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Effect of ionizing radiations on vegetative characteristics and yield attributes of maize (*Zea mays* L.)

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Ionization irradiation was utilized to induce mutation in maize cultivars (Azam and Jalal) through 4 ionization irradiation dosages (10 Krad, 15 Krad, and 20 Krad) and analyzed with control. The germ plasma irradiated in the Nuclear institute for food and agriculture at Peshawar. The irradiated seeds were seeded within the study region department of botany Sheringal university in the crop time period of 2016. It had been noted that an adverse correlation was created in dosages of 10,15,20 Krad against parameters such as number of leaves per plant, 1000 grain weight, and plant height reductions in mean values for the mentioned parameters were studied. Significant decreases within the mean values were observed for stated parameters in both hybrids. Direct relationship took place the mean values of number of cob per plant, significantly increased with all the increasing of dosages. It was furthermore determined that increasing of dosages induced restricting within the mean values of all the parameters, which explained that the two hybrids were responsive to high dosages of gamma irradiation. Moreover, there have been also recovered a few Mutant genotypes in Azam hybrid at 10 Krad as a result of genetic variation with an increase of three cobs and blue and pink color leaves. The cultivar effect through analysis of variance for all the parameters other than the plant height, number of branches per taseel, number of grains per cob were significant and the parameters number grain per cob and grain row per cob also observed highly significant, while due to the hybrids effect of the plant height, number of grain row per cob was non-significant. Additionally, non-significant effects were obtained within the mean square values because of the interaction among hybrids and dosage for plant height, number of branches per tassel, number grain per row, 100 grain weight.

Keywords: Gamma radiation, Doses, maize cultivars, Mutant, Genotypes, Phenotypes, Parameters.

INTRODUCTION

Maize (*Zea mays* L.) is all over the world essential grain crop, commonly used for edible items, foods and commercial use. The developing countries more than 73 percent of the 153 million ha of total maize cultivated around the globe to the yearly increase in production expected to become 6% (Prasanna, 2011). The average productivity is not satisfactory in spite of large coverage of cultivable area. The need for Maize usage is anticipated compared to rice and wheat (Prasanna and Hoisington, 2003) Because of its

adjustable utilize, and it has possessed the greatest production in developing countries by 2050 (Prasanna, 2011). Different techniques are held to improve the production of maize like nuclear methods. As opposed to traditional breeding tools, nuclear practices concentrate on utilizing physical mutagens to enhance the characteristics in a plant. Between different physical real mutagens, ionizing irradiation can be used as a tool for nuclear breeding process (Peri et al., 2011). The ionizing irradiation creates the free radicals within the cells, which the potentials to destroy or alter cellular feature (Minisi et al., 2013. Ionization irradiation is broadly applied for variation cause for enhancing genetic hereditary in agriculture because of its higher saturation capability in comparison, using different ionizing irradiation (Akshatha et al., 2013). Their utilization in agriculture is restricted because of doubt within the dosage of irradiation that is differs for various crops and application (Peri et al., 20110). Past research reports have reflected that application of ionization irradiation has reduced paid down plant height and number of leaves per plant, number of branched per tassel, because of aggregation of phenolic compounds (Minisi et al., 2013 and (Aly, 201 0). Girija and Dhanavel, (2013) The seed embryo exposed to low degree of irradiation effects in chromosomal damage to reduced number leaves per plant. Ambavane et al., (2014) These ionization radiations destructively influence on large and small plants. Such ionization radiations reflected consequence on cell photosynthetic activity which finally cause improper development of the plant (Jansen *et al*., 1998) Higher dosages of Ionization irradiation are recognized to become harmful to plant DNA because of these destroying result various plants might show various degrees of threshold. The physiological impact of gamma irradiation is a result of the synthesis of release radicals through the breaking of water, which could lead to cause the inflection of an antioxidative system, deposition of phenolic substances and chlorophyll pigments (Kovacs and Keresztes, 2002; Kim et al.,2004; Wi et al., 2007 and Ashraf, 2009). Although, lower doses of ionizing irradiation can be useful in enhancing the enzymatic stimulation of younger embryo, exciting the speed of cell division and improving the development of plant metabolites for appropriate physiological growth of the plant (Moussa, 2011).

MATERIALS AND METHODS

The recent research had been executed in the sowing time frame on 29 May 2017 in the research area of Botany Department Shaheed Benazir Bhutto University Sheringal Dir upper. to determine the effectual levels of ionizing radiation on different varieties of maize (Zea mays L.). Two varieties of maize (Azam and Jalal) had been purchased from Tarnab farm Peshawar. The ionization irradiation was utilized to induce mutation in maize cultivars (Azam and Jalal) through 4 ionization irradiation dosages (10 Krad, 15 Krad, and 20 Krad). The germplasm were irradiated in the nuclear institute for food and agriculture (NIFA), Peshawar. The data were collected on target parameters such as Plant height (cm), number of leaves per plant, number of branches per tassel, number of cobs per plant, cob length (cm), number of grain rows per cob, number of grains per row, number of grains per cob, 100 grain weight. Experiment field prepared by split plot - design and plot overall size was fixed as 110 x84.38=9281 8 using three replications and four treatments. Every replication split into 4-sub plot. The line to line space was kept as 75 cm and plant to plant space has been fixed as 30 cm. The row length was kept 3 meters. The routine cultural procedures were applied throughout the entire period of crop. One dosage of nitrogen and P_2O_5 fertilizer was produced three times to the field at the time of developing of maize crop in the field. The soil for growing of seeds was ploughed. Common agricultural procedures for cultivating the maize plants were used consistently for all the treatments. Hoeing was done repeatedly to control the weed growth. The experimental plot was irrigated at appropriate time periods in such a way that, the crop did not suffer with water stress. Seeds were sown about 4-5 centimeters depth in the soil. Yield per plot were estimated by harvesting plants of each treatment and replication separately. The ears were removed from stalks to keep its dryness and then threshed it.

The data of the following parameters for morphological characteristics was recorded.

Plant height (cm)

The typical height of chosen plants was taken in cm. The plant height was observed from aboveground till to peak of the plant..

Number of leaves per plant.

Number of leaves for every plant was documented from the average of all the leaves of the decided plants.

