes and increase the amount of production in the unit area. Potatoes are moderately salt-sensitive and have a salt tolerance threshold of 1.6-2.5 dm / m (Mass and Hoffman, 1977; Al-Shahwany, 2006). To reduce the problems of agriculture in soils and saline water and to improve plant tolerance to salinity, the current study aimed to study the genetic composition of potatoes to give a recommendation for their tolerance to different levels of salinity.

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Materials and Methods

Two potato tubers Arizona and Labera class Elite were irradiated with six doses of Gamma radiation namely (0.0, 2.5, 5, 10, 15 or 20 Gry) with Cobalt 60 source (CO^{60}) at Protection of radiations Center, Ministry of Science and Technology. Potato tubers were immersed in water solution contain 10 mg.l^{-1} of GA_3 for 10 min, dried and stored in room temperature for 10 according to Salman *et al* (2018). Sprouting of potato tubers were isolated and sterilized according to Bhuiyan (2013). Meristems were cultured on MS salts (Murashige and Skoog, 1962) supplemented with (GA3 0.1 +Kin 0.01+IAA 0.1 mg.l^{-1}) for shoots initiation while (2, 4-D 2+BA 2 mg.l^{-1}) for callus induction (Salman *et al,*2018). Regenerated plants from callus successfully performed in media MS supplemented with BA (2.0) mg.l^{-1}+NAA (0.5) mg.l^{-1} (Afrasiab and Iqbal, 2012). Plants acclimatized and transplanting in polyethylene bags inside plastic house. Plants height, dry growth weight, leaf area, chlorophyll, number and yield of mini tubers were recorded. The experiment was

designed in Completely Randomized (C.R.D) with 3 replicates, means were compare according to Duncan's multiple range (DMRT) test at $p \leq 0.05$ using GenStat softwere program 12ed (Glaser and Biggs, 2010).

Results

Plant height

Table 1 showed that Labera cultivar was significantly increased on plant height compared with Arizona cultivar reached (33.07 and 29.06cm), respectively. The radiation doses (5Gy) was significantly higher in the above character (40.74cm) compared with ether doses 0, 2.5, 10, 15 and 20 Gyreached (25.78, 26.68, 31.75, 30.84 and 30.63cm), respectively. The combination (Labera with 5 Gy gave highest mean that reached to 41.22cm ,but Arizona cultivar in control (without radiation) has a less value of plant height (23.77cm).

Leaf area

Table 2 shows the significant differences between the genotypes in the leaf area of plants. Labera cultivar was significantly increased on plant height (94.8 cm^2) compared with Arizona cultivar (91.8 cm^2). In the same table shows the significant differences between irradiation doses in the leaf area per plant. The leaves area at 20Gy was 148.2 cm^2 significantly higher than the dose rest in this study. From the table 1, there are significant differences in interaction between irradiation dose and cultivars, Labera with 20Gy gave highest mean that reached to 157.1 cm^2 ,but Arizona cultivar in 2.5Gy has a less value of plant height (31.2 cm^2).

Dry weightof vegetative growth (gm)

The results in table 3 showed no significantly between Arezona and Labera cultivars on dry weight of vegetative growth. The radiation doses (20Gy) was significantly higherin the above character (6.35g) compared with ether doses 0, 2.5, 5, 10 and 15 Gyreached (5.00, 5.31, 5.50, 5.61 and 5.03g), respectively. The combination (Arezona with 20Gy gave highest mean that reached to 6.60g ,butin same cultivar (without radiation has a less value of dry weightof vegetative growth (4.93g).

Chlorophyll content ($mg.m^{-2}$)

Table 4 shows the significant differences between the genotypes on the chlorophyll content. Labera cultivar was significantly increased on chlorophyll content (130.46 $mg.m^{-2}$) compared with Arizona cultivar (113.08 $mg.m^{-2}$). In the same table shows the significant differences between irradiation doses in the chlorophyll content,The dose at 20Gy was 126.48$mg.m^{-2}$ significantly higher than the dose rest in this study except control treatment and 5Gy (122.57 and 126.61 $mg.m^{-2}$), respectively. From the table above, there are significant differences in interaction between irradiation dose and cultivars, Labera with 20Gy gave highest mean that reached to 142.35$mg.m^{-2}$, but Arezona cultivar in 2.5Gy has a less value of chlorophyll content(106.98 $mg.m^{-2}$).

