RESULTS AND DISCUSSION

4 - RESULTS AND DISCUSSIONS

The effects of seeds soaking of two papaya cvs. (Solo and Betty) in some chemical substances solutions at different concentrations i.e., "GA_3" at (50 , 100 and 150 ppm) ; " NAA " at (25 , 50 and 75 ppm) ; "Yeast extract " at (50 , 100 and 150 m l /L ; colchicine at (20 , 30 and 40) mg / L and EMS at 0.2 , 0.3 and 0.4 % besides the control treatment (seeds soaking in tap water only) and the seeds treated with gamma rays .

Such effects were evaluated through the response of some seeds germination parameters (the percentage and the rate of seeds germination, some seedling growth measurements i.e., (seedling height , root length , number of leaves per seedling , vegetative growth fresh and dry weights , root fresh and dry weights and leaf / root ratio of dry weight) and mineral composition of leaf and root as well as the cytological study to throw some light on the effect of both colchicine and EMS solutions on the chromosome behaviour of the papaya seedlings .

Thus, obtained results during the two seasons of study dealing with any of the abovementioned three aspects are separately discussed as follows:

Part I: Effect of soaking (Solo) papaya seeds in some chemical substances and gamma rays on germination parameters, vegetative growth and seedlings mineral content.

Part II: Effect of soaking (Betty) papaya seeds in some chemical substances and gamma rays on germination

parameters, vegetative growth and seedlings mineral content.

Part III: Cytological study of the papaya seedlings which resulted from germinated seeds and treated with both colchicine and EMS solutions to throw some light on their chromosomal behaviour.

I.A.1. Effect of soaking (Solo) papaya seeds in some chemical substances at different concentrations on germination parameters.

I.A.1.1. Germination Percentage:

It is obvious from **Table (1)** that all tested treatments namely gibberellic acid (GA_3), yeast extract, naphthalene acetic acid " NAA " caused highly significant increase in germination percentage as compared with " colchicine ", " EMS " and untreated seeds " Control " .

Generally, seeds soaking in 100 ppm " GA3 " induced the highest germination percentage (84.67 and 88.00 %) , followed by seeds soaking in 50 ml/L " yeast extract (82.67and 86.00 %) and 25 ppm " NAA " (82.00and 84.00 %). On the other hand , seeds soaking in tap water " Control " caused the lowest germination percentage(56.00and 58.67 %) followed by seeds soaking in 0.4 % " EMS " (56.20 and 60.00%) and seeds soaking in 40 mg / L " colchicines (58.00and 62.00 %) during the first and second season, respectively.

I.A.1.2. Germination rate:

It is clear from **Table (1)** that, all tested treatments i.e " GA_3 " yeast extract, and " NAA " resulted in higher rates of

Table (1) : Germination percentage and rate of papaya seeds cv. Solo as affected by soaking in some chemical solutions during 2008 and 2009 seasons.

Treatments	Germination %		Germination rate	
	2008	2009	2008	2009
Seeds soaking in tap water "control"	56.00 D	58. 67 E	2.800 I	2.933 I
Seeds soaking in " GA_3" at 50 ppm	80.67 AB	86.00 AB	4.033 BCD	4.300 AB
Seeds soaking in "GA_3" at 100 ppm	84.67 A	88.00 A	4.233 A	4.400 A
Seeds soaking in" GA_3" at 150 ppm	80.00 AB	82.00 ABC	4.000 BCDE	4.100 CD
Seeds soaking in" NAA" at 25 ppm	82.00 AB	84.00 ABC	4.100 ABC	4.200 BC
Seeds soaking in "NAA" at 50 ppm	78.00 BC	80.00 BC	3.900 DE	4.000 DE
Seeds soaking in "NAA" at 75 ppm	74.00 C	78.00 C	3.700 F	3.900 E
Seeds soaking in" yeast extract" at 50 ml/l	82.67 AB	86.00 AB	4.133 AB	4.300 AB
Seeds soaking in "yeast extract" at 100 ml/l	78.67 ABC	83.33 ABC	3.933 CDE	4.167 BC
Seeds soaking in "yeast extract" at 150 ml/l	76.67 BC	81.33 BC	3.833 EF	4.067 CD
Seeds soaking in "Colchicine" at 20 mg/l	60.00 D	64.00 DE	3.000 GH	3.200 FG
Seeds soaking in" Colchicine" at 30 mg/l	60.67 D	65.33 D	3.033 G	3.267 F
Seeds soaking in" Colchicine" at 40 mg/l	58.00 D	62.00 DE	2.900 GHI	3.100 GH
Seeds soaking in" EMS" at 0.2 %	58.00 D	60.00 DE	2.900 GHI	3.000 HI
Seeds soaking in "EMS" at 0.3 %	56.67 D	60.67 DE	2.833 HI	3.033 HI
Seeds soaking in "EMS" at 0.4 %	60.00 D	60.67 DE	3.000 GH	3.033 HI

Means followed by the same letter (S)within each column are not significantly different at 5% level.

germination as compared with " colchicine " , " EMS " and untreated seeds " control " . The highest germination rates were obtained when seeds were soaked in 100 ppm " GA_3 " (4.233and 4.400) , 50 ml/L " yeast extract " (4.133 and 4.300) and 25 ppm " NAA " (4.100 and 4.200) as compared with untreated seeds " control "(2.800 and 2.933), 0.4 % " EMS " (3.000 and 3.033) and 30 mg/L " colchicine " (3.033 and 3.267) , and during the first and second season ,respectively .

The obtained results of gibberellic acid are in harmony with earlier reports of **Chacko and Singh (1966), Eshuys (1975), Salazar and Perez (1976), Sen and Ghunti (1976), Yahiro and Oryoji (1980), Choudhari and Chakrawar (1981), Asare (1984), Xu and Gu (1984), Nagao and Furutani (1986), Furutani and Nagao (1987), Palanisamy and Ramamoorthy (1987), Begum *et al.,* (1988), Ram and Govind (1990), Sen *et al.,* (1990), Gupta (1992), Bertocci *et al.,* (1997), Ananthakalaiselvi and Dharmalingam (1998), Salama (1998), Zhao *et al.,* (2004), Gunes and Gubbuk (2006), Yogeesha *et al.,* (2007) and Andrade *et al.,* (2008).**

The obtained results of naphthalene acetic acid are coincided with earlier reports of **Chiesotsu *et al* ., (1995), Prakash (1998), Salama (1998), Kalalbandi *et al* ., (2003) and Shinde *et al* ., (2008).**

The obtained results of yeast extract are in agreement with the findings of **Ismaeil and Bakry (2005).**

The obtained results of colchicine are in harmony with earlier reports of **Bakry and Ismaeil (2002) and Jaskani *et al.,* (2004).**

Finally, the recorded results of ethyl methane sulphonate (EMS) in this respect are in agreement with the findings of **Bakry and Ismaeil (2002) and Padma and Chauhan (2005).**

I.A.2. Effect of soaking (Solo) papaya seeds in some chemical substances at different concentrations on some growth measurements.

Table (2. 3 and 4) shows the effect of seeds soaking in some chemical solutions on some growth measurements of emerged papaya seedlings during 2008 and 2009 seasons.

I.A.2.1. Seedling height (cm):

It is obvious from **Table (2)** that in both seasons , seedlings arised from 100 ppm " GA_3 " had the tallest seedlings (68.43 and 70.33 cm), followed by 50 ml / L " yeast extract (67.63and 69.00 cm) and 25 ppm " NAA" (63.23 and 65.70 cm).

On thecontrary, seedlings arised from 20 mg/L " colchicines had the shortest seed lings " (40.77and 41.83 cm) , 0.2 % " EMS " (41.33 and 43.10cm) and untreated seeds " Control " (53.17 and 56.47 cm) during the first and second season ,respectively .

I.A.2.2. Root length (cm):

It is obvious from **Table (2)** that in 2008 and 2009 seasons , seeds soaked in " GA_3 " ,at 100 ppm" yeast extract " ,at 50ml/L and " NAA "at 25 ppm induced the highest length of root as compared with seeds soaked in "Colchicine "at 40" mg/L and "EMS" at "0.2% .

Table (2) : Seedling height, root length and number of leaves per seeding of papaya seedlings cv solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Seedling height (cm)		Root length (cm)		Number of leaves per seedling	
	2008	2009	2008	2009	2008	2009
Seeds soaking in tap water "control"	53.17 D	56.47 E	13.60 CDE	15.33 E	14.33 DE	14.67 DEF
Seeds soaking in " GA_3" at 50 ppm	65.83 B	67.87 B	14.60 C	16.47 D	15.33 BC	15.33 BCD
Seeds soaking in "GA_3" at 100 ppm	68.43 A	70.33 A	19.13 A	20.83 A	16.33 A	17.00 A
Seeds soaking in" GA_3" at 150 ppm	62.87 C	65.87 C	13.47 CDE	14.90 E	15.67 AB	15.67 BC
Seeds soaking in" NAA" at 25 ppm	63.23 C	65.70 C	16.73 B	17.57 C	14.67 CD	15.00 CDE
Seeds soaking in "NAA" at 50 ppm	62.40 C	62.53 D	14.57 C	15.37 E	14.33 DE	14.33 EFG
Seeds soaking in "NAA" at 75 ppm	62.27 C	61.77 D	13.33 CDE	14.50 EF	14.00 DEF	14.00 FGH
Seeds soaking in" yeast extract" at 50 ml/l	67.63 A	69.00 AB	18.03 A	19.13 B	15.67 AB	16.00 B
Seeds soaking in "yeast extract" at 100 ml/l	65.27 B	65.53 C	14.27 CD	15.10 E	14.67 CD	15.00 CDE
Seeds soaking in "yeast extract" at 150 ml/l	62.90 C	64.90 C	13.90 CDE	13.73 FG	14.33 DE	14.67 DEF
Seeds soaking in "Colchicine" at 20 mg/l	40.77 G	41.83 I	11.43 F	13.40 FG	13.33 FG	13.33 H
Seeds soaking in" Colchicine" at 30 mg/l	42.10 FG	45.53 FG	12.87 E	14.87 E	13.67 EFG	14.00 FGH
Seeds soaking in" Colchicine" at 40 mg/l	42.00 FG	41.87 I	11.20 F	12.80 G	13.00 G	13.33 H
Seeds soaking in" EMS" at 0.2 %	41.33 FG	43.10 HI	12.87 E	13.47 FG	13.667 EFG	13.67 GH
Seeds soaking in "EMS" at 0.3 %	42.73 F	44.60 GH	13.20 DE	13.67 FG	13.00 G	13.33 H
Seeds soaking in "EMS" at 0.4 %	44.50 E	47.23 F	13.90 CDE	15.63 DE	14.00 DEF	14.33 EFG

Means followed by the same letter (S)within each column are not significantly different at 5% level.

Generally, seeds soaked in 100 ppm " GA_3 " " Produced seedlings with the highest length of root (19. 13 and 20.83 cm) followed by 50 ml / L " yeast extract " (18.03 and 19.13 cm) and 25 ppm " NAA" (16.73 and 17.57 cm) .

On the other hand , seeds soaked in 40 mg/L " colchicine" EMS " gave seedlings with the lowest length of root(11.20 and 12.80 cm 20mg/L" colchicine"(11.43 and 13.40)and 0.2% EMS (12.87 and 13.47) during the first and second season, respectively.

I.A.2.3. Number of leaves per seedling :

It is clear from **Table (2)** that in both seasons , the highest number of leaves were obtained from 100 ppm " GA_3 " (16.33 and 17.00) , 50 ml / L " yeast extract (15.67 and 16.00) and 50 ppm " GA_3 " (15.33 and 15.33) .

On the contrary , the lowest number of leaves per seedling were obtained and 40 mg/L " colchicine " (13.00 and 13.33), 0.3%EMS(13.00 and 13.33) and (untreated seeds) (control) (14.33 and 14.67). during the first and second season, respectively.

I.A.2.4. Fresh weight of vegetative growth (gm):

It is obvious from **Table (3)** that in both seasons , the highest fresh weight of vegetative growth were obtained from 100 ppm " GA_3 " (46.79 and 48.67 gm .) , 50 ml /L " yeast extract " (44.18 and 46.93 gm .) and 50ppm " GA_3 " (43.11 and 45.87 gm) .