Number of branches per Tassel

The number of branches for every tassel had been observed by using the average number of Tassel branches of the specified plants.

Number of Cobs per Plant

Numbers of cobs for each plant were documented after harvesting from the selected plants.

Cob length (cm)C

Cob length was observed in cm through using the average length of the selected cobs.

Number of grain rows per cob.

Number of grain rows for each cob were noticed through taking the average number of grain rows from particular cobs.

Number of grains row

Number of grains row-I was observed by taking the average number of rows according to cob.

Number of grains per cob

Number of grains in each cob was studied by using the average number of grains at all the chosen cobs.

100 grains weight.

The 100 grains weight was documented in grams from the targeted cobs in every one treatment.

STATISTICAL ANALYSIS

Statistician evaluated of every parameter regarding the data was applied statistic software Statistix 8.1. Tukey's least significant difference test used for comparison inside the hybrid mean, treatment means, and relationship within treatment and cultivars.

RESULTS

Two varieties of corn (Zea mays L.); Azam and Jalal were utilized to determine the results of ionizing radiation, according to doses of 10, 15 and 20 Krad on vegetative characteristics along with yield components. The results collected within the time frame for this study are well presented from table 1 to 9. Assessment and evaluations of mean values were obtained through the utilization of Analysis of difference and Tukey's significant test. The statistics that has been used to assess listed here parameters were put on the documented data in the first generation (M1-generation).

Plant height.

The exploration of difference (Appendix 1b) demonstrates that the differences in the values for the plant height in consequence to irradiation dosages had been significant, impact of varieties found insignificant. But the association within the varieties and dosages has been carried out as non- significant. At the (table 1a) the ionization irradiation effect of plant height ranging from (115.03-155.97). The variation documented within the main table because of the varietal effect for plant height 142.77 for Azam and 139.98 for Jalal. The interaction within cultivars and doses was statistically as insignificant and procured effect between 120.6-156.36 and 109.46-155.56 correspondingly Azam and Jalal. In the current study it had been observed that the plant height constantly reduce because of the raises of irradiation level. The greatest mean value detected in control (155.56, 155.56) respectively Azam and Jalal whilst the smallest mean values recorded at 20 Krad (120.6, 109.46,) respectively Azam and Jalal. The highest possible percent decrease (22.87%) for Azam and (29.63%) for Jalal. Sharif *et al*. (2000) analyzed two types of cotton with multiple dosage of ionizing radiation 0, 25, 30 and 35 KR. Seedling height, plant height was decreased because of mutagenic results of gamma irradiation. Plant height of the maize crop was decreased with raising of ionization radiations that was revealed by Singh and Balyon, 2009; the plant height of wheat reduce because of mutagenesis utilizing ionization radiations. The entire permanent variation in plant development as well as their development that finally result the plant height can be caused by alterations in plant genome as stated previously (Jan *et al*., 2011). Entire the gamma irradiation altered the genome associated with maize it revealed in which the size shoot was reduce in comparison with control. (Ambavane et al., 2014) These ionization radiations have inversely proportional destructive influence on large and small plants. These ionization radiations reflected consequence on cell photosynthetic activity which finally cause improper development of the plant (Jansen et al., 1998)