Number of mini tubers (mini tubers.$plant^{-1}$)

Arezona cultivar was significantly increased on number of mini tubers per plant compared with Labera cultivar

Table 1 : Effect of potato cultivars , radiation doses (Gy) and their interaction on plants height (cm)

Potato cultivars	Radiation doses (Gy)						Mean of cultivars
	0.0	2.5	5	10	15	20	
Arezona	23.77f	25.28ef	40.27a	30.88c	27.48de	26.7de	29.06b
Labera	27.78d	28.07d	41.22a	32.62bc	34.2b	34.55b	33.07a
Mean of radiation	25.78c	26.68c	40.74a	31.75b	30.84b	30.63b	

Table 2 : Effect of potato cultivars, radiation doses (Gy) and their interaction on leaf area (cm^2).

Potato cultivars	Radiation doses (Gy)						Mean
	0.0	2.5	5	10	15	20	
Arezona	63.8e	31.2f	62.8e	140ab	95.9cd	157.1a	91.8a
Labera	117.6bc	78.2de	56.3e	60.5e	116.9bc	139.2ab	94.8a
Mean	90.7b	54.7c	59.5c	100.2b	106.4b	148.2a	

Table 3 : Effect of potato cultivars , radiation doses (Gy) and their interaction on Dry weight of vegetative growth (gm).

Potato cultivars	Radiation doses (Gy)						Mean
	0.0	2.5	5	10	15	20	
Arezona	4.93g	5.13f	5.37e	5.56cd	5.05fg	6.60a	5.4a
Labera	5.08f	5.49d	5.62c	5.67c	5.01fg	6.09b	5.5a
Mean	5.00e	5.31d	5.50c	5.61b	5.03e	6.35a	

Table 4 : Effect of potato cultivars , radiation doses (Gy) and their interaction on chlorophyll content (mg.m^{-2}).

Potato cultivars	Radiation doses (Gy)						Mean
	0.0	2.5	5	10	15	20	
Arezona	112.18efg	106.98g	116.26ef	117.72ef	114.75ef	110.62fg	113.08b
Labera	132.97b	119.11de	136.96ab	125.18cd	126.22c	142.34a	130.46a
Mean	122.57ab	113.04c	126.61a	121.45b	120.48b	126.48a	

Table 5 : Effect of potato cultivars , radiation doses (Gy) and their interaction on number of mini tubers (mini tubers.plant^{-1}).

Potato cultivars	Radiation doses (Gy)						Mean
	0.0	2.5	5	10	15	20	
Arezona	3.83i	7.33de	4.0hi	5.67fg	11.0b	12.67a	7.42a
Labera	6.83ef	9.5c	2.83i	5.67fg	5.33gh	8.33cd	6.42b
Mean	5.33c	8.42b	3.42d	5.67c	8.17b	10.5a	

Table 6 : Effect of potato cultivars, radiation doses (Gy) and their interaction on yield (gm.plant^{-1}).

Potato cultivars	Radiation doses (Gy)						Mean
	0.0	2.5	5	10	15	20	
Arezona	12.1g	73.9ef	101.3cde	138.7ab	125.6bc	90.6def	90.4b
Labera	60.3f	160.4a	66.1f	133ab	145.1ab	116.5bcd	113.6a
Mean	36.2d	117.1ab	83.7c	135.9a	135.4a	103.5bc	

reached (7.42 and 6.42 f mini tubers.plant^{-1}) respectively (tabel 5). The radiation doses (20Gy) was significantly higher in the above character (10.5 mini tubers.plant^{-1}) compare with ether doses. The combination (Arezona with 20Gy gave highest mean that reached to 12.67 mini tubers.plant^{-1}, but Labera cultivar in 15Gy has a less value of number of mini tubers per plant (5.33 mini tubers.plant^{-1}).