On the other hand, the lowest fresh weight of vegetative growth were obtained from 0.2% EMS (18.95and 20.56), 20

Table (3): Fresh weight of vegetative growth and root of papaya seedlings cv. Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Fresh weight of vegetative growth (gm)		Root fresh weight (gm)	
	2008	2009	2008	2009
Seeds soaking in tap water " Control "	24.12 H	25.13 G	9.44 FG	10.69 HI
Seeds soaking in " GA_3 " at 50 ppm	43.11 BC	45.87 B	15.99 BC	16.98 BC
Seeds soaking in " GA_3 " at 100 ppm	46.79 A	48. 67A	18.42 A	19.05 A
Seeds soaking in " GA_3" at 150 ppm	42.09 CD	43.16 C	17.01 AB	17.81 AB
Seeds soaking in " NAA " at 25 ppm	40.26 E	41.26 D	14.29 CD	15.14 DE
Seeds soaking in " NAA " at 50 ppm	36.29 G	37.18 F	13.08 DE	13.23 FG
Seeds soaking in " NAA " at 75 ppm	37.74 FG	39.29 E	11.81 E	12.02 GH
Seeds soaking in yeast extract at 50 ml/l	44.18 B	46.93 AB	17.40 AB	18.88 A
Seeds soaking in yeast extract at 100 ml/l	41.18 DE	43.62 C	14.67 CD	15.77 CD
Seeds soaking in yeast extract at 150 ml/l	38.31 F	39.84 DE	13.34 DE	14.01 EF
Seeds soaking in Colchicine at 20 mg/l	19.29 J	20.68 H	7.81 G	8.21 K
Seeds soaking in Colchicine at 30 mg/l	22.49 I	24.68 G	8.47 FG	9.57 IJK
Seeds soaking in Colchicine at 40 mg/l	20.46 J	21.64 H	8.20 FG	9.18 IJK
Seeds soaking in " EMS " at 0.2 %	18.95 J	20.56 H	8.15 FG	8.51 JK
Seeds soaking in " EMS " at 0.3 %	20.39 J	21.88 H	9.27 FG	9.42 IJK
Seeds soaking in " EMS " at 0.4 %	22.62 I	24.14 G	9.78 F	10.20 IJ

Means followed by the same letter (S)within each column are not significantly different at 5% level.

mg/L " colchicine " (19.29and 20.68 gm.)and untreated seeds " control " (24.12 and 25.13 .) during the first and second season, respectively.

I.A.2.5. Fresh weight of root system:

It is clear from **Table (3)** that in both seasons , the highest fresh weight of root system were obtained from 100 ppm " GA_3 " (18.42 and 19.05 gm .) 50 ml/L " yeast extract " (17.40 and18.88 gm) . and 150 ppm " GA_3 " (17.01and 17.81 gm.) .

On the other hand , the lowest fresh weight of root system were obtained from " colchicine " at 20 mg/L (7.81 and 8.21), 0.2 % EMS (8.15 and 8.51) and untreated seeds " Control " (9.44, 10.69 gm.) during the first and second season, respectively.

I.A.2.6. Dry weight of vegetative growth (gm):

It is obvious from **Table (4)** that in both seaons , seeds soaked in 100 ppm " GA_3 " increased dry weight of vegetative growth , (8.79 and 9.34 gm .) 50 ml/L " yeast extract " (8.20 and 8.27 gm .) 150 ppm " GA_3" (7.79 and 8.65 gm)

On the contrary , seeds soaked in 20mg/L colchicine % decreased dry weight of vegetative growth (4.13and 4.54 gm .) followed by 40 mg / L colchicine (4.82and 5.06 gm .) and untreated seeds (control) (4.77and 5.88 gm .) during the first and second season ,respectively.

I.A.2.7. Dry weight of root system (gm):

It is clear from **Table (4)** that in both seasons , seeds soaked in 100 ppm " GA_3 " increased dry weight of root system (6.80 and 7.32 gm . , followed by 50 ml/L " yeast extract " (6.05and 6.78 gm) and 150 ppm " GA_3" (6.03 and 6.32 gm.).

Table(4) : Dry weight of vegetative growth and root and Top / root ratio of papaya seedlings cv. Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons

Treatments	Dry weight of vegetative growth (gm)		Root dry weight (gm)		Top/ root ratio	
	2008	2009	2008	2009	2008	2009
Seeds soaking in tap water " Control "	4.77 HI	5.88 EFGH	4.43 EF	4.77 GHI	1.076 G	1.232 DA
Seeds soaking in " GA_3 " at 50 ppm	7.93 B	8.33 B	5.80 BC	6.03 CDE	1.367 A	1.381 A
Seeds soaking in " GA_3 " at 100 ppm	8.79 A	9.34 A	6.80 A	7.32 A	1.292 ABC	1.275 CD
Seeds soaking in " GA_3 " at 150 ppm	7.79 B	8.65 AB	6.03 B	6.32 BC	1.291 ABC	1.368 B
Seeds soaking in " NAA " at 25 ppm	6.79 C	7.05 CD	5.36 CD	5.67 DEF	1.266 BC	1.243 CDE
Seeds soaking in " NAA " at 50 ppm	6.14 CD	6.61 CDE	4.98 DE	5.42 EFG	1.232 CD	1.219 E
Seeds soaking in " NAA " at 75 ppm	5.69 DEF	6.24 DEF	4.52 EF	4.83 GHI	1.258 BCD	1.291 C
Seeds soaking in yeast extract at 50 ml/l	8.20 AB	8.27 B	6.05 B	6.78 AB	1.355 AB	1.219 E
Seeds soaking in yeast extract at 100 ml/l	6.68 C	7.10 C	5.70 BC	6.14 CD	1.171 D	1.156 FG
Seeds soaking in yeast extract at 150 ml/l	5.91 DE	6.37 CDEF	5.27 CD	5.62 DEF	1.121 F	1.133 GH
Seeds soaking in Colchicine at20 mg/l	4.13 I	4.54 I	4.00 F	4.18 I	1.032 H	1.086 I
Seeds soaking in Colchicine at 30 mg/l	5.01 FGH	5.31 GHI	4.58 EF	4.75 GHI	1.093 FG	1.117 HI
Seeds soaking in Colchicine at 40 mg/l	4.82 GHI	5.06 HI	4.12 F	4.37 I	1.169 DE	1.157 FG
Seeds soaking in " EMS " at 0.2 %	4.98 FGH	5.24 GHI	4.44 EF	4.66 HI	1.121 F	1.124 H
Seeds soaking in " EMS " at 0.3 %	5.25 EFGH	5.69 FGH	4.53 EF	4.83 GHI	1.158 E	1.178 F
Seeds soaking in " EMS " at 0.4 %	5.60 DEFG	6.07 EFG	4.94 DE	5.29 FHG	1.133 EF	1.147 G

Means followed by the same letter (S)within each column are not significantly different at 5% level.

On the other hand, seeds soaked in 20mg/L" colchicine "decreased dry weight of root system (4.00 and 4.18 gm .) followed by 40 mg / L " colchicine " (4.12 and 4.37 gm .) and untreated seeds (control) (4.43 and 4.77 gm .) during the first and second season ,respectively.

I.A.2.8. Top / root ratio of dry weight:

It is obvious from **Table (4)** that in both seasons , the highest top / root ratio of dry weight was obtained from 50 ppm " GA_3 " (1.367and 1.381) .

The gained results of gibberellic acid in this respect go in line with findings of **Guha and Chaturvedi (1972), Sen and Ghunti (1976), Sen *et al.*, (1990), Salama (1998), Pandit *et al.*, (2001), Zhao *et al.*, (2004), Andrade *et al.*, (2008) and Rajesh *et al.*,(2008)**.

The obtained results of naphthalene acetic acid (NAA) are in agreement with the findings of **Kalabandi *et al* ., (2003)**.

The recorded results of yeast extract are in agreement with the findings of **Ahmed *et al.*, (1998), Mostafa (2004) and Ismaeil and Bakry (2005).**

The obtained results of colchicine are coincided with earlier reports of **Jaskani *et al.*, (2004).**

The obtained results of ethyl methane sulphonate (EMS) are in harmony with earlier reports of **Jawaharlal *et al* ., (1991), Konzak (1993), Patra *et al.*,(1998), Bakry and Ismaeil (2002), Nusrat and Mirza (2002)** and **Padma and Chauhan (2005)**.

I.A.3.Effect of soaking (Solo) papaya seeds in some chemical substances at different concentrations on seedling mineral content.

I.A.3.1. Effect on leaf and root nitrogen content :

Table (5) shows leaf and root nitrogen content (%) of papaya seedlings cv. Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons .

It is obvious from **Table (5)** that in both seasons , the highest value of leaf nitrogen content was obtained from 100 ppm " GA_3" (1.800and 1.850) followed by 50 mL/L " yeast extract (1.750and 1.800 (and 25 ppm " NAA" (1.700 and 1.750).

On the other hand , the lowest value of leaf nitrogen content were obtained from untreated seeds " control " (1.150 and 1.165), 0.2% " EMS " (1.270 and 1.300) and 40 mg/L " Colchicine " (1.300 and 1.350).

As for the highest value of root nitrogen content was obtained from 100 PPm " GA_3 " (1.550 and 1.580), followed by 50 mL/L " yeast extract " (1.500 and 1.550), and 25 ppm " NAA " (1.470 and1.500) .

On the contrary, the lowest value of root nitrogen content were obtained from untreated seeds " control " (1.100 and1.120) 0.3 % " EMS " (1.110 and 1.130) and 40 mg / L " colchicine (1.170 and 1.200). during the first and second season, respectively.

Table (5) : Leaf and root nitrogen content (%) of papaya seedlings c v . Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Leaf nitrogen content (%)		Root nitrogen content (%)	
	2008	2009	2008	2009
Seeds soaking in tap water "control "	1.150I	1.165J	1.100I	1.120IJ
Seeds soaking in "GA_3" at 50 ppm	1.600D	1.700 D	1.300 EF	1.350 EF
Seeds soaking in "GA_3" at100 ppm	1.800 A	1.850 A	1.550A	1.580 A
Seeds soaking in "GA_3" at150 ppm	1.650 C	1.680 DE	1.440 CD	1.490 CD
Seeds soaking in "NAA" at 25 ppm	1.700 BC	1.750 C	1.470 BC	1.500 C
Seeds soaking in "NAA" at 50 ppm	1.500 EF	1.550 FG	1.270 FG	1.300 EFG
Seeds soaking in "NAA" at 75 ppm	1.550 DE	1.600EFG	1.350 DEF	1.400 DE
Seeds soaking in "yeast extract" at 50 ml/l	1.750 B	1.800 B	1.500AB	1.550B
Seeds soaking in "yeast extract" at100 ml/l	1.620 D	1.650 DEF	1.400 DF	1.420D
Seeds soaking in "yeast extract" at 150 mg/l	1.580 DE	1.630 EF	1.320 EF	1.350 EF
Seeds soaking in "colchicine" at 20 mg/l	1.350 FGH	1.400 HI	1.200 GH	1.250 GH
Seeds soaking in colchicine" at 30 mg/l	1.450 F	1.500 FGH	1.210 GH	1.280 FG
Seeds soaking in "colchicine" at 40 mg/l	1.300 GHI	1.350 HIJ	1.170 GHI	1.200 GHI
Seeds soaking in "EMS"at 0.2 %	1.270 HI	1.300 IJ	1.150 HI	1.180 HI
Seeds soaking in 'EMS" at 0.3 %	1.300 GHI	1.350 HIJ	1.110 I	1.130 J
Seeds soaking in "EMS" at 0.4 %	1.400FG	1.450 GH	1.180 GHI	1.200 GHI

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.A.3.2. Effect on leaf and root phosphorus content :

Table (6) shows leaf and root phosphorus content (%) of papaya seedlings cv. Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons .

It is obvious from **Table (6)** that in both seasons , the highest value of leaf phosphorus content was obtained from 100 ppm " GA_3 " (.360 and, 0.370) followed by 50 ml / L " yeast extract (0.350 and 0.365) and 150 ppm " GA_3 " (0.345 and 0.344).

On the contrary , the lowest value of leaf phosphorus content was obtained from untreated seeds " control " (0.195, 0.200) ,40 mg/L"colchicine " (0.225 and 0.230) and 0.2 % " EMS " (0.215 and 0.220).

As for the highest value of root phosphorus content was obtained from 100 ppm " GA_3 " (0.285and 0.290) , followed by 50 ml / L " yeast extract " (0.276 and 0.282), and 150 ppm " GA_3 " (0.270 and 0.270) .

On the other hand , the lowest value of root phosphorus content was obtained from 0.3% " EMS " (0.175and 0.180),40 mg/L " colchicines(0.178 and 0.182) and untreated seeds control " (0.178 and 0.185) . during the first and second season ,respectively.

Table(6) : Leaf and root phosphorus content (%) of papaya seedlings cv . Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Leaf phosphorus content (%)		Root phosphorus content (%)	
	2008	2009	2008	2009
Seeds soaking in tap water "control "	0.195 I	0.20J	0.178 FG	0.185 EFG
Seeds soaking in "GA_3" at 50 ppm	0.335 CDE	0.340 D	0.255 CD	0.261 CD
Seeds soaking in "GA_3" at100 ppm	0.360 A	0.370 A	0.285 A	0.290 A
Seeds soaking in "GA_3" at150 ppm	0.345 BC	0.344 CD	0.270 ABC	0.270 C
Seeds soaking in "NAA" at25 ppm	0.337 CDE	0.355 BC	0.260 BCD	0.272BC
Seeds soaking in "NAA"at 50 ppm	0.320 E	0.325 DEF	0.250 D	0.260 CD
Seeds soaking in NAA at 75 ppm	0.317 E	0.330 DE	0.244 E	0.250 D
Seeds soaking in "yeast extract" at 50 ml/l	0.350 AB	0.365 B	0.276 AB	0.282 B
Seeds soaking in "yeast extract" at100 ml/l	0.340 CD	0.350 C	0.258 CD	0.265 BCD
Seeds soaking in "yeast extract" at 150 ml/l	0.330DE	0.348 CD	0.265 BC	0.270C
Seeds soaking in "Colchicine" at 20 mg/l	0.236 FGH	0.240 FG	0.180 EFG	0.185 EFG
Seeds soaking in Colchicine" at 30 mg/l	0.247 FG	0.255 D-G	0.187 EF	0.197 DE
Seeds soaking in "Colchicine" at 40 mg/l	0.225 GH	0.230 HI	0.178 FG	0.182 FG
Seeds soaking in "EMS"at 0.2 %	0.215 GHI	0.220 IJ	0.177 G	0.179 FG
Seeds soaking in 'EMS" at 0.3 %	0.200 HI	0.235 GH	0.175 GH	0.180FG
Seeds soaking in "EMS" at 0.4 %	0.242 FG	0.250 EFG	0.180 EFG	0.190 EF

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.A.3.3. Effect on leaf and root potassium content :

Table (7) shows leaf and root potassium content (%) of papaya seedlings cv. Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons .