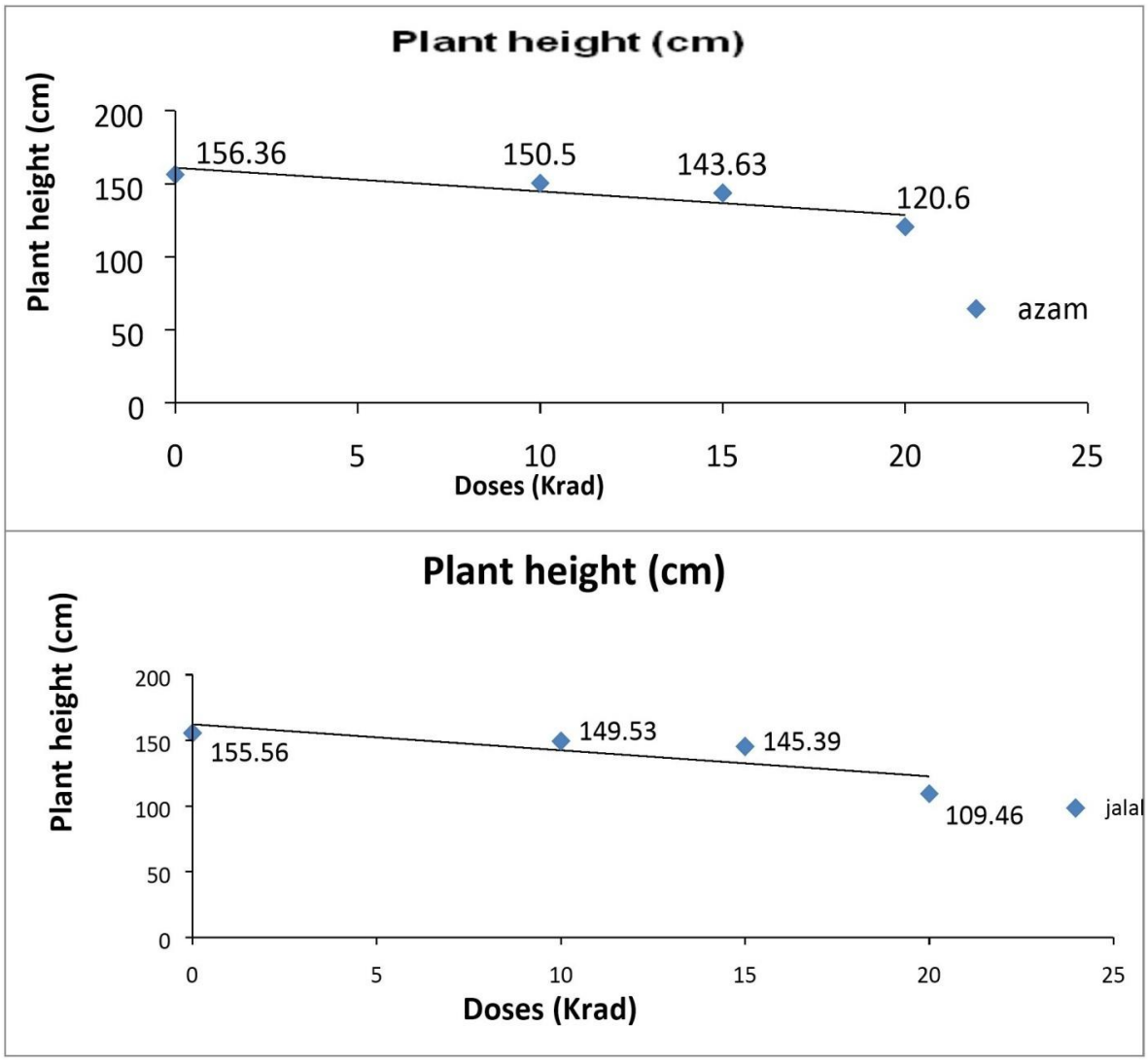

Figure 1: Impact of ionization irradiation on plant height (cm) for Azam and Jalal varieties.

Table 1a: Effects of ionization irradiation on the plant height (cm) for Azam and Jalal hybrids."

T0 Control	156.36 a	155.56 a
T1 10 Krad	150.5 a	149.53 a
T1 15 Krad	143.63 a	145.39 a
T1 20 Krad	120.6 a	109.46 a
Mean	142.77	139.98

Mean using the same alphabetic are not significantly various with respect to Tukey's Least significant difference at 5% probability level.

Table 1b: Summary of statistics for the plant height (cm) in maize hybrids due to ionization rays

Source.	D.F	S.S	M.S	F value	Prob	Sig
Replication.	2	405.5	202.77			
Hybrids.	1	14.1	14.14	0.14	0. 7430	NS
Replication Error*Hybrids.	2	199.8	99.91			
Treatment.	3	3653.4	1217.79	1.77	0.02069	*
Hybrids*Treatment.	3	67.8	22.6	0.03	0.9916	NS
Erorr*Rep*Treatment.	12	8270.8	689.24			
Total	23					

Abbreviations in tables symbolizing: DF "degree of freedom", SS "sum of square", MS "means square", F "fisher", P "probability value", Sig "significant via Tukey HSD test", ** "highly significant", * "significant"

Number of leaves per plant.

Summary statistics for number of leaves for each plant (Appendix 2b) reflect that the effect of ionizing radiation dosage varietal effect and the interaction of ionization radiation dosage and varieties was significant. From table (2a) A continues reduction was documented in each cultivar as a result of raising the ionization irradiation dosages concentration other than of 5 Krad. The mean values for the multiple ionization irradiation dosage effect for the number of leaves for each plant ranging from 12.33-14.26. The variation for varietal effect revealed for the number of leaves per plant was 12.69 for Azam and 14.04 for Jalal. Similarly, the interaction within ionization irradiation doses and cultivars effects was ranged 12.4-13.46 and 12.26-14.23 respectively for Azam and Jalal. Max percent reduction 34.16%, 41.95% was realized according to the effect of 20 Krad dose for Azam and Jalal respectively over the control. Similarly the linear regression reflects that number of leaves per plant ultimately decreases with raise of the radiation level. The maximum mean values documented in control (12.76, 14.23) correspondingly Azam and Jalal. Even though the smallest mean values seen at 20 Krad dose (8.4). The linear regression shows that the ionization irradiation level inversely proportional in to the number of leaves per plant because the ionization irradiation power rises to the number of leaves for each plant continually diminishes. Hedimbi et al., (2012) revealed effect of ionization irradiations on maize the number of leaves per plant. There is in number of leaves per plant with enhance of irradiation strength Gnanamurthy et al., (2012) reported results of multiple dosage on quantitative characters of maize. There was clearly an amazing decrease in the number of leaves per plant because of the raising in level of mutagens. The current research consented with (Todorović et al., 2015), (Girija and Dhanavel, 2013) who also stated that ionization irradiation dosages reciprocal to number leaves per plant because the gamma irradiation engrossment raise number of leaves per plant decline.

Number of branches per tassel.

Analysis of difference for number of branches for each tassel (Appendix 3b) shows that the effect of ionizing radiation dosage hybrid effect and the interaction of ionization radiation dosage and varieties was insignificant. From table (3a) it determined that the mean value for the number of branches for each tassel was reduced because of the radiation power raising other than of 10 Krad. The number of branches per tassel significantly increased at 10 Krad. The mean for the number of branches per tassel because of multiple ionization irradiation dosage effect ranged from 14.73-19.33. The difference noticed in mean values because of cultivars effects observed 17.04 and 16.42 respectively for Azam and Jalal. Furthermore the interaction inside cultivars and gamma radiation for the number of branches per tassel was fixed between 14.76-19.96 for Azam while 14.7-18.7 for Jalal. Number of branches per tassel reduced by increases of ionization irradiation level. Linear regression reflects that both varieties branches per tassel is gradually reduced as the ionization radiation level increased. Maximum percent reduction 12.82%, 21.39% was observed because of the effect of 20 Krad dose for Azam and Jalal respectively over the control The maximum mean value for the

branches per tassel was obtained at control (18.7, 19.96) as the smallest mean values were seen at 20 Krad dosage (14.34, 14.7) correspondingly Azam and Jalal. Kumar *et al*. (2014) revealed an association in F1 generations of maize for twelve various traits. The negative relation within numbers of branch per tassel and multiple radiation dosages reported. Ramya *et al*. (2014) described negative effect on the number of branches for each tassel effects by rise of ionization radiation power the number of branches significantly decreases. Girija and Dhanavel (2013) analyzed the result of multiple levels of ionization irradiation on the number of branches per tassel, 100 seed weight and yield for each plant. There was greater minimization number of branches per tassel at raising doses in M1 generation.