Total yield (g.plant^{-1})

The results in table 6 showed significant differences between Arezona and Labera cultivars on total yield character, Labera cultivar was significantly increased on total yield per plant (113.6g) compared with Arizona cultivar (90.4). The radiation doses (10 and 15 Gy) were significantly higher in the above character (135.9 and 135.4 g, respectively) compared with ether doses. The combination of Labera with 2.5 Gy gave highest mean that reached to 160.4g, but Arezona cultivar (without radiation) has a less value of total yield character (12.1g).

Discussion

The reasons for morphological differences between Arezona and Labera such as plant height, Leaves area, and dry weight of vegetative growth (tables 1, 2 and 3) perhaps because of the genetic differences between themfor the different content of plant hormones responsible for vegetative growth such as Auxin, Gibbererellin and Cytokinine (Issa *et al*., 2018), which reflected positively on number of mini tubers per plant (table 5). This agree with Salman *et al.* (2018). Moral superiority of the dose 20 Gy on leaves area, dry growth weigh, chlorophyll content and number of mini tubers per plant may be the appropriate dose on the chromosomes to increase cell division process (Yayclli and Alikamanoglu, 2012).

Conclusion

The dose 20Gy is the best treatment is recommended to give the highest on leaves area, dry growth weight, chlorophyll content and number of mini tubers per plant. Dispute Arezona showed high response for growth characters and number of mini tubers per plant. However, Labera cultivar was higher on total yield than Arezona.

References

Afrasiab, H. and J. Iqbal (2012). Biochemical and molecular characterization of somaclonal variants and induced mutants of potato (*Solanum tuberosum* L.) CV. Desiree. *Pak. J. Bot.*, **44(5)**: 1503-1508.

Al-Shwany, A. W. R. (2006). Effect of irrigation water salinity stress on growth, yield op potato and methods to reduce

it. A thesis submitted to the council of the college of agriculture at the University of Baghdad in partial fulfillment of the requirement for the degree of doctor of philosophy science in Horticulture.

Bhuiyan, F. R. (2013). *In vitro* meristem culture and regeneration of threepotato varieties of Bangladesh. *Research in Biotech*., **4(3)**: 29-37.

Glaser, A. and C. Biggs (2010). *An Introduction to Statistical Methods inGenStat*.

Issa, F. H., A. N. Alhasnawi and S. S. Sabah (2018). Influence of gamma radiation on in vitro growthmicrotubersation and hormonal content of some potato (*Solanum tuberosum* L.) cultivars. *Plant Archives*, **18(2)** : 2317-2323.

Maas, E. V. and G. J. Hoffman (1977). Crop salt tolerance-current assessment. *J. Irrig. Drainage Division*, **103 (2)** : 115-134.

Murashige, T. and T. Skoog (1962). A revised medium for rapid growthand bioassays with tobacco tissue cultures. *Physiol Plant*., **15**: 473-479.

Salman, M. A., F. H. Issa and E. A. Elkaaby (2018). *In vitro* effect of Gamma rays and NaCl stress on yield and some morphological traits of two potato cultivars (*Solanum tuberosoum* L.). *Merit Research Journal of Agricultural Science and Soil Sciences*, **6(7)** : 8.

Taher, A. I. K. (2016). Evaluation of certain potato (*Solanum tuberosum* L.) cultivars for salinity tolerance *in vitro*. A Dissertation Submitied to the College of Agriculture, University of Basrah.

Yaycili, O. and S. Alikamanoglu (2012). Induction of salt-tolerant potato (*Solanum tuberosum* L.) mutants with gamma irradiation and characterization of genetic variations via RAPD-PCR analysis. *Turk J Biol*., **36** : 405-412.

Zamotaeva (1997). *Potato Production Guide*. Moscow Ed.Agropromizdat. P. 348.