It is clear from **Table (7)** that in both seasons , the highest value of leaf potassium content was obtained from 100 ppm " GA_3 " (1.717 and 1.750) followed by 50mL/L " yeast extract " (1.650 and 1.700) and 25 ppm " NAA " (1.580 and 1.630) .

On the other hand, the lowest value of leaf potassium content was obtained from and untreated seeds " control " (1.170 and 1.185) 0.2 % " EMS "(1.177 and 1.190) and 40 mg/L " colchicines " (1.190 and 1.220) .

As for the highest value of root potassium content was obtained from 100 ppm " GA_3" (1.467 and 1.490) followed by 50 ml/L" yeast extract" (1.387 and 1.400) and 25 ppm" NAA" (1.360 and 1.380).

On the contrary, the lowest value of root potassium content was obtained from 0.3%" EMS" (1.070 and 1.085), untreated seeds control (1.050 and 1.100). 40mg/L colchicine (1.110 and 1.130) during the first and second season ,respectively.

Table (7) : Leaf and root potassium content (%) of papaya seedlings cv . Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Leaf potassium content (%)		Root potassium content (%)	
	2008	2009	2008	2009
Seeds soaking in tap water "control "	1.170 I	1.185 J	1.050HI	1.100 I
Seeds soaking in "GA_3" at 50 ppm	1.537 C	1.570 DE	1.357 BC	1.370 C
Seeds soaking in "GA_3" at100 ppm	1.717 A	1.750 A	1.467 A	1.490 A
Seeds soaking in "GA_3" at150 ppm	1.550 BC	1.600 D	1.300 CD	1.350 D
Seeds soaking in "NAA" at 25 ppm	1.580 B	1.630 C	1.360 ABC	1.380 B
Seeds soaking in "NAA" at 50 ppm	1.500 CDE	1.540 DEF	1.230 DE	1.245 F
Seeds soaking in "NAA" at 75 ppm	1.400 E	1.480 F	1.210 DEF	1.250 E
Seeds soaking in "yeast extract" at 50 ml/l	1.650 AB	1.700 B	1.387 AB	1.400 AB
Seeds soaking in "yeast extract" at100 ml/l	1.517 CD	1.540 DEF	1.330 C	1.356 CD
Seeds soaking in "yeast extract" at 150 ml/l	1.460 DE	1.500 DEF	1.250 CDE	1.300 DE
Seeds soaking in "colchicine" at 20 mg/l	1.200 FGH	1.2240 GHI	1.130 FG	1.150 GH
Seeds soaking in colchicine" at 30 mg/l	1.247 EF	1.280 FG	1.167 D-G	1.190 FG
Seeds soaking in "colchicine" at 40 mg/l	1.190 GH	1.220 HI	1.110 F-I	1.130 HI
Seeds soaking in "EMS"at 0.2 %	1.177 H	1.190I	1.120 FGH	1.143 GHI
Seeds soaking in 'EMS" at 0.3 %	1.203 FG	1.250 GH	1.070 GHI	1.085 I J
Seeds soaking in "EMS" at 0.4 %	1.223 F	1.265 FGH	1.140 EFG	1.178 G

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.A.3.4. Effect on leaf and root iron content :

Table (8) shows that leaf and root iron content (ppm) of papaya seedlings cv. Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons .

It is obvious from **Table (8)** that, in both seasons , the highest value of leaf nitrogen content was obtained from 100 ppm " GA_3" (116.7and 122.2) followed by 50 mL/L " yeast extract (115.3and 120.7) and 25 ppm " NAA " (113.8and 118.4).

On the other hand , the lowest value of leaf iron content was obtained from untreated seeds " control " (79.10and 85.60), 0.3% EMS (83.60 and 85.30) and 40 mg/L " colchicine " (87.70 and 96.80).

As for the highest value of root iron content was obtained from 100 PPm " GA_3 " (99.20and 107.00) , followed by 50 ml/L " yeast extract " (98.40and 105.30) , and 25 ppm " NAA " (95.90and 102.50) .

On the contrary, the lowest value of root iron content was obtained from untreated seeds ." control " (58.90 and 65.40), 0.3 % " EMS " (73.20and 76.80) and 40 mg / L " colchicine (77.60 and 81.00) . during the first and second season ,respectively .

Table (8) : Leaf and root iron content (ppm) of papaya seedlings cv . Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Leaf iron content (ppm)		Root iron content (ppm)	
	2008	2009	2008	2009
Seeds soaking in tap water "control "	79.10L	85.60 J	58.90N	65.40L
Seeds soaking in "GA_3" at 50 ppm	112.0BCD	116.6D	94.70F	101.10DE
Seeds soaking in "GA_3" at100 ppm	116.7A	122.2A	99.20A	107.00A
Seeds soaking in "GA_3" at150 ppm	113.7BC	117.1C	95.60D	100.80EF
Seeds soaking in "NAA" at 25 ppm	113.8ABC	118.48B	95.90C	102.50CD
Seeds soaking in "NAA" at 50 ppm	108.2EF	111.8F	92.00I	95.70I
Seeds soaking in "NAA" at 75 ppm	109.7E	112.0E	92.80H	98.10H
Seeds soaking in "yeast extract" at 50 ml/l	115.3AB	120.7AB	98.40B	105.30B
Seeds soaking in "yeast extract" at100 ml/l	111.3CD	111.3CD	95.30DE	100.60FG
Seeds soaking in "yeast extract" at 150 ml/l	110.5D	115.5DE	93.20G	98020GH
Seeds soaking in "colchicine" at 20 mg/l	89.80H	95.20GH	79.40J	82.60IJK
Seeds soaking in colchicine" at 30 mg/l	95.60F	102.50FG	83.90H	89.20HI
Seeds soaking in "colchicine" at 40 mg/l	87.70I	96.80GHI	77.60JK	81.00JK
Seeds soaking in "EMS"at 0.2 %	85.30J	87.60HI	75.90K	80.00JKL
Seeds soaking in 'EMS" at 0.3 %	83.60K	85.30I	73.20M	76.80KL
Seeds soaking in "EMS" at 0.4 %	94.50G	96.10FGH	80.00I	85.60IJ

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.A.3.5. Effect on leaf and root Zinc content:

Table (9) shows leaf and root Zinc content (ppm) of papaya seedlings cv. Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons .

It is obvious from **Table (9)** that in both seasons , the highest value of leaf Zinc content was obtained from 100 ppm " GA_3 " (25.80and27.30 followed by 50 ml / L " yeast extract " (25.00and 26.00 and 25 ppm " NAA " (24.70and 25.10) .

On the contrary , the lowest value of leaf Zinc content was obtained from untreated seeds " control " (14.50and15.70), 0.2 % " EMS " (15.70and 16.20)and 40 mg/L " colchicine " (16.80and 17.80).

As for the highest value of root Zinc content was obtained from 100 ppm " GA_3 " (22.90and 24.20) , followed by 50 ml / L " yeast extract " (22.50 and 23.00), and 25 ppm " NAA " (21.50and22.60).

On the other hand , the lowest value of root Zinc content was obtained from untreated seeds (control) (12.80 and 14.80), 0.2% " EMS" (13.70 and 14.10) and 40 mg/L " colchicine" (14.20. and 15.00) during the first and second season ,respectively .

Table (9) : Leaf and root zinc content (ppm) of papaya seedlings cv . Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Leaf zinc content (ppm)		Root zinc content (ppm)	
	2008	2009	2008	2009
Seeds soaking in tap water "control "	14.50K	15.70I	12.80J	14.80H
Seeds soaking in "GA_3" at 50 ppm	23.30D	24.00C	21.00C	22.30BC
Seeds soaking in "GA_3" at100 ppm	25.80A	2730A	22.90A	24.20A
Seeds soaking in "GA_3" at150 ppm	23.90C	24.60BC	20.30 CD	21.00D
Seeds soaking in "NAA" at 25 ppm	24.70BC	25.10ABC	21.50BC	22.60B
Seeds soaking in "NAA" at 50 ppm	22.50E	23.20DE	20.00 E	21.00D
Seeds soaking in "NAA" at 75 ppm	20.00FG	21.30EF	19.70 F	20.70DE
Seeds soaking in "yeast extract" at 50 ml/l	25.00B	26.00AB	22.50B	23.00AB
Seeds soaking in "yeast extract" at100 ml/l	22.90DE	23.80CD	21.00C	22.00BCD
Seeds soaking in "yeast extract" at 150 ml/l	21.80F	22.30DEF	20.10DE	21.70CD
Seeds soaking in "Colchicine" at 20 mg/l	17.00H	18.50FGH	15.00GH	17.10F
Seeds soaking in Colchicine" at 30 mg/l	18.30FG	20.00F	17.30FG	18.50E
Seeds soaking in "Colchicine" at 40 mg/l	16.80HI	17.80GHI	14.20I	15.00FGH
Seeds soaking in "EMS"at 0.2 %	15.70J	16.20HI	13.70IJ	14.10GH
Seeds soaking in 'EMS" at 0.3 %	16.20I	17.90GH	14.30H	15.50FG
Seeds soaking in "EMS" at 0.4 %	17.40G	19.20FG	15.60G	16.40EF

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.A.3.6.Effect on leaf and root manganese content:

Table (10) shows leaf and root manganese content (ppm) of papaya seedlings cv. Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons .

It is clear from **Table (10)** that, in both seasons the highest value of leaf manganese content was obtained from 100 ppm " GA_3 (39.00and 44.10) followed by 50ml/L" yeast extract" (38.70and 43.40) and 25 ppm " NAA " (37.70 and 42.30) .

On the other hand , the lowest value of leaf manganese content was obtained from untreated seeds " control. (20.90 and 21.20),0.3% EMS (20.40 and 21.60)and 40 mg/L"Colchicine " (21.50 and 22.60).

The highest value of leaf manganese content was obtained from 100 ppm " GA_3 " (33.70and 36.80) followed by 50ml/L " yeast extract(32.30and 34.80) and 25 ppm " NAA(31.80and33,70) .

On the contrary , the lowest value of root manganese content was obtained from untreated seeds " control " (17.00and 18.90), 0.3% " EMS " (18.20and 20.00) and 40 mg/l " Colchicine " (19.40and 22.00) during the first and second season ,respectively .

These results are in agreement with findings of **Loyd *et al.*, (1961), Ting (1962), Saito and Yamato (1964), Randhawa and Iwata (1965) and Mohmodov (1967).**

Table (10) : Leaf and root manganese content (ppm) of papaya seedlings cv. Solo as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Leaf manganese content (ppm)		Root manganese content (ppm)	
	2008	2009	2008	2009
Seeds soaking in tap water "control "	20.90J	21.20IJ	17.00I	18.90K
Seeds soaking in "GA_3" at 50 ppm	36.30CD	40.00DE	31.60BC	33.00D
Seeds soaking in "GA_3" at100 ppm	390.0A	44.10A	33.70A	36.80A
Seeds soaking in "GA_3" at150 ppm	37.00C	41.50CD	30.10D	32.20EF
Seeds soaking in "NAA" at 25 ppm	37.70B	42.30C	31.80ABC	33.70C
Seeds soaking in "NAA" at 50 ppm	35.50DE	39.10EF	31.00DE	32.50E
Seeds soaking in "NAA" at 75 ppm	34.00EF	37.70F	30.60E	31.10F
Seeds soaking in "yeast extract" at 50 ml/l	38.70AB	43.40B	32.30AB	34.80B
Seeds soaking in "yeast extract" at100 ml/l	36.00D	40.50D	30.00EF	33.00D
Seeds soaking in "yeast extract" at 150 ml/l	35.20E	39.30E	31.50C	32.80DE
Seeds soaking in "Colchicine" at 20 mg/l	22.10GH	24.80GH	20.30G	23.00H
Seeds soaking in Colchicine" at 30 mg/l	23.30F	28.00fG	22.80F	24.00G
Seeds soaking in "Colchicine" at 40 mg/l	21.50G	22.60H	19.40H	22.0HI
Seeds soaking in "EMS"at 0.2 %	21.00H	22.30HI	19.60GH	21.60I
Seeds soaking in 'EMS" at 0.3 %	20.40I	21.60HI	18.20HI	20.00J
Seeds soaking in "EMS" at 0.4 %	22.80FG	25.30G	20.0FG	23.30GH

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.B.1.Effect of treating (Solo) papaya seeds with gamma irradiation at various doses on germination parameters.

I.B.1.1. Germination percentage:

It is obvious from **Table (11)** that in both seasons water – soaked seeds and treated with different doses of gamma rays had higher germination percentage as compared with untreated seeds " control " .

Shortly , water – soaked seeds , and treated with gamma rays at (40 Kr). proved to be the superior treatments improving germination percentage (74.00 and 78.00 %) during the first and second season ,respectively .

I.B.1.2.Germination rate:

It is clear from **Table (11)** that in both seasons , water – soaked seeds and treated with different doses of gamma rays had higher germination rate as compared with untreated seeds " Control ".