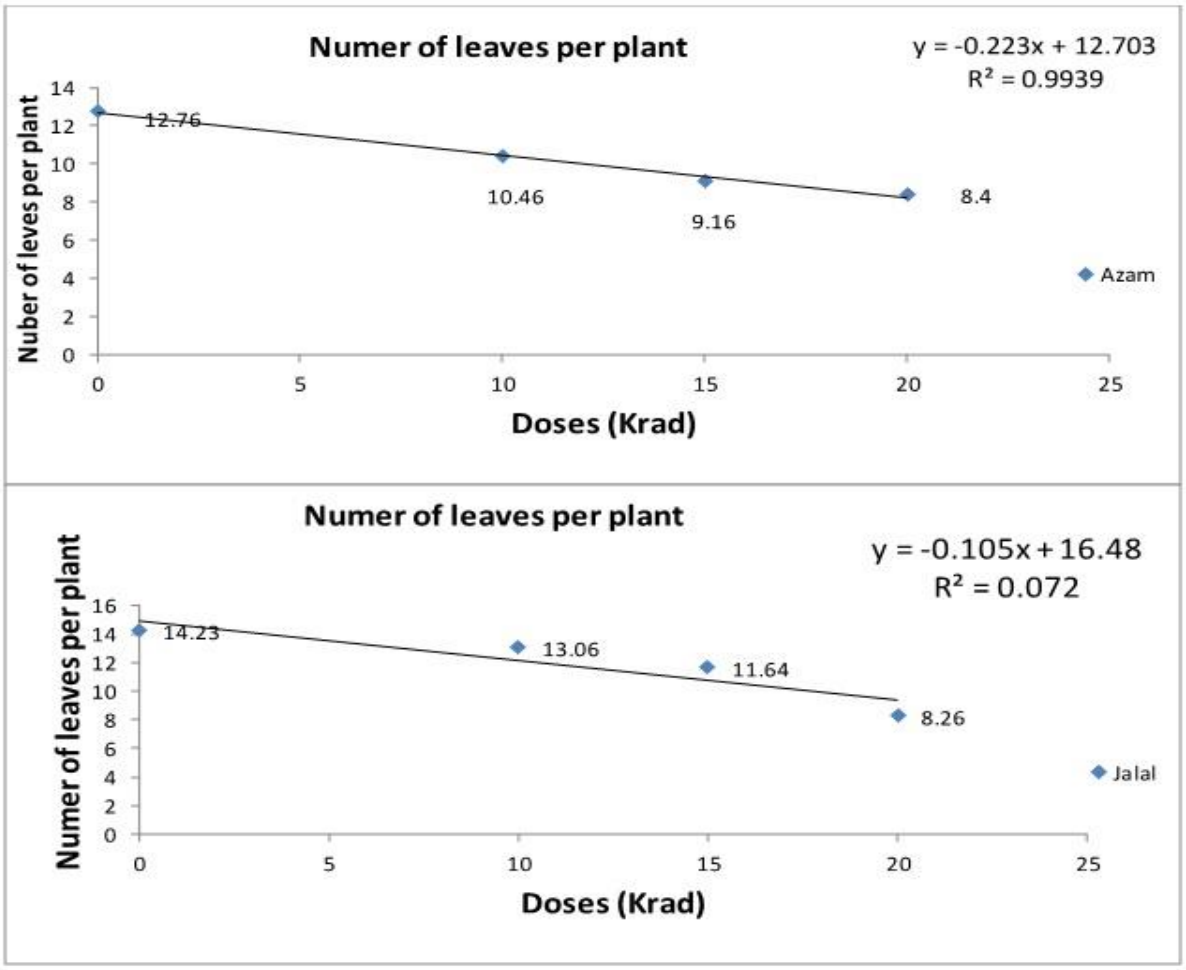

Figure 2: Impact of ionization irradiation on number of leaves per plant for Azam and Jalal hybrids

Table 2a: Effects of ionization irradiation on the number of leaves per plant for Azam and Jalal Hybrids

T0 Control	12.76 ab	14.23 a
T1 10 Krad	10.46 a	13.06 a
T1 15 Krad	9.16 bc	11.64 bc
T1 20 Krad	8.4 c	8.26 c
Mean	10.19	11.79

Mean using the the same alphabetic are not significantly various with respect to Tukey's Least significant difference at 5% probability level.

Table 2b: Summary of statistics for the number of leaves per plant in maiz hybrids due to ionization irradiation.

Source.	D.F	S.S	M.S	F value	Prob	Sig
Replication.	2	1.5358	0.76792			
Hybrids.	1	5.2267	5.22667	23.19	0.0405	*
Replication Error*Hybrids.	2	0.4508	0.22542			
Treatment.	3	7.215	2.405	4.86	0.0194	*
Hybrids*Treatment.	3	1.5367	0.51222	1.04	0.04117	*
Erorr*Rep*Treatment.	12	5.9333	0.49444			
Total	23					

Abbreviations in tables symbolizing: DF "degree of freedom", SS "sum of square", MS "means square", F "fisher", P "probability value", Sig "significant via Tukey HSD test", ** "highly significant", * "significant"