Briefly , water – soaked seeds , and treated with gamma rays at (40 kr) proved to be the superior treatments improving germination rate (3.537 and 3.744) during the first and second season ,respectively .

These results are in harmony with earlier studies of **Kalinichenko (1971), Spiegel-Roy and Kochba (1972), Kawecki (1973), Dronnikov (1977), Lange and Toit (1977), Shchepot *et al* ., (1978), Vonkyi and Amuh (1979), Alamgir and Rahman (1991), Jawaharlal *et al* .,(1991), Sharma and Sharma (1994),Salama (1998), Nargis *et al.,* (1998), Sunil *et al* . , (2002),Bakry and Ismaeil (2002), Hafiz *et al* ., (2005) and Murlee *et al.,* (2008).**

Table (11) : Germination percentage and rate of papaya seeds cv. Solo as affected by treating with gamma rays during 2008 and 2009 seasons.

Treatments	Germination %		Germination rate	
	2008	2009	2008	2009
Seeds soaking in tap water "control"	56.00 D	58.67 D	2.800 C	2.933 C
Seeds soaking in tap water + 10 k.rad	66.67 C	70.00C	3.500 B	3.631 B
Seeds soaking in tap water + 20 k.rad	70.67 B	72.67 B	3.525 AB	3.688 AB
Seeds soaking in tap water + 40 k.rad	74.00 A	78.00 A	3.537 A	3.744 A

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.B.2. Effect of treating (Solo) papaya seeds with gamma irradiation at various doses on some growth measurements .

I.B.2.1.Seedling height (cm):

It is obvious from **Table (12)** that, in both seasons, water – soaked seeds gave the tallest seedlings as compared with other treatments. On the other hand, water – soaked seeds and treated with gamma rays at 10 Kr produced shorter seedlings.

I.B.2.2.Root length (cm):

It is clear from **Table (12)** that in both seasons , water – soaked seeds produced seedlings with the highest length of root as compared with other tested treatments . On the contrary , water – soaked seeds and treated with gamma rays at 10 kr produced the lowest of length of root .

I.B.2.3.Number of leaves per seedlings:

It is obvious from **Table (12)** that, in both seasons , water – soaked seeds produced seedlings with the highest number of leaves as compared with other tested treatments . On the other hand , water – soaked seeds and treated with gamma rays at 10 Kr. produced seedlings with the lowest number of leaves .

Table (12): Seedling height, root length and number of leaves per seedling of papaya seedlings cv. Solo as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Seedling height (cm)		Root length (cm)		Number of leaves per seedling	
	2008	2009	2008	2009	2008	2009
Seeds soaking in tap water " Control "	53.17 A	56.47 A	13.60 A	15.33 A	14.33 A	14.67 A
Seeds soaking in tap water + 10 k. rad	38.97 D	43.07 D	8.03 D	10.10 D	13.00 D	13.33 D
Seeds soaking in tap water + 20 k. rad	44.80 C	48.10 C	9.50 C	11.03 C	13.33 C	13.67 C
Seeds soaking in tap water + 40 k. rad	50.47 B	53.17 B	10.13 B	12.30 B	14.00 B	14.33 B

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.B.2.4.Fresh weight of vegetative growth (gm):

It is clear from **Table (13)** that, in both seasons, water – soaked seeds increased the fresh weight of vegetative growth as compared with other tested treatments. On the contrary, water – soaked seeds and treated with gamma rays at 10 Kr decreased the fresh weight of vegetative growth.

I.B.2.5.Fresh weight of root system (gm):

It is obvious from **Table (13)** that in both seasons, water – soaked seeds increased the fresh weight of root system as compared with other tested treatments. On the other hand, water – soaked seeds and treated with gamma rays at 10 Kr decreased the fresh weight of root system.

Table (13) : Fresh weight of vegetative growth and root of papaya seedlings cv .Solo as affected by treating the seeds with gamma rays during 2008 and 2009 seasons

Treatments	Fresh weight of egetative growth (gm)		Root fresh weight (gm)	
	2008	2009	2008	2009
Seeds soaking in tap water " Control "	24.12 A	25.13 A	9.44 A	10.69 A
Seeds soaking in tap water + 10 k. rad	17.37 D	18.76 D	5.46 D	6.35 D
Seeds soaking in tap water + 20 k. rad	18.85 C	19.84 C	6.60 C	7.47 C
Seeds soaking in tap water + 40 k. rad	21.18 B	23.08 B	7.46 B	8.04 B

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.B.2.6. Dry weight of vegetative growth:

It is clear from **Table (14)** that, in both seasons, water – soaked seeds increased the dry weight of vegetative growth as compared with other tested treatments. On the contrary, water – soaked seeds and treated with gamma rays at 10 Kr decreased the dry width of vegetative growth.

I.B.2.7.Dry weight of root system:

It is obvious from **Table (14)** that, in both seasons, water – soaked seeds increased the dry weight of root system as compared with other tested treatments. On the other hand , water – soaked seeds and treated with gamma rays at 10 Kr decreased the dry weight of root system.

I.B.2.8.Top/root ratio of dry weight:

It is clear from **Table (14)** that, in both seasons water – soaked and treated with gamma rays at 10 Kr. increased top/ root ratio of dry weight.

The tabulated results are in harmony with the analogous ones mentioned by **Jawaharlal *et al.*, (1991), Salama (1998), Sunil *et al.*, (2002) Bakry and Ismaeil (2002) and Hafiz *et al.*, (2005).**

Table (14): dry weight of vegetative growth and root and Top / root ratio of papaya seedlings cv. Solo as affected by treating the seeds with gamma rays during 2008 and 2009 seasons

Treatments	Leaf dry weight (gm)		Root dry weight (gm)		top / root ratio	
	2008	2009	2008	2009	2008	2009
Seeds soaking in tap water " Control "	4.77 A	5.88 A	4.43 A	4.77 A	1.076 B	1.232 A
Seeds soaking in tap water + 10 k. rad	3.93 C	4.24 C	3.29 C	3.84 C	1.194 A	1.104 AB
Seeds soaking in tap water + 20 k. rad	4.16 BC	4.37 BC	3.81 BC	4.15 BC	1.091 AB	1.053 C
Seeds soaking in tap water + 40 k. rad	4.39 B	4.71 B	4.05 B	4.45 B	1.083 C	1.053 B

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.C.1.Effect of treating (Solo) papaya seeds with gamma irradiation at various doses on seedling mineral content:

I.C.1.1.Effect on leaf and root nitrogen content:

It is clear from **Table (15)** that in both seasons, water – soaked seeds and treated with different of gamma rays had higher value of leaf nitrogen content as compared with untreated seeds " control " .

Shortly, water – soaked seeds and treated with gamma rays at (40 k. rad) gave the highest value of leaf nitrogen content (1.185 and 1.195).

As for, water – soaked seeds and treated with different doses of gamma rays had higher value of root nitrogen content as compared with untreated seeds "control".

Shortly, water – soaked seeds and treated with gamma rays at (40 k . rad) gave the highest value of root nitrogen content (1.139 and 1.160) during the first and second season ,respectively .

Table (15) : Leaf and root nitrogen content (%) of papaya seedlings cv . Solo as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Leaf nitrogen content (%)		Root nitrogen content (%)	
	2008	2009	2008	2009
Seeds soaking in tap water "control"	1.150 D	1.165 D	1.100 C	1.120 C
Seeds soaking in tap water +10 k.rad	1.168 C	1.170 C	1.115 B	1.135 B
Seeds soaking in tap water +20 k.rad	1.175 B	1.182 B	1.127 AB	1.143 AB
Seeds soaking in tap water +40 k.rad	1.185 A	1.195 A	1.139 A	1.160 A

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.C.1.2. Effect on leaf and root phosphorus content:

It is obvious from **Table (16)** that in both seasons , water – soaked seeds and treated with different doses of gamma rays had higher value of leaf phosphorus content as compared with untreated seeds " control " .

Shortly, water – soaked seeds and treated with gamma rays at (40 k. rad) gave the highest value of leaf phosphorus content (0.215 and 0.221).

As for , water – soaked seeds and treated with different doses of gamma rays had higher value of root phosphorus content as compared with untreated seeds " control " .

Briefly, water – soaked seeds and treated with gamma rays at (40 k. rad) gave the highest value of root phosphorus content

(0.204 and 0.208) during the first and second season, respectively.

Table (16) : Leaf and root phosphorus content (%) of papaya seedlings cv . Solo as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Leaf phosphorus content (%)		Root phosphorus content (%)	
	2008	2009	2008	2009
Seeds soaking in tap water "control"	0.195 BC	0.200 BC	0.178 D	0.185 D
Seeds soaking in tap water +10 k.rad	0.200 B	0.208 B	0.180 C	0.191 C
Seeds soaking in tap water +20 k.rad	0.205 AB	0.218 AB	0.195 B	0.200 B
Seeds soaking in tap water +40 k.rad	0.215 A	0.221 A	0.204 A	0.208 A

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.C.1.3.Effect on leaf and root potassium content:

It is clear from **Table (17)** that in both seasons , water – soaked seeds and treated with different doses of gamma rays had higher value of leaf potassium content as compared with untreated seeds " control " .

Shortly, water – soaked seeds and treated with gamma rays at (40 k. rad) gave the highest value of leaf potassium content (1.198 and 1.200).

As for , water – soaked seeds and treated with different doses of gamma rays had higher value of root potassium content as compared with untreated seeds " control " Briefly , water – soaked seeds and treated with gamma rays at (40 k. rad) gave the highest value of root potassium content (1.176 and1.190). during the first and second season , respectively .

Table (17) : Leaf and root potassium content (%) of papaya seedlings cv . Solo as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Leaf potassium content (%)		Root potassium content (%)	
	2008	2009	2008	2009
Seeds soaking in tap water "control"	1.170 D	1.185 D	1.050 C	1.100 C
Seeds soaking in tap water +10 k.rad	1.180 C	1.188 C	1.100 B	1.140 B
Seeds soaking in tap water +20 k.rad	1.187 B	1.194 B	1.150 AB	1.162A B
Seeds soaking in tap water +40 k.rad	1.198 A	1.200 A	1.176 A	1.190 A

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.C.1.4.Effect on leaf and root iron content:

It is clear from **Table (18)** that, in both seasons water – soaked seeds and treated with different of gamma rays had higher value of leaf iron content as compared with untreated seeds "control".

Shortly, water – soaked seeds and treated with gamma rays at (40 k. rad) gave the highest value of leaf iron content (85. 90and 90.00)

As for , water – soaked seeds and treated with different doses of gamma rays had higher value of root iron content as compared with untreated seeds " control " .

Shortly, water – soaked seeds , and treated with gamma rays at (40 k. rad) gave the highest value of root iron content (68.80 and 72.30) during the first and second season, respectively.

Table (18) : Leaf and root iron content (ppm) of papaya seedlings cv . Solo as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Leaf iron content (ppm)		Root iron content (ppm)	
	2008	2009	2008	2009
Seeds soaking in tap water "control"	79.10C	85.60C	58.90d	65.40D
Seeds soaking in tap water +10 k.rad	80.10BC	86.50BC	65.50C	66.80C
Seeds soaking in tap water +20 k.rad	82.00AB	88.70AB	67.40AB	69.10B
Seeds soaking in tap water +40 k.rad	85.90A	90.00A	68.80A	72.30A

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.C.1.5.Effect on leaf and root zinc content:

It is obvious from **Table (19)** that in both seasons water – soaked seeds and treated with different doses of gamma rays had higher value of leaf zinc content as compared with untreated seeds "control".

Shortly, water – soaked seeds and treated with gamma rays at (40 k. rad) gave the highest value of leaf zinc content (20.40 and 22.00).

As for , water – soaked seeds and treated with different doses of gamma rays had higher value of root zinc content as compared with untreated seeds " control Briefly , water – soaked seeds and treated with gamma rays at (40 k . rad) gave the highest value of root zinc content

(17.30 and 19.70) during the first and second season, respectively.

Table (19) : Leaf and root zinc content (ppm) of papaya seedlings cv . Solo as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Leaf zinc content (ppm)		Root zinc content (ppm)	
	2008	2009	2008	2009
Seeds soaking in tap water "control"	14.50D	15.70D	12.80 C	14.80 C
Seeds soaking in tap water +10 k.rad	16.50 C	18.00 C	13.50 B	16.00 B
Seeds soaking in tap water +20 k.rad	18.90 B	20.50 B	16.00 AB	18.20 AB
Seeds soaking in tap water +40 k.rad	20.40A	22.00 A	17.30 A	19.70 A

Means followed by the same letter (S)within each column are not significantly different at 5% level.

I.C.1.6.Effect on leaf and root manganese content:

It is clear from **Table (20)** that, in both seasons water – soaked seeds and treated with different doses of gamma rays had higher value of leaf manganese content as compared with untreated seeds "control".

Shortly, water – soaked seeds , and treated with gamma rays at

(40 k. rad) gave the highest value of leaf manganese content (30.50 and 32.00).

As for, water – soaked seeds and treated with different doses of gamma rays had higher value of root manganese content as compared with untreated seeds "control"

Briefly, water – soaked seeds and treated with gamma rays at (40 k. rad) gave the highest value of root manganese content (23.10and 24.50) during the first and second season, respectively.

These results are coincided with those mentioned earlier by **El-Azzoni *et al.*, (1970), Rennie and Nelson (1975), Zham yansuren and Voloozh (1976), Ragab (1979), Tikhonov *et al.*, (1980), Meawad (1981), El-Shafie *et al.*, (1987), Korosi, Mohamed *et al.*,, (1988, a & b) Mohamed (1989) Hussein *et al.*, (1995), EI-Essawy (1995), Orabi, (1997 and 1998), Maghraby (1997), Hassanein *et* al., (1998), Taha (2000) and Mohamed *et* al., (2000).**

Table (20) : Leaf and root manganese content (ppm) of papaya seedlings cv . Solo as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Leaf manganese content (ppm)		Root manganese content (ppm)	
	2008	2009	2008	2009
Seeds soaking in tap water "control"	20.90 C	21.20 C	17.00 D	18.90 D
Seeds soaking in tap water +10 k.rad	25.20 B	27.60 B	18.50 C	20.00 C
Seeds soaking in tap water +20 k.rad	27.00 AB	29.10 AB	20.40 B	21.80 B
Seeds soaking in tap water +40 k.rad	30.50 A	32 .00 A	23.10 A	24.50 A

Means followed by the same letter (S)within each column are not significantly different at 5% level.

II.A.1. Effect of soaking (betty) papaya seeds in some chemical substances at different concentrations on germination parameters.

II.A.1.1.Germination percentage:

It is obvious from **Table (21)** that, in both seasons , all tested treatments namely gibberellic acid " GA_3 ", yeast extract , naphthalene acetic acid " NAA " caused highly significant increase in germination percentage as compared with (Colchicine) ", EMS " and untreated seeds." control ".

Generally , seeds soaking in 100 ppm " GA_3 " induced the highest germination percentage (83.33 and 85.33 %) followed by seeds soaking in 50 ml /L " yeast extract " (80.67 and 84.00 %) and 25 ppm " NAA " (80.00 and 82.00%) . On the other hand , untreated seeds " control " caused the lowest germination percentage (54.67 and 58.00 %),0.2% " EMS " (56.67and 58.67 %) and 40 mg / L " Colchicine (56.67 and 60.00) during the first and second season ,respectively.

II.A.1.2.Germination rate:

It is clear from **Table (21)** that in both seasons , all tested treatments i.e., " GA_3 ", " yeast extract " and " NAA" resulted in higher rates of germination as compared with " Colchicine " , " EMS " and untreated seeds " Control " . The highest germination rates were obtained when seeds were soaked in 100 ppm " GA_3" (4.167 and 4.267) , 50 mLl/L " yeast extract " (4.033 and 4.200) and 25 ppm " NAA " (4.000 and 4.100) as compared with and untreated seeds (control) (2.733 and 2.900), 0.2% "EMS"(2.833

Table (21) : Germination percentage and rate of papaya seeds cv. Betty as affected by soaking in some chemical solutions during 2008 and 2009 seasons.

Treatments	Germination %		Germination rate	
	2008	2009	2008	2009
Seeds soaking in tap water " Control "	54.67 D	58.00 C	2.733 G	2.900 H
Seeds soaking in " GA_3 " at 50 ppm	75.33 BC	82.00 AB	3.933 BCD	4.100 ABC
Seeds soaking in " GA_3 " at 100 ppm	83.33 A	85.33 A	4.167 A	4.267 A
Seeds soaking in " GA_3" at 150 ppm	76.67 BC	80.67 AB	3.833 CDE	4.033 BCD
Seeds soaking in " NAA " at 25 ppm	80.00 ABC	82.00 AB	4.000 ABC	4.100 ABC
Seeds soaking in " NAA " at 50 ppm	76.00 BC	80.00 AB	3.800 DE	4.000 CDE
Seeds soaking in " NAA " at 75 ppm	74.00 C	76.67 B	3.700 E	3.833 E
Seeds soaking in yeast extract at 50 ml/l	80.67 AB	84.00 A	4.033 AB	4.200 AB
Seeds soaking in yeast extract at 100 ml/l	76.67 BC	80.67 AB	3.833 CDE	4.033 BCD
Seeds soaking in yeast extract at 150 ml/l	75.33 BC	78.00 B	3.767 DE	3.900 DE
Seeds soaking in Colchicine at 20 mg/l	58.00 D	60.67 C	2.900 FG	3.033 FGH
Seeds soaking in Colchicine at 30 mg/l	60.00 D	62.67 C	3.000 F	3.133 F
Seeds soaking in Colchicine at 40 mg/l	56.67 D	60.00 C	2.833 FG	3.000 FGH
Seeds soaking in " EMS " at 0.2 %	56.67 D	58.67 C	2.833 FG	2.933 GH
Seeds soaking in " EMS " at 0.3 %	56.00 D	60.00 C	2.800 FG	3.000 FGH
Seeds soaking in " EMS " at 0.4 %	58.67 D	62.00 C	2.933 FG	3.100 FG

Means followed by the same letter (S)within each column are not significantly different at 5% level.

and 2.933)and 40mg/L" Colchicine "(2.833 and 3.000) during the first and second season , respectively.

The obtained results of gibberellic acid are in harmony with earlier reports of **Chacko and Singh (1966), Eshuys (1975), Salazar and Perez (1976), Sen and Ghunti (1976), Yahiro and Oryoji (1980), Choudhari and Chakrawar (1981), Asare (1984), Xu and Gu (1984), Nagao and Furutani (1986), Furutani and Nagao (1987), Palanisamy and Ramamoorthy (1987), Begum *et al.,* (1988), Ram and Govind (1990), Sen *et al* ., (1990), Gupta (1992), Bertocci *et al.,* (1997), Ananthakalaiselvi and Dharmalingam (1998), Salama (1998), Zhao *et al.,* (2004), Gunes and Gubbuk (2006), Yogeesha *et al.,* (2007) and Andrade *et al.,* (2008).**

The obtained results of naphthalene acetic acid are coincided with earlier reports of **Chiesotsu *et al* ., (1995), Prakash (1998), Salama (1998), Kalalbandi *et al* ., (2003) and Shinde *et al* ., (2008).**

The obtained results of yeast extract are in agreement with the findings of **Ismaeil and Bakry (2005).**

The obtained results of colchicine are in harmony with earlier reports of **Bakry and Ismaeil (2002) and Jaskani *et al.,* (2004).**

Finally, the recorded results of ethyl methane sulphonate (EMS) in this respect are in agreement with the findings of **Bakry and Ismaeil (2002) and Padma and Chauhan [(2005).**

II.A.2.Effect of soaking (Betty) papaya seeds in some chemical substances at different concentration on some growth measurements.

Table (22, 23 and 24) shows the effect of seeds soaking in some chemical solutions on some growth measurements of emerged papaya seedlings during 2008 and 2009 seasons.

II.A.2.1.Seedling height (cm):

It is obvious from **Table (22)** that, in both seasons , seedlings arised from 100 ppm " GA_3 " had the tallest seedlings (67.60 and 71.95 cm) , followed by 50 ml/L " yeast extract " (66.73 and 70.67 cm) and 50 ppm " GA_3 " (64.77 and 66.65 cm).

On the contrary, seedlings arised from and 20 mg/L " Colchicine " had the shortest seedlings (41.33 and 42.30 cm),followed. by 0.2 % " EMS" (42.00 and 42.33 cm) and untreated seeds " control "(52.60 and 53.90 cm) , during the first and second season ,respectively.

II.A.2.2. Root length (cm):

It is obvious from **Table (22)** that in 2008 and 2009 seasons , seeds soaked in " GA_3 ", yeast extract " and " NAA " induced the highest length of root as compared with seeds soaked in "EMS" "Colchicine " and untreated seeds " Control " .

Generally , seeds soaked in 100 ppm " GA_3 " produced seedlings with the highest length of root (19.47 and 20.93 cm) followed by 50 ml /L " yeast extract " (18.37 and19.10 cm) and 25 ppm " NAA " (16.77and 17.63 cm) .

Table (22) : Seedling height, root length and number of leaves per seedling of papaya cv. Betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Seedling neight (cm)		Root length (cm)		Number of leaves per seedling	
	2008	2009	2008	2009	2008	2009
Seeds soaking in tap water " Control "	52.60 E	53.90 F	13.50 GHI	14.40 FGH	13.87 F	14.33 DE
Seeds soaking in " GA_3 " at 50 ppm	64.77 B	66.65 BC	15.00 DEF	16.10 D	15.33 BC	15.33 C
Seeds soaking in " GA_3 " at 100 ppm	67.60 A	71.95 A	19.47 A	20.93 A	16.67 A	17.67 A
Seeds soaking in " GA_3" at 150 ppm	64.23 BC	64.57 CD	15.87 CD	16.03 DE	16.00 AB	16.33 AB
Seeds soaking in " NAA " at 25 ppm	62.50 CD	62.93 DE	16.77 C	17.63 C	14.67 CDE	15.67 BC
Seeds soaking in " NAA " at 50 ppm	61.37 D	61.60 E	14.97 DEF	15.37 DEF	14.67 CDE	15.00 CD
Seeds soaking in " NAA " at 75 ppm	60.80 D	61.80 E	13.73 GHI	14.57 FG	14.33 DEF	14.33 DE
Seeds soaking in yeast extract at 50 ml/l	66.73 A	70.67 A	18.37 B	19.10 B	16.33 A	17.00 A
Seeds soaking in yeast extract at 100 ml/l	63.87 BC	67.87 B	15.47 DE	15.70 DEF	15.33 BC	15.33 C
Seeds soaking in yeast extract at 150 ml/l	63.43 BC	65.47 BC	14.43 FFG	14.87DEFG	14.67 CDE	15.00 CD
Seeds soaking in Colchicine at 20 mg/l	41.33 H	42.30 H	13.73 GHI	13.80 GH	13.67 F	13.67 E
Seeds soaking in Colchicine at 30 mg/l	42.37 GH	44.33 GH	14.10 FGH	15.07DEFG	14.67 C	15.00 CD
Seeds soaking in Colchicine at 40 mg/l	41.10 H	42.47 H	13.00I	13.20 H	14.00 EF	14.33 DE
Seeds soaking in " EMS " at 0.2 %	42.00 GH	42.33 H	13.20 HI	14.47 FG	14.33 DEF	14.33 DE
Seeds soaking in " EMS " at 0.3 %	43.73 FG	44.13 H	13.67 GHI	14.73 EFG	13.67 F	14.00 E
Seeds soaking in " EMS " at 0.4 %	45.43 F	46.63 G	14.83 DEF	16.03 DE	15.00 CD	15.00 CD

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

On the other hand , seeds soaked in 40mg/L " Colcicine " gave seedlings with the lowest length of root (13.00 and 13.20),0.2%" EMS " (13.20 and 14.47) and untreated seeds (control) (13.50 and 14.40 cm) . during the first and second season ,respectively

II.A.2.3. Number of leaves per seedling:

It is clear from **Table (22)** that in both seasons , the highest number of leaves were obtained from 100 ppm " GA_3 "(16.67and 17.67) , 50 mL/L " yeast extract " (16.33 and 17.00) , and 150 ppm " GA_3 " (16.00 and 16.33) .

On the contrary , the lowest number of leaves per seedling were obtained from 20 mg / L " colchicine " gave (13.67 and 13.67), 0.3% "EMS" and untreated seeds (13.87 and 14.00). control (13.87 and 14.33) during the first and second season , respectively.

II.A.2.4.Fresh weight of vegetative growth (gm):

It is obvious from **Table (23)** that in both seasons, the highest fresh weight of vegetative growth were obtained from 100 ppm" GA_3 " (44.41 and 46.87 gm), followed by 50 ml/L "yeast extract" (43.71 and 45.39 gm.) and 50 ppm " NAA "(42.70 and 43.41 gm.).

On the other hand , the lowest fresh weight of vegetative growth were obtained from 0.2 % " EMS " (17.71 and 18.97 gm), 20 mg / L "Colchicine " (18.94 and 19.13 gm) and untreated seeds (control) (23.70 and24.58 gm.) during the first and second season ,respectively .

Table (23) : Fresh weight of vegetative growth and Root of papaya seedlings cv. Betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Fresh weight of vegetative growth (gm)		Root fresh weight (gm)	
	2008	2009	2008	2009
Seeds soaking in tap water " Control "	23.70E	24.58F	9.53F	10.34F
Seeds soaking in " GA_3 " at 50 ppm	41.79AB	44.75AB	14.71BC	14.72CD
Seeds soaking in " GA_3 " at 100 ppm	44.41A	46.87A	17.98A	18.40A
Seeds soaking in " GA_3" at 150 ppm	40.60B	41.64CD	16.11AB	16.43BC
Seeds soaking in " NAA " at 25 ppm	42.70AB	43.41BC	13.74CD	14.82CD
Seeds soaking in " NAA " at 50 ppm	38.87CD	39.16DE	12.59DE	13.77DE
Seeds soaking in " NAA " at 75 ppm	36.92D	38.32E	11.72E	12.65E
Seeds soaking in yeast extract at 50 ml/l	43.71A	45.39AB	16.69A	17.34AB
Seeds soaking in yeast extract at 100 ml/l	42.01AB	43.69BC	13.48CDE	14.20DE
Seeds soaking in yeast extract at 150 ml/l	39.84BC	40.59DE	13.01CDE	14.72CD
Seeds soaking in Colchicine at 20 mg/l	18.94G	19.13I	7.88FG	8.46FG
Seeds soaking in Colchicine at 30 mg/l	21.99EF	23.19FG	8.55FG	9.52FG
Seeds soaking in Colchicine at 40 mg/l	19.71FG	20.99GHI	8.33FG	8.34FG
Seeds soaking in " EMS " at 0.2 %	17.71G	18.97I	7.13G	7.72G
Seeds soaking in " EMS " at 0.3 %	18.91G	19.46HI	7.93FG	8.71FG
Seeds soaking in " EMS " at 0.4 %	20.30FG	22.10FGH	8.49G	9.23FG

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

II.A.2.5. Fresh weight of root system(gm):

It is clear from **Table (23)** that in both seasons , the highest fresh weight of root system were obtained from 100 ppm " GA_3 " (17.98 and 18.40 gm) , 50 ml/L " yeast extract " (16.69 and 17.34 gm.) and 150ppm " GA_3 " (16.11and 16.43 gm) .