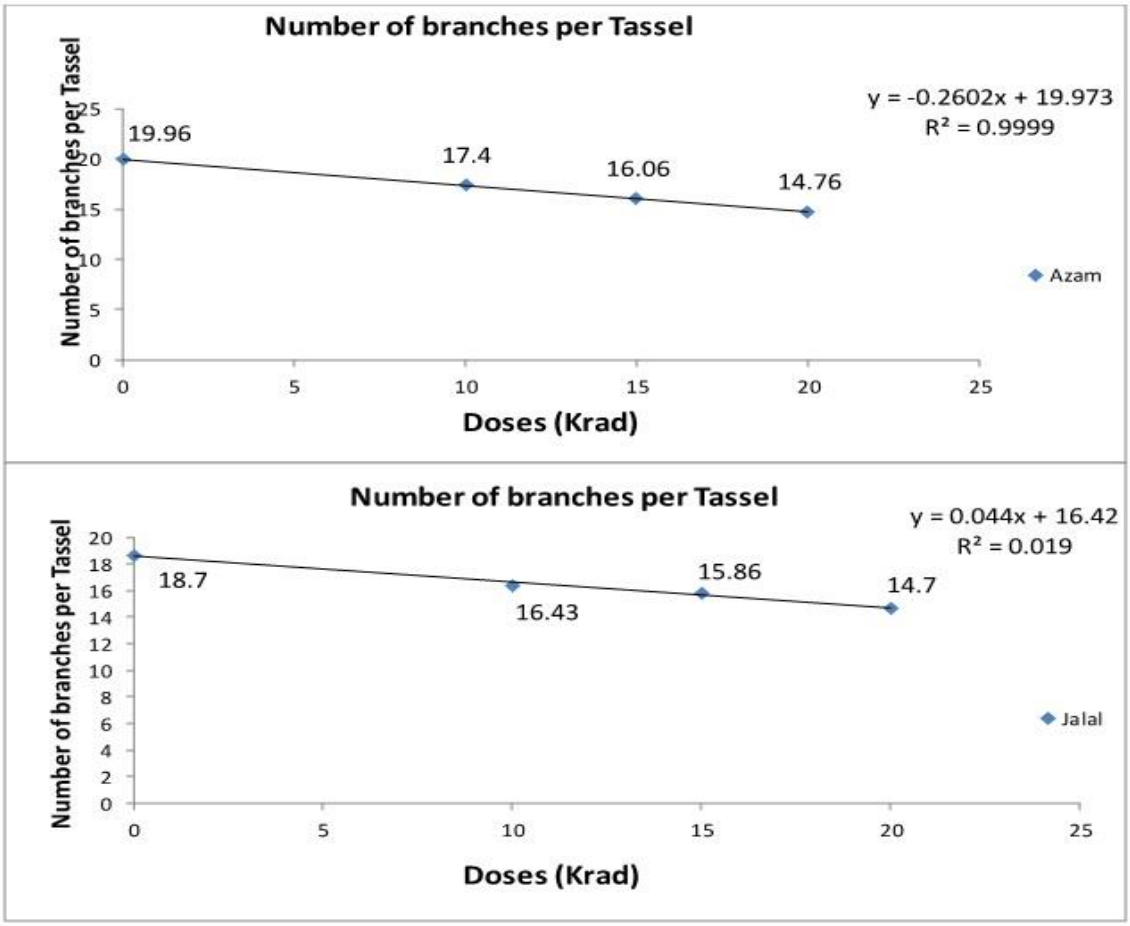

Figure 3: Impact of ionization irradiation on number of branches per tassel for Azam and Jalal varieties.

Table 3a: Effects of ionization irradiation on the number of branches per tassel for Azam and Jalal hybrids

T0 Control	19.96 a	18.7 a
T1 10 Krad	17.4 a	16.43 a
T1 15 Krad	16.06 a	15.86 a
T1 20 Krad	14.76 a	14.7 a
Mean	17.04	16.42

Mean using the same alphabetic are not significantly various with respect to Tukey's Least significant difference at 5% probability level.

Table 3b: Summary of statistics for the number of branches per tassel in maize hybrids due to ionization irradiation.

Source.	D.F	S.S	M.S	F value	Prob	Sig
Replication.	2	30.258	15.1288			
Hybrids.	1	11.344	11.3438	0.51	0.5508	NS
Replication Error*Hybrids.	2	44.883	22.4413			
Treatment.	3	4.588	1.5293	1.33	0.3098	NS
Hybrids*Treatment.	3	4.731	1.5771	1.37	0.2979	NS
Erorr*Rep*Treatment.	12	13.773	1.1478			
Total	23					

Abbreviations in tables symbolizing: DF "degree of freedom", SS "sum of square", MS "means square", F "fisher", P "probability value", Sig "significant via Tukey HSD test", ** "highly significant", * "significant"

Number of cobs per plant .

Conclusion statistics for number of cob per plant (Appendix 4b) reflect that the effect of ionizing radiation dosage hybrid effect and the interaction of ionization radiation dosage and varieties was significant. Through the (Table 4a) the effect of ionization radiation for the number of cobs per plant was assorted 1.26-2.26. The fluctuation documented within the mean because of cultivar effect 1.67 for Azam and 1.79 for Jalal. The interaction among cultivars and doses was statistically as significant and obtained effect ranging from 1.3-2.03 and 1.23-2.5 correspondingly Azam and Jalal. In this study it was reported that the ionization radiation strength rate closely enhance into the number of cobs for each plant when the radiation level raises the number of cobs per drastically enhance in all case. The uppermost mean value revealed at 10 Krad (2.05, 2.5) and as well as the mean values that are lower (1.3, 1.23) respectively for Azam and Jalal recorded at control. Even while both cultivars show desired feedback at 10 Krad but Jalal proved good response comparatively Azam. Highest percent raise (35.96%) for Azam and (50%) regarding Jalal cultivar. Farkorede and Ayoola (1981); Javed (1987); Mather et al., (1998); Kahkim et al., (1998); Singh et al., (1998); Sanvicente et al. (1998); Almeida et al. (1999) and Nass et al., (2000) observed an optimistic and valuable genotypic and phenotypic association of production about number of cobs per plant. It reflects that cobs per plant have vital trait that have the seeds production. It is a common perception that grain yield plants are basically influenced by a number of cobs for each plant. Reddy and Joshi (1990) ;Beck et al., (1990) and Debnath and Sarkar (1990); stated that effective genotypic that is significant phenotypic.

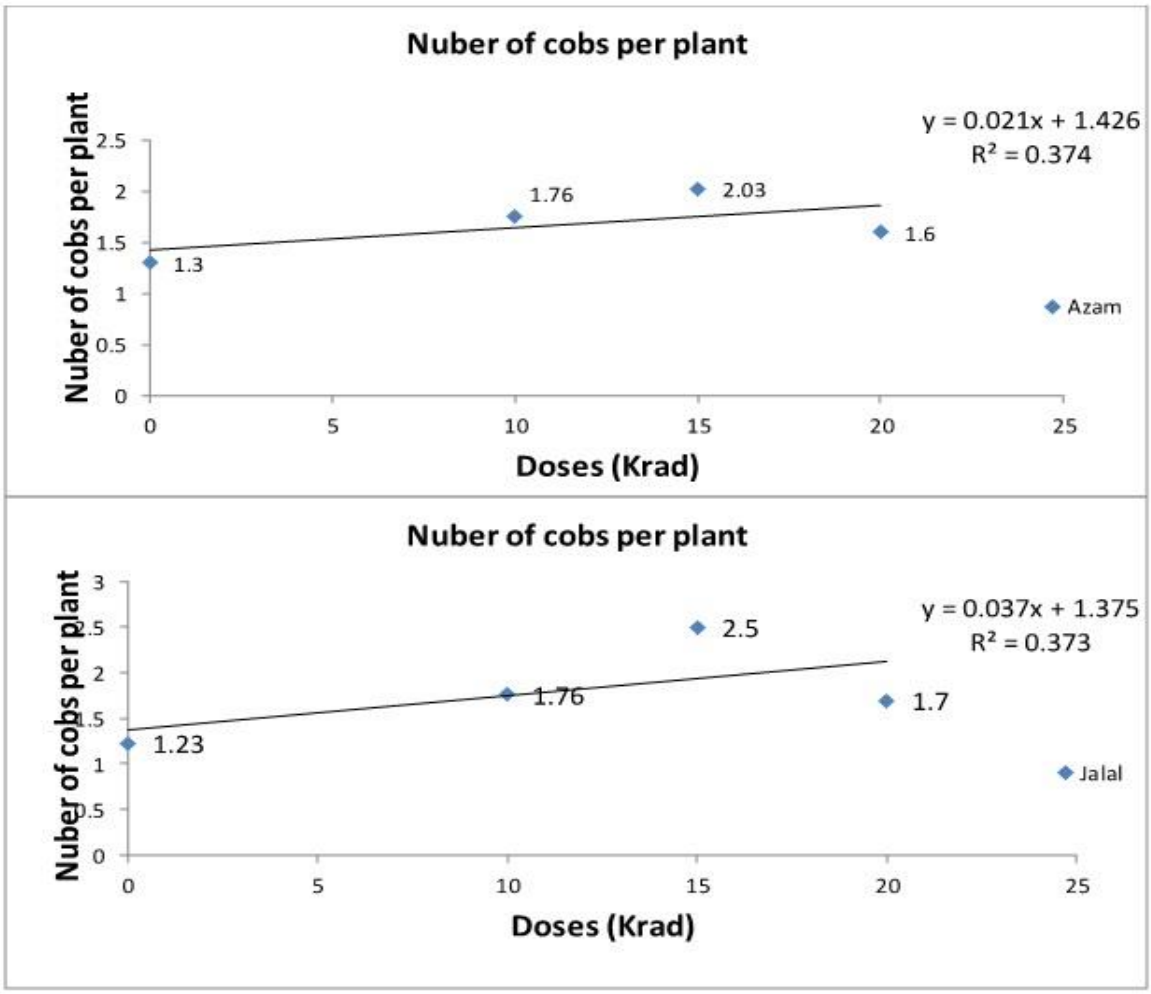

Figure 4: Impact of ionization irradiation on number of cob per plant for Azam and Jalal varieties.

Table 4a: Effects of ionization irradiation on the number of cob per plant for Azam and Jalal hybrids.

T0 Control	1.3 bc	1.23 c
T1 10 Krad	1.76 a	1.76 a
T1 15 Krad	2.03 abc	2.5 a
T1 20 Krad	1.6 abc	1.7 ab
Mean	1.67	1.79

Mean using the the same alphabetic are not significantly various with respect to Tukey's Least significant difference at 5% probability level.

Table 4b: Summary of statistics for the number of cob per plant in maize hybrids due to ionization irradiation.

Source.	D.F	S.S	M.S	F value	Prob	Sig
Replication.	2	0.30333	0.15167			
Hybrids.	1	0.07042	0.07042	2.64	0.02457	*
Replication Error*Hybrids.	2	0.05333	0.02667			
Treatment.	3	0.15458	0.05153	2.41	0.01178	*
Hybrids*Treatment.	3	0.06125	0.02042	0.95	0.04454	*
Erorr*Rep*Treatment.	12	0.25667	0.02139			
Total	23					

Abbreviations in tables symbolizing: DF "degree of freedom", SS "sum of square", MS "means square", F "fisher", P "probability value", Sig "significant via Tukey HSD test", ** "highly significant", * "significant"

Cob length (cm)

Summary statistics for cob length (Appendix 5b) reflect that the effect of ionizing radiation dosage, varietal effect and the relationships of ionization radiation doses and varieties was significant. At (Table 5a) a continues reduction was documented with the enhancing of irradiation doses level instead of 10 krad in each variety the size of cob grow well. The mean values regarding multiple radiation doses effect ranging from 16.82-26.52. The difference for the varietal effect was documented 20.2 for Azam while 20.4 for Jalal. Similarly, the association within ionization irradiation dosages and cultivars was ranged 16.78-26.25 and 16.87-26.89 correspondingly for Azam and Jalal. Maximal percent raise was 36.07% and 37..02 % under the effect of 10 Krad dose for Azam and Jalal respectively. Furthermore it had been proven from the (Table 5a) that the cob length continually reduces with enhancing of radiation concentration besides of 10 Krad. Similarly the optimum percent reduction 12.42% and 11.62% revealed under the effect of 20 Krad. The uppermost mean values were documented in 10 Krad (26.25, 26.79) correspondingly Azam and Jalal. While the smallest mean values documented at 20 Krad dose (16.78) for Azam and (16.87) for the Jalal variety. Chapman et al., (1997) and Tusuz and Balabanli (1997) stated that the cob size significantly reduce at higher dosages and the seeds production was absolute and significantly associated with cob length. Sanvicente et al., (1998); Mather et al., (1998); Khakim et al., (1998) find out the grain yield had an optimistic and a significant genotypic association with a number of grain for each cob also reported that the size of cob constantly decrease with the raise of ionization radiation Ravilla et al., (1999) and Torun et al., (1999) documented the GCA and SCA influence on the length of cob. All previously mentioned debate has arrived at on one aim that higher doses decrease the cob length and instantly effect the production of the maize crop.

Number of grains rows per cob.