On the other hand , the lowest fresh weight of root system were obtained from 0.2 % " EMS " (7.13and 7.72 gm), 20 mg/L "Colchincine " (7.88 and 8.46 gm) and untreated seeds " control " (9.53 and 10.34 gm) during the first and second season , respectively

II.A.2.6.Dry weight of vegetative growth (gm):

It is obvious from **Table (24)** that, in both seasons , seeds soaked in 100 ppm " increased dry weight of vegetative growth (7.41and 8.36 gm.) followed by 50 ml / L " yeast extract " (6.58 and 7.72 gm .) and 50 ppm " GA_3 " (6.00 and 7.53 gm .) .

On the contrary, seeds soaked in 0.2 % " EMS " decreased dry weight of vegetative growth (4.18 and 4.90 gm),0.3% "EMS" (4.35 and 5.11) and 20mg/ L "Colchicine" (4.54 and 7.87) during the first and second season ,respectively .

II.A.2.7. Dry weight of root system (gm):

It is clear from **Table (24)** that in both seasons , seeds soaked in 100 ppm " GA_3 " increased dry weight of root system (6.96 and 7.33 gm), followed by 50 mL/L " yeast extract " (6.53and 7.06 gm) and 150 ppm " GA_3 " (5.79 and 6.57 gm .) .

Table (24) : Dry weight of vegetative growth and Root and Top / root ratio of papaya seedlings cv. Betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Dry weight of vegetative growth (gm)		Root dry weight (gm)		Top / root ratio	
	2008	2009	2008	2009	2008	2009
Seeds soaking in tap water " Control "	5.00EFGH	5.57E	4.57 DE	4.71 FG	1.094 D	1.182 B
Seeds soaking in " GA_3 " at 50 ppm	6.00BC	7.53B	4.99 CD	6.33 BC	1.202 A	1.189 AB
Seeds soaking in " GA_3 " at 100 ppm	7.41A	8.36A	6.96 A	7.33 A	1.064 E	1.140 DE
Seeds soaking in " GA_3" at 150 ppm	5.52CDEF	6.92CD	5.79 B	6.57 ABC	1.048 EF	1.053 G
Seeds soaking in " NAA " at 25 ppm	5.72CD	6.70CD	5.33 BC	6.51 BC	1.073 DE	1.029 GH
Seeds soaking in " NAA " at 50 ppm	5.47CDEF	6.38D	5.00 CD	5.51 DE	1.094 D	1.157 D
Seeds soaking in " NAA " at 75 ppm	4.77GHI	6.36D	4.92 CD	5.11 EF	0.9695 I	1.093 F
Seeds soaking in yeast extract at 50 ml/l	6.58B	7.72BC	6.53 A	7.06 AB	1.007 G	1.093 F
Seeds soaking in yeast extract at 100 ml/l	5.61CDE	6.81CD	5.70 B	6.80 ABC	0.9842 H	1.001 H
Seeds soaking in yeast extract at 150 ml/l	5.18DEFG	6.44D	5.32 BC	6.02 CD	1.027 F	0.9347I
Seeds soaking in Colchicine at 20 mg/l	4.54GHI	4.87FG	3.94 FG	4.16 G	1.152 C	1.170 C
Seeds soaking in Colchicine at 30 mg/l	4.90FGH	5.17EFG	4.25 EF	4.43 FG	1.152 C	1.167 CD
Seeds soaking in Colchicine at 40 mg/l	4.43HI	4.76G	3.65 FG	4.39 FG	1.213 AB	1.084 G
Seeds soaking in " EMS " at 0.2 %	4.18I	4.90FG	3.52 G	4.20 FG	1.187 B	1.166 CD
Seeds soaking in " EMS " at 0.3 %	4.35HI	5.11EFG	3.84 FG	4.53 FG	1.132 CD	1.128 A
Seeds soaking in " EMS " at 0.4 %	4.62GHI	5.43EF	4.00 EFG	4.36 FG	1.155 BC	1.245 A

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

On the other hand , seeds soaked in 0.2 % " EMS " decreased dry weight of root system (3.52 and 4.20gm) , 40 mg / L " Colchicine " (3.65 and 4.39 gm) during the first and second season ,respectively .

II.A.2.8. Top / root ratio of dry weight:

It is obvious from **Table (24)** that in both seasons, the highest top / root ratio of dry weight was obtained from 50 ppm "GA3" (1.202, 1.189).

The gained results of gibberellic acid in this respect go in line with findings of **Guha and Chaturvedi (1972), Sen and Ghunti (1976), Sen *et al.*, (1990), Salama (1998), Pandit *et al.*, (2001), Zhao *et al.*, (2004), Andrade *et al.*, (2008) and Rajesh *et al.*,(2008)**.

The obtained results of naphthalene acetic acid (NAA) are in agreement with the findings of **Kalabandi *et al.*, (2003)**.

The recorded results of yeast extract are in agreement with the findings of **Ahmed *et al.*, (1998), Mostafa (2004) and Ismaeil and Bakry (2005).**

The obtained results of colchicine are coincided with earlier reports of **Jaskani *et al.*, (2004).**

The obtained results of ethyl methane sulphonate (EMS) are in harmony with earlier reports of **Jawaharlal *et al.*, (1991), Konzak (1993), Patra *et al.*,(1998), Bakry and Ismaeil (2002), Nusrat and Mirza (2002)** and **Padma and Chauhan (2005)**.

II.A.3. Effect of soaking (Betty) papaya seeds in some chemical substances at different concentrations on seedling mineral content.

II.A.3.1.Effect on leaf and root nitrogen content:

Table (25) shows leaf and root nitrogen content (%) of papaya seedlings cv. Betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

It is obvious from **Table (25)** that in both seasons the highest value of leaf nitrogen content were obtained from 100 ppm " GA_3 " (1.750 and 1.850) followed by 50 ml / L " yeast extract " (1.700 and 1.803) and 25 ppm " NAA " (1.650 and 1.700).

On the other hand , the lowest value of leaf nitrogen content were obtained from untreated seeds " control " (1.130 and 1.145), 40 mg/ L " Colchicine " (1150 and 1.200) 0.3 % " EMS " (1.180 and 1.230).

As for the highest value of root nitrogen content were obtained from 100 ppm " GA_3 " (1.450 and 1.550) , followed by 50 ml/L " yeast extract " (1.400 and 1.480) , and 25 ppm " NAA" (1.380and 1.450) .

On the contrary , the lowest value of root nitrogen content were obtained from untreated seeds " control " (1.050 and 1.100) , 0.3 % "EMS " (1.100 and 1.150) and 40 mg / L " Colchicine (1.150 and 1.170 during the first and second season ,respectively.

Table (25) : Leaf and root nitrogen content (%) of papaya seedlings cv. Betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Leaf nitrogen content (%)		Root nitrogen content (%)	
	2008	2009	2008	2009
Seeds soaking in tap water "control "	1.130 IJ	1.145 J	1.050 H	1.100 I
Seeds soaking in "GA_3" at 50 ppm	1.550 DE	1.600 E	1.300 DE	1.400 D
Seeds soaking in "GA_3" at100 ppm	1.750 A	1.850 A	1.450 A	1.550 A
Seeds soaking in "GA_3" at150 ppm	1.600 CD	1.630 DE	1.340 CD	1.390 DE
Seeds soaking in "NAA" at 25 ppm	1.650 BC	1.700 C	1.380 ABC	1.450 C
Seeds soaking in "NAA" at 50 ppm	1.450 EF	1.550 E	1290 E	1.330 E
Seeds soaking in "NAA" at 75 ppm	1.500 E	1.598 E	1.330 CDE	1.370 EF
Seeds soaking in "yeast extract" at 50 ml/l	1.700 AB	1.803 B	1.400 AB	1.480 B
Seeds soaking in "yeast extract" at100 ml/l	1.610 BCD	1.660 CD	1.370 ABCD	1.400 D
Seeds soaking in "yeast extract" at 150 ml/l	1.560 D	1.650 CDE	1.350 BCD	1.380 DEF
Seeds soaking in "Colchicine" at 20 mg/l	1.200 GH	1.280 F-I	1.180 FG	1200 F-I
Seeds soaking in Colchicine" at 30 mg/l	1.300 F	1.350 FG	1.250 EF	1.290 FG
Seeds soaking in "Colchicine" at 40 mg/l	1.150 HIJ	1.200 I	1.150 FGH	1.170 GHI
Seeds soaking in "EMS"at 0.2 %	1.208 G	1.250 GHI	1.150 FGH	1.200 F-I
Seeds soaking in 'EMS" at 0.3 %	1.180 HI	1.230 HI	1.100 GH	1.150 HI
Seeds soaking in "EMS" at 0.4 %	1.250 FG	1.300 FGH	1.200 EFG	1.250 FGH

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

II.A.3.2. Effect on leaf and root phosphorus content:

Table (26) shows leaf and root phosphorus content (% of papaya seedlings cv. Betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

It is obvious from **Table (26)** that, in both seasons 100 ppm " GA_3" (0.350 and 0.360) followed by 50 ml/L " yeast extract " (0.346 and 0.358) and 25 ppm " NAA " (0.338 and 0.355) .

On the other hand , the lowest value of leaf phosphorus content was obtained from untreated seeds " control " (0.180 and 0.190) , 0.3 % " EMS " (0.205 and 0.210) and 40 mg/L " Colchicine " (0.217and 0.220)

As for the highest value of root phosphorus content was. obtained from 100 ppm " GA_3 " (0.280 and 0.285) , followed by 50 ml /L " yeast extract " (0.269and 0.275) and 25 ppm " NAA " (0.256 and 0.265) .

On the other hand , the lowest value of root phosphorus content was obtained from untreated seeds " control " (1.162 and 1.170), 0.3 % "EMS " (1.168 and 1.170) and 40 mg/L " Colchicine " (1.170 and 1.175) during the first and second season ,respectively.

Table (26) : Leaf and root phosphorus content (%) of papaya seedlings cv . betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Leaf phosphorus content (%)		Root phosphorus content (%)	
	2008	2009	2008	2009
Seeds soaking in tap water "control "	0.180 H	0.190 K	0.162 J	0.170 G
Seeds soaking in "GA_3" at 50 ppm	0.336 C	0.342 DEF	0.245 DE	0.250 CD
Seeds soaking in "GA_3" at100 ppm	0.350 A	0.360 A	0.280 A	0.285 A
Seeds soaking in "GA_3" at150 ppm	0.340 ABC	0.350 D	0.240 E	0.251 CD
Seeds soaking in "NAA" at 25 ppm	0.338 BC	0.355 C	0.256 C	0.265 B
Seeds soaking in "NAA" at 50 ppm	0.320 E	0.325 G	0.240 E	0.244 D
Seeds soaking in "NAA" at 75 ppm	0.325 DE	0.330 F	0.232 F	0.235 DE
Seeds soaking in "yeast extract" at 50 ml/l	0.346 AB	0.358 B	0.269 B	0.275 AB
Seeds soaking in "yeast extract" at100 ml/l	0.332 CD	0.345 DE	0.248 CDE	0.255 C
Seeds soaking in "yeast extract" at 150 ml/l	0.328 D	0.338 EF	0.252 CD	0.261 BC
Seeds soaking in "colchicine" at 20 mg/l	0.220 FG	0.225 HI	0.175 HI	0.180 EF
Seeds soaking in colchicine" at 30 mg/l	0.234 EF	0.237 GH	0.180G	0.185 E
Seeds soaking in "colchicine" at 40 mg/l	0.217 FGH	0.220 I	0.170 HIJ	0.175F`
Seeds soaking in "EMS"at 0.2 %	0.215 FGH	0.218 I J	0.176 HI	0.179 EF
Seeds soaking in 'EMS" at 0.3 %	0.205 GH	0.210J	0.168 I J	0.170 G
Seeds soaking in "EMS" at 0.4 %	0.228 F	0.234 GHI	0.178 H	0.183 EF

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

II.A.3.3. Effect on leaf and root potassium content:

Table (27) shows leaf and root potassium content (%) of papaya seedlings cv. Betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons .

It is clear from **Table (27)** that, in both seasons , the highest value of leaf potassium content was obtained from 100 ppm " GA_3 " (1.640 and1.680) followed by 50 ml / L " yeast extract " (1.520 and1.550) and 25 ppm " NAA " (1.500 and 1.530) .

On the other hand , the lowest value of leaf potassium content was obtained from untreated seeds " control " (1.160 and 1.177) . 0.3 % "EMS" (1.180 and 1.185) and 40 mg/L " Colchicine " (1.177 and 1.187).

As for the highest value of root potassium content was obtained from 100 ppm " GA_3 " (1.410and 1.450) followed by 50 ml/L " yeast extract " (1.350and 1.380) and 25 ppm " NAA " (1.330 and 1.360) .