The evaluation of difference (Appendix 6b) demonstrates that the fluctuation in the values of the number of grain row per cob in response to radiation dosages was revealed highly significant, and the effect of varieties found insignificant. While the interaction within the varieties and dosages was too noticed significant. From table (6a) it realized that the mean value for the number of grains per row cob were significantly different as raise the ionization irradiation intensity number of grains for each row cob reduces other than 10 Krad. The effect of multiple ionization rays for the number of grain row per cob ranged from 11.76-18.48. The cultivars effects revealed 14.03 and 14.1 correspondingly for Azam and Jalal. Moreover the interaction within cultivars and gamma irradiation were viewed significantly and their mean values was organize from 11.66-18.23 for Azam while 11.86-18.73 for the Jalal. Maximal percent, enhancing observed at 10 Krad dose of gamma radiation Azam for (36.03%) and Jalal for (36.67%) over the control. The maximum percent reduction was noted (16.89, 11.02%) respectively Azam and Jalal. The uppermost mean values were obtained at 10 Krad (18.23) for Azam and (18.73) for Jalal while the smallest mean values were observed at 15 Krad dose (11.66, 11.86) respectively Azam and Jalal. Singh et al., (1998); Khakim et al., (1998); Sanvicente et al., (1998); Mather et al., (1998); Almeida et al., (1999) and Nass et al., (2000) determined that number of grain rows per cob had important relationship having the increasing of ionization radiation level. Previously discussed that mean value of the worth of mutant seed at 40 gray indicated greater number of grain rows per cob when compared with control, and smallest value for number of

rows per cob were seen at 60 gray This sindictes that multiple dosages of ionization radiation introduced variations in genetic material which leads to variation in number of rows per cobs arbitrarily. A number of| grain row per cob is a vital feature that is morphological and allows us to to estimate production of this regarding the maize crop.

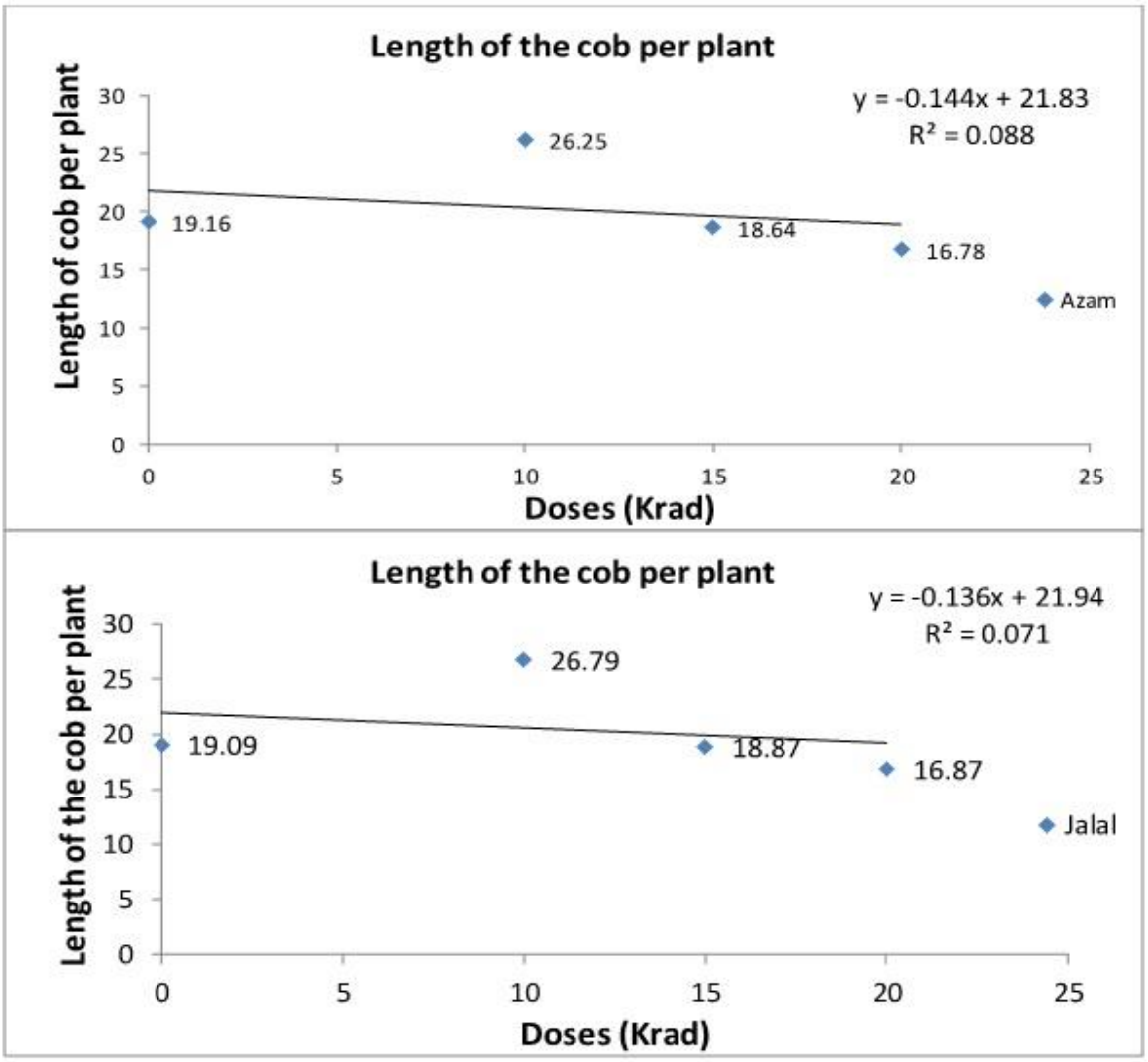

Figure 5: Impact of ionization irradiation on length of cob per plant for Azam and Jalal varieties

Table 5a: Effects of ionization irradiation on the length of cob per plant for Azam and Jalal hybrids.

T0 Control	19.16 ab	19.09 ab
T1 10 Krad	26.25 ab	26.79 a
T1 15 Krad	18.64 ab	18.87 ab
T1 20 Krad	16.78 b	16.87 b
Mean	20.2	20.4

Mean using the the same alphabetic are not significantly various with respect to Tukey's Least significant difference at 5% probability level.

Table 5b: Summary of statistics for the length of cob per plant in maize hybrids due to ionization irradiation.