On the contrary , the lowest value of root potassium content was obtained from untreated seeds " control " (1.000 and 1.070) 0.3 % "EMS" (1.050 , 1.087) and 40 mg/L " Colchicine " (1.087and 1.100) during the first and second season, respectively.

Table (27) : Leaf and root Potassium content (%) of papaya seedlings cv . Betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Leaf potassium content (%)		Root potassium content (%)	
	2008	2009	2008	2009
Seeds soaking in tap water "control "	1.160 I	1.177 K	1.000 J	1.070 I
Seeds soaking in "GA_3" at 50 ppm	1.410 CDE	1.433 EF	1.313 CD	1.340 C
Seeds soaking in "GA_3" at100 ppm	1.640 A	1.680 A	1.410 A	1.450 A
Seeds soaking in "GA_3" at150 ppm	1.450 C	1.500 D	1.310 CD	1.330 CD
Seeds soaking in "NAA" at 25 ppm	1.500 B	1.530 C	1.330 BC	1.360 ABC
Seeds soaking in "NAA" at 50 ppm	1.400 DE	1.450 DEF	1.210DE	1.245 DE
Seeds soaking in "NAA" at 75 ppm	1.354 EF	1.400 FG	1.200 E	1.220 E
Seeds soaking in "yeast extract" at 50 ml/l	1.520 AB	1.550 B	1.350 B	1.380 AB
Seeds soaking in "yeast extract" at100 ml/l	1.430 CD	1.480 DE	1.320 C	1.350 BC
Seeds soaking in "yeast extract" at 150 ml/l	1.380 E	1.410 F	1.280 D	1.300 D
Seeds soaking in "Colchicine" at 20 mg/l	1.180 GH	1.190 H	1.110 GH	1.140 GH
Seeds soaking in Colchicine" at 30 mg/l	1.200 EFG	1.215 G	1.150 F	1.187 F
Seeds soaking in "Colchicine" at 40 mg/l	1.177 H	1.187 I	1.087 HI	1.100 H
Seeds soaking in "EMS"at 0.2 %	1.180 GH	1.185 J	1.100 H	1.150 G
Seeds soaking in 'EMS" at 0.3 %	1.185 G	1.199 GH	1.050 I	1.087 HI
Seeds soaking in "EMS" at 0.4 %	1.190 FG	1.200 GH	1.130 G	1.160 FG

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

II.A.3.4. Effect on leaf and root iron content:

Table (28) shows leaf and root nitrogen content (ppm) of papaya seedlings cv. Betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

It is obvious from **Table (28)** that, in both seasons , the highest value of leaf iron content were obtained from 100 ppm " GA_3 " (113.5and117.1) followed by 50 ml / L " yeast extract "(112.2and116.2) and 25 ppm " NAA " (110.8 and 115.7)

On the other hand , the lowest value of leaf iron content were obtained from untreated seeds " control " (75.80and 81.80) 0.2 % " "EMS" (80.50 and 87.20).and 40 mg/ L " colchicine " (82.00and89.30).

As for the highest value of root iron content were obtained from 100 ppm " GA_3 " (94.80 and 102.50) , followed by 50 ml/L " yeast extract " (93.80and 101.20) , and 25 ppm " NAA" (92.60and 100.90).

On the contrary , the lowest value of root iron content were obtained from untreated seeds " control " (51.80and 60.40), 0.2 % " EMS " (72.80 and 76.40) and 20 mg / L " colchicine (73.50 and 80.00) during the first and second season, respectively.

Table (28) : Leaf and root iron content (ppm) of papaya seedlings cv . betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Leaf iron content (ppm)		Root iron content (ppm)	
	2008	2009	2008	2009
Seeds soaking in tap water "control "	75.80 L	81.80 K	51.80J	60.40 O
Seeds soaking in "GA_3" at 50 ppm	108.7 D	112.50 E	90.10 DE	95.30 H
Seeds soaking in "GA_3" at100 ppm	113.50 A	117.1 A	94.80 A	102.50 A
Seeds soaking in "GA_3" at150 ppm	109.4 CD	114.6 D	91.50 CD	98.10 D
Seeds soaking in "NAA" at 25 ppm	110.8 B	115.7 BC	92.60 B	100.90 B
Seeds soaking in "NAA" at 50 ppm	105.3 F	112 .2 EF	90.00 E	98.00 E
Seeds soaking in "NAA" at 75 ppm	107.8 DE	113.5 DE	88.50 F	95.40 G
Seeds soaking in "yeast extract" at 50 ml/l	112.2 AB	116.2 ABC	93.80AB	101.20 AB
Seeds soaking in "yeast extract" at100 ml/l	107.6 E	114.7 CD	91.30 D	98.70 C
Seeds soaking in "yeast extract" at 150 ml/l	110.4 BCD	115.5 C	92.00 C	96.10 F
Seeds soaking in "Colchicine" at 20 mg/l	84.10 I	91.20 H	73.50 I J	80.00 K
Seeds soaking in Colchicine" at 30 mg/l	87.40 G	94.60 F	81.90 G	84.50 I
Seeds soaking in "Colchicine" at 40 mg/l	82.00 J	89.30HI	77.20 H	78.20 M
Seeds soaking in "EMS"at 0.2 %	80.50K	87.20J	72.80 J	76.40 N
Seeds soaking in 'EMS" at 0.3 %	81.30JK	88.40 I	74.50 I	78.70 L
Seeds soaking in "EMS" at 0.4 %	84.60 H	91.80G	77.70 GH	80.30 J

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

II.A.3.5. Effect on leaf and root zinc content:

Table (29) shows leaf and root zinc content (ppm) of papaya seedlings cv. Betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

It is obvious from **Table (29)** that in both seasons, the highest value of leaf zinc content was obtained from 100 ppm "GA3" (24.60 and 26.70) 50 ml/L yeast extract(24.00 and 25.70).

On the contrary, the lowest value of leaf zinc content were obtained from untreated seeds (control) (14.00 and 15.20), 0.2% EMS (14.80 and 16.00) and 40 mg/L Colchicine(16.00 and 18.10).

As for the highest value of root zinc content was obtained from 100 ppm " GA_3 " (21.20 and 22.60) , followed by 50 ml /L " yeast extract " (21.00 and 22.30) and 25 ppm " NAA " (20.80 and 21.80)

On the other hand, the lowest value of root zinc was obtained from untreated seeds "control" (12.20 and 13.70), 0.2% "EMS" (12.90 and 13.90) and 40mg/L Colchicine (13.30 and 14.20) during the first and second season, respectively.

Table (29) : Leaf and root zinc content (ppm) of papaya seedlings cv . Betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Leaf zinc content (ppm)		Root zinc content (ppm)	
	2008	2009	2008	2009
Seeds soaking in tap water "control "	14.00 L	15.20 J	12.20 J	13.70 K
Seeds soaking in "GA_3" at 50 ppm	21.00 F	24.30 CD	20.40 BC	21.50 C
Seeds soaking in "GA_3" at100 ppm	24.60 A	26.70 A	21.20 A	22.60 A
Seeds soaking in "GA_3" at150 ppm	22.20 DE	25.00 BC	20.00 C	20.40 D
Seeds soaking in "NAA" at 25 ppm	22.80 C	25.40 ABC	20.80 ABC	21.80 B
Seeds soaking in "NAA" at 50 ppm	22.10 E	24.00 D	18.40 D	19.10 F
Seeds soaking in "NAA" at 75 ppm	20.00 G	22.20 E	17.00 E	18.50 FG
Seeds soaking in "yeast extract" at 50 ml/l	24.00 B	25.70 AB	21.00 AB	22.30 AB
Seeds soaking in "yeast extract" at100 ml/l	22.70 D	24.80 C	20.00 C	21.50 C
Seeds soaking in "yeast extract" at 150 ml/l	21.00 F	23.20 DE	19.50 CD	20.00 E
Seeds soaking in "Colchicine" at 20 mg/l	17.20 I J	17.40 GHI	14.60 GH	15.20 HI
Seeds soaking in Colchicine" at 30 mg/l	18.00 H	20.50 F	15.80 F	16.70 G
Seeds soaking in "Colchicine" at 40 mg/l	16.00 G	18.10 GH	13.30 H	14.20 I
Seeds soaking in "EMS"at 0.2 %	14.80 KL	16.00 I	12.90 I	13.90 J
Seeds soaking in 'EMS" at 0.3 %	15.40 K	17.30 HI	13.00 HI	14.20 I
Seeds soaking in "EMS" at 0.4 %	17.30 I	18.60 G	14.90 G	15.30 H

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

II.A.3.6.Effect on leaf and root manganese content:

Table (30) shows leaf and root manganese content (ppm) of papaya seedlings cv. Betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons .

It is clear from **Table (30)** that, in both seasons , the highest value of leaf manganese content obtained from 100 ppm " GA_3 " (37.90and 42.20) followed by 50 ml / L " yeast extract " (36.50 and 40.00) and 25 ppm " NAA " (35.90 and 39.50) .

On the other hand , the lowest value of leaf manganese content was obtained from untreated seeds "control" (19.90 and 21.40), 0.3 % " EMS " (20.80 and 22.00) and 20 mg/L " Colchicine " (20.00 and 23.20).

As for the highest value of root manganese content was obtained from 100 ppm " GA_3 " (32.30and 36.50) followed by 50 ml/L " yeast extract " (31.80and35.70) and 25 ppm " NAA " (30.60and34.40) .

On the contrary, the lowest value of root manganese content was obtained from untreated seeds " control " (16.20 and 17.50), 0.3 % " EMS " (19.80 and 20.40) and.40 mg/L " Colchicine " (18.60 and 20.20) during the first and second season , respectively.

These results are in agreement with findings of **Loyd *et al.*, (1961), Ting (1962), Saito and Yamato (1964), Randhawa and Iwata (1965) and Mohmodov (1967).**

Table (30) : Leaf and root manganese content (ppm) of papaya seedlings cv . Betty as affected by soaking the seeds in some chemical solutions during 2008 and 2009 seasons.

Treatments	Leaf manganese content (ppm)		Root manganese content (ppm)	
	2008	2009	2008	2009
Seeds soaking in tap water "control "	19.90 N	21.40 J	16.20 J	17.50 L
Seeds soaking in "GA_3" at 50 ppm	34.30 E	37.50 CD	30.20 CD	32..90 DE
Seeds soaking in "GA_3" at100 ppm	37.90 A	42.20 A	32.30 A	36.50 A
Seeds soaking in "GA_3" at150 ppm	35.20 C	38.40 BC	30.00 D	34.20 C
Seeds soaking in "NAA" at 25 ppm	35.90 B	39.50 ABC	30.60 B	34.40 B
Seeds soaking in "NAA" at 50 ppm	33.30 G	36.00 DE	28.00 E	31.20 E
Seeds soaking in "NAA" at 75 ppm	34.00 F	35.40 E	29.50 DE	31.00 F
Seeds soaking in "yeast extract" at 50 ml/l	36.50 AB	40.00 AB	31.80 AB	35.70AB
Seeds soaking in "yeast extract" at100 ml/l	34.60 D	38.20 C	30.00 D	33.80 D
Seeds soaking in "yeast extract" at 150 ml/l	35.20 C	37.00 D	30.40 C	34.00 CD
Seeds soaking in "Colchicine" at 20 mg/l	20.00 M	23.20 G	19.10 HI	21.30 H
Seeds soaking in Colchicine" at 30 mg/l	22.80 H	25.60 F	21.60 F	23.00 FG
Seeds soaking in "Colchicine" at 40 mg/l	20.30 L	22.80 H	18.60 I	20.20 K
Seeds soaking in "EMS"at 0.2 %	21.00 J	22.30 HI	20.00 G	21.10 I
Seeds soaking in 'EMS" at 0.3 %	20.80 K	22.00 I	19.80 H	20.40 J
Seeds soaking in "EMS" at 0.4 %	21.50 I	23.70 FG	20.40 FG	22.50 G

Means followed by the same letter (S)within each column are not significantly different at 5% level.

II.B.1. Effect of treating (Betty) papaya seeds with gamma irradiation at various doses on germination parameters.

II.B.1.1.Germination percentage:

It is obvious from **Table (31)** that, in both seasons , water – soaked seeds and treated with different doses of gamma rays had higher germination percentage as compared with untreated seeds " control " .

Shortly , water – soaked seeds , and treated with gamma rays at (40 Kr) proved to be the superior treatments improving germination percentage (70.67and 74.67 %) . Other treatments of water – soaked seeds and treated with different doses of gamma rays induced statisticaly similar germination percentage. during the first and second season ,respectively.

II.B.1.2.Germination rate:

It is clear from **Table (31)** that in both seasons , water – soaked seeds and treated with different doses of gamma rays had higher germination rate as compared with untreated seeds " control " .

Briefly , water – soaked seeds and treated with gamma rays at (40 kr) proved to be the superior treatments improving germination rate (3.481 and 3.606). Other treatments of water – soaked seeds and treated with different doses of gamma rays induced statisticaly similar germination rate . during the first and second season ,respectively.

Table (31) : Germination percentage and rate of papaya seeds cv. Betty as affected by treating with gamma rays during 2008 and 2009 seasons

Treatments	Germination %		Germination rate	
	2008	2009	2008	2009
Seeds soaking in tap water " Control "	54.67D	58.00D	2.733D	2.900D
Seeds soaking in tap water + 10 k. rad	64.67C	68.00C	3.375C	3.588C
Seeds soaking in tap water + 20 k. rad	66.67B	72.00B	3.475B	3.600B
Seeds soaking in tap water + 40 k. rad	70.67A	74.67A	3.481A	3.606A

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

These results are in harmony with earlier studies of **Kalinichenko (1971), Spiegel-Roy and Kochba (1972), Kawecki (1973), Dronnikov (1977), Lange and Toit (1977), Shchepot *et al* ., (1978), Vonkyi and Amuh (1979), Alamgir and Rahman (1991), Jawaharlal *et al* .,(1991), Sharma and Sharma (1994),Salama (1998), Nargis *et al.,* (1998), Sunil *et al* . , (2002),Bakry and Ismaeil (2002), Hafiz *et al* ., (2005) and Murlee *et al.,* (2008).**

II.B.2. Effect of treating (Betty) papaya seeds with gamma irradiation at various doses on some growth measurements.

II.B.2.1.Seedlings height (cm):

It is obvious from **Table (32)** that, in both seasons , water – soaked seeds gave the tallest seedlings as compared with other treatments . On the other hand , water – soaked seeds and treated with gamma rays at different doses produced shorter seedlings .

II.B.2.2. Root length (cm):

It is clear from **Table (32)** that, in both seasons , water – soaked seeds produced seedlings with the highest length of root as compared with other tested treatments . On the contrary , water – soaked seeds and treated with gamma rays at different doses produced the lowest length of root .

II.B.2.3.Number of leaves per seedlings:

It is obvious from **Table (32)** that, in both seasons , water – soaked seeds produced seedlings with the highest number of leaves as compared with other tested treatments . On the other

Table (32) : Seedling height , Root length and Number of leaves per seedling of papaya seedlings cv .Betty as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Seedling height (cm)		Root length (cm)		number of leaves per seeding	
	2008	2009	2008	2009	2008	2009
Seeds soaking in tap water " Control "	52.60 A	53.90 A	13.50 A	14.40 A	13.87 A	14.33 A
Seeds soaking in tap water + 10 k. rad	35.93 D	40.53 D	6.80 D	8.80 D	13.00 D	13.33 D
Seeds soaking in tap water + 20 k. rad	42.10 C	46.17 C	7.73 C	9.90 C	13.33 C	13.67 C
Seeds soaking in tap water + 40 k. rad	45.13 B	50.60 B	9.30 B	10.80 B	13.67 B	14.00 B

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

hand, water – soaked seeds and treated with gamma rays at different doses produced seedlings with the lowest number of leaves .

II.B.2.4. Fresh weight of vegetative growth (gm):

It is clear from **Table (33)** that, in both seasons , water – soaked seeds increased the fresh weight of vegetative growth as compared with other tested treatments . On the contrary , water – soaked seeds and treated with gamma rays at different doses decreased the fresh weight of vegetative growth .

II.B.2.5. Fresh weight of root system (gm):

It is obvious from **Table (33)** that in both seasons , water – soaked seeds increased the fresh weight of root system as compared with other tested treatments . On the other hand , water – soaked seeds and treated with gamma rays at different doses decreased the fresh weight of root system .

Table (33) : Fresh weight of vegetative growth and root of papaya seedlings cv .Betty as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Fresh weight of vegetative growth (gm)		Root fresh weight (gm)	
	2008	2009	2008	2009
Seeds soaking in tap water " Control "	23.70 A	24.58 A	9.53 A	10.34 A
Seeds soaking in tap water + 10 k. rad	16.52 D	17.02 D	5.96 D	6.69 D
Seeds soaking in tap water + 20 k. rad	18.83 C	20.25 C	6.43 C	7.70 C
Seeds soaking in tap water + 40 k. rad	21.77 B	23.16 B	7.24 B	8.19 B

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

II.B.2.6.Dry weight of vegetative growth (gm):

It is clear from **Table (34)** that, in both seasons, water – soaked seeds increased the dry weight of vegetative growth as compared with other tested treatments. On the contrary, water – soaked seeds and treated with gamma rays at different doses decreased the dry weight of vegetative growth.

II.B.2.7.Dry weight of root system (gm):

It is obvious from **Table (34)** that, in both seasons, water – soaked seeds increased the dry weight of root system as compared with other tested treatments. On the other hand, water – soaked seeds and treated with gamma rays at different doses decreased dry weight of root system.

II.B.2.8.Top/root ratio of dry weight:

It is clear from **Table (34)** that in both seasons, water – soaked seeds and treated with gamma rays at10 kr increased top / root ratio of dry weight.

The tabulated results are in harmony with the analogous ones mentioned by **Jawaharlal *et al* ., (1991), Salama (1998), Sunil *et al.*, (2002) Bakry and Ismaeil (2002) and Hafiz *et al.*, (2005).**

Table (34) : Dry weight of vegetative growth and root and top / root ratio of papaya seedlings cv. Betty as affected by treating the seeds with gamma rays during 2008 and 2009 seasons

Treatments	Dry weight of vegetative growth (gm)		Root dry weight (gm)		Top / root ratio	
	2008	2009	2008	2009	2008	2009
Seeds soaking in tap water " Control "	5.00 A	5.57 A	4.57 A	4.71 A	1.094 C	1.182 B
Seeds soaking in tap water + 10 k. rad	3.87 D	4.05 D	3.30 D	3.40 D	1.172 A	1.191 A
Seeds soaking in tap water + 20 k. rad	4.03 C	4.52 C	3.67 C	4.13 C	1.098 B	1.094 C
Seeds soaking in tap water + 40 k. rad	4.30 B	4.72 B	4.10 B	4.46 B	1.048 D	1.058 D

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

II.C.1. Effect of treating (Betty) papaya seeds with gamma irradiation at various doses on seedling mineral content:

II.C.1.1.Effect on leaf and root nitrogen content:

It is clear from **Table (35)** that in both seasons , water – soaked seeds and treated with different doses of gamma rays had higher value of leaf nitrogen content as compared with untreated seeds " Control " .

Shortly , water – soaked seeds , and treated with gamma rays at (40 k. rad) gave the highest value of leaf nitrogen content (1.169 and1.189).

As for , water – soaked seeds and treated with different doses of gamma rays had higher value of root nitrogen content as compared with untreated seeds " control "

Shortly , water – soaked seeds, and treated with gamma rays at

(40 k. rad) gave the highest value of root nitrogen content (1.146 and 1.60). during the first and second season ,respectively.

Table (35) : Leaf and root nitrogen content (%) of papaya seedlings cv .Betty as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Leaf nitrogen content (%)		Root nitrogen content (%)	
	2008	2009	2008	2009
Seeds soaking in tap water "control"	1.130 C	1.145 C	1.050 D	1.100 D
Seeds soaking in tap water +10 k.rad	1.145 B	1.155 B	1.120 C	1.134 C
Seeds soaking in tap water +20 k.rad	1.158 AB	1.166 AB	1.132 B	1.148 B
Seeds soaking in tap water +40 k.rad	1.169 A	1.189 A	1.146 A	1.160 A

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

II.C.1.2.Effect on leaf and root phosphorus content:

It is obvious from **Table (36)** that, in both seasons , water – soaked seeds and treated with different doses of gamma rays had higher value of leaf phosphorus content as compared with untreated seeds " control " .

Shortly, water – soaked seeds and treated with gamma rays at (40 k. rad) gave the highest value of leaf phosphorus content (0.200 and 0.208).

As for, water – soaked seeds and treated with different doses of gamma rays had higher value root phosphorus content as compared with untreated seeds " control".

Briefly , water – soaked seeds , and treated with gamma rays at (40K. rad) gave the highest value of root phosphorus content (0.190 and 0.193) during the first and second season , respectively

Table (36) : Leaf and root Phosphorus content (%) of papaya seedlings cv. Betty as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Leaf phosphorus content (%)		Root phosphorus content (%)	
	2008	2009	2008	2009
Seeds soaking in tap water "control"	0.180D	0.190D	0.162 C	0.170 C
Seeds soaking in tap water +10 k.rad	0185 C	0.197 C	0.176 B	0.179 B
Seeds soaking in tap water +20 k.rad	0.195 B	0.203 B	0.180 AB	0.185 AB
Seeds soaking in tap water +40 k.rad	0.200 A	0.208 A	0.190 A	0.193A

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

II.C.1.3.Effect on leaf and root potassium content:

It is clear from **Table (37)** that, in both seasons , water – soaked seeds and treated with different doses of gamma rays had higher value of leaf potassium content as compared with untreated seeds " control " .

Shortly, water – soaked seeds, and treated with gamma rays at (40 K. rad) gave the highest value of leaf potassium content (1.193 and 1.199).

As for, water – soaked seeds and treated with different doses of gamma rays had higher value of root potassium content as compared with untreated seeds "control".

Briefly , water – soaked seeds and treated with gamma rays at (40 K . rad) gave the highest value of root potassium content (1.180 and 1.190). during the first and second season ,respectively

Table (37) : Leaf and root Phosphorus content (%) of papaya seedlings cv . Betty as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Leaf potassium content (%)		Root potassium content (%)	
	2008	2009	2008	2009
Seeds soaking in tap water "control"	1.160 C	1.177 C	1.000 D	1.070 D
Seeds soaking in tap water +10 k.rad	1.177 B	1.185 B	1.050 C	1.098 C
Seeds soaking in tap water +20 k.rad	1.184 AB	1.190 AB	1.150 AB	1.182 B
Seeds soaking in tap water +40 k.rad	1.193 A	1.199 A	1.180 A	1.190 A

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

II.C.1.4.Effect on leaf and root iron content:

It is clear from **Table (38)** that in both seasons , water – soaked seeds and treated with different doses of gamma rays had higher value of leaf iron content as compared with untreated seeds " Control " .

Shortly, water – soaked seeds, and treated with gamma rays at (40 k. rad) gave the highest value of leaf iron content (87.00 and 88.10).

As for , water – soaked seeds and treated with different doses of gamma rays had higher value of root iron content as compared with untreated seeds " control " .

Shortly, water – soaked seeds, and treated with gamma rays at (40 k . rad) gave the highest value of root iron content (60.00 and 67.30) during the first and second season, respectively.

Table (38) : Leaf and root iron content (ppm) of papaya seedlings cv . Betty as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Leaf iron content (ppm)		Root iron content (ppm)	
	2008	2009	2008	2009
Seeds soaking in tap water "control"	75.80 D	81.20 D	51.80 BC	60.40 BC
Seeds soaking in tap water +10 k.rad	81.50C	83.40 C	55.30 ABC	62.10 ABC
Seeds soaking in tap water +20 k.rad	84.30 B	85.60 B	58.70 AB	65.20 AB
Seeds soaking in tap water +40 k.rad	87.00 A	88.10 A	60.00 A	67.30 A

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

II.C.1.5.Effect on leaf and root zinc content:

It is obvious from **Table (39)** that, in both seasons , water – soaked seeds and treated with different doses of gamma rays had higher value of leaf zinc content as compared with untreated seeds " control " .

Shortly, water – soaked seeds, and treated with gamma rays at (40 k. rad) gave the highest value of leaf zinc content (20.10 and 20.90).

As for water – soaked seeds and treated with different doses of gamma rays had higher value of root zinc content as compared with untreated seeds "control".

Briefly, water – soaked seeds, and treated with gamma rays at (40K.andrad) gave the highest value of root zinc content (16.00 and 18.40) during the first and second season, respectively.

Table (39) : Leaf and root zinc content (ppm) of papaya seedlings cv . Betty as affected by treating the seeds with gamma rays during 2008 and 2009 seasons.

Treatments	Leaf zinc content (ppm)		Root zinc content (ppm)	
	2008	2009	2008	2009
Seeds soaking in tap water "control"	14.00 C	15.20 C	12.20 D	13.70 D
Seeds soaking in tap water +10 k.rad	15.40 B	17.00 B	13.70 C	15.20 C
Seeds soaking in tap water +20 k.rad	17.50 AB	18.60 AB	15.30 B	16.80 B
Seeds soaking in tap water +40 k.rad	20.10 A	20.90A	16.00 A	18.40 A

Means followed by the same letter (S)within each column are not significantly different at 5 % level.

II.C.1.6.Effect on leaf and root manganese content:

It is clear from **Table (40)** that in both seasons water – soaked seeds and treated with different doses of gamma rays had higher value of leaf manganese content as compared with untreated seeds "control".

Shortly, water – soaked seeds, and treated with gamma rays at (40 K. rad) gave the highest value of leaf manganese content (29.00 and30.20).

As for, water – soaked seeds and treated with different doses of gamma rays had higher value of root manganese content as compared with untreated seeds "control".

Briefly, water – soaked seeds, and treated with gamma rays at (40 K r.ad) gave the highest value of root manganese content (23.40 and 25.70) during the first and second season, respectively.

These results are coincided with those mentioned earlier by **El-Azzoni *et al.*, (1970), Rennie and Nelson (1975), Zham yansuren and Voloozh (1976), Ragab (1979), Tikhonov *et al.*, (1980), Meawad (1981), El-Shafie *et al.*, (1987), Korosi, Mohamed *et al.*,, (1988, a & b) Mohamed (1989) Hussein *et al.*, (1995), EI-Essawy (1995), Orabi, (1997 and 1998), Maghraby (1997), Hassanein *et* al., (1998), Taha (2000) and Mohamed *et* al., (2000).**