Source.	D.F	S.S	M.S	F value	Prob	Sig
Replication.	2	4.367	2.18352			
Hybrids.	1	0.238	0.238	0.34	0.04209	*
Replication Error*Hybrids.	2	1.4182	0.70912			
Treatment.	3	25.75	8.58335	3.82	0.03941	*
Hybrids*Treatment.	3	0.3029	0.10097	0.04	0.05867	*
Erorr*Rep*Treatment.	12	26.9881	2.24901			
Total	23					

Abbreviations in tables symbolizing: DF "degree of freedom", SS "sum of square", MS "means square", F "fisher", P "probability value", Sig "significant via Tukey HSD test", ** "highly significant", * "significant"

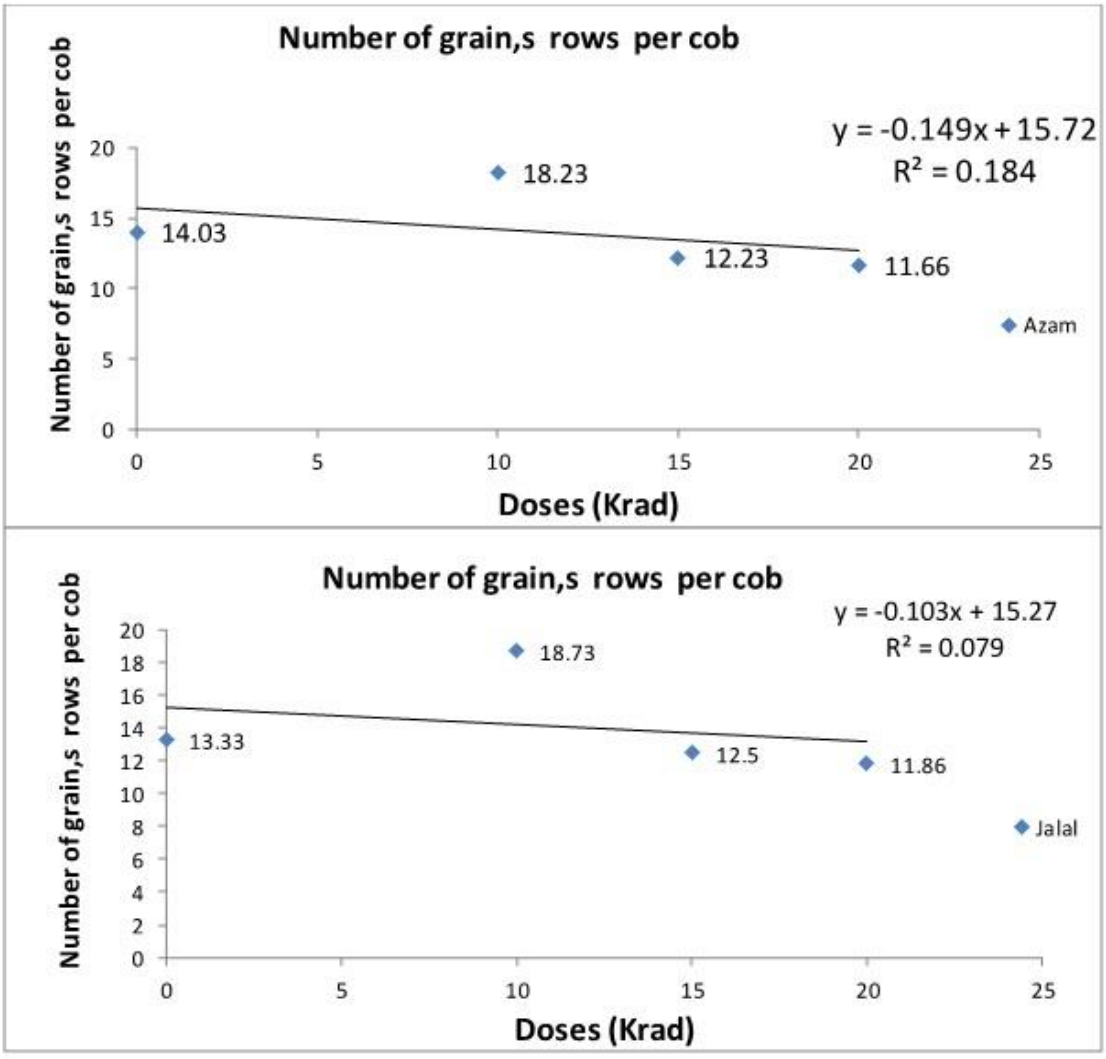

Figure 6: Impact of ionization irradiation on number of grain row per cob for Azam and Jalal varieties

Table 6a Effects of ionization irradiation on the number of grain row per cob for Azam and Jalal hybrids

T0 Control	14.03 a	13.33 ab
T1 10 Krad	18.23 ab	18.73 a
T1 15 Krad	12.23 c	12.5 bc
T1 20 Krad	11.66 c	11.86 c
Mean	14.03	14.1

Mean using the the same alphabetic are not significantly various with respect to Tukey's Least significant difference at 5% probability level.

Table 6b. Summary of statistics for number of grain row per cob in maize hybrids due to ionization irradiation.

Source.	D.F	S.S	M.S	F value	Prob	Sig
Replication.	2	11.7075	5.85375			
Hybrids.	1	0.0267	0.02667	0.13	0.7517	NS
Replication Error*Hybrids.	2	0.4058	0.20292			
Treatment.	3	15.0017	5.00056	19.52	0.0001	**
Hybrids*Treatment.	3	1.25	0.41667	1.63	0.02352	*
Erorr*Rep*Treatment.	12	3.0733	0.25611			
Total	23					

Abbreviations in tables symbolizing: DF "degree of freedom", SS "sum of square", MS "means square", F "fisher", P "probability value", Sig "significant via Tukey HSD test", ** "highly significant", * "significant"

Number of grains per row.

Conclusion of statistics for cob length (Appendix 7b) reflect that the influence of ionizing radiation dosage was non- significant and the varietal effect found significant and similarly the relationships of ionization radiation doses and varieties was also insignificant. From table (7a) it calculated that the mean value for number of grain for each row were significantly varied as raise the ionization radiation level the number of grain for each row constantly reduces. The influence of ionization irradiation of multiple dosage ranged from 36.64-39.3. And the cultivars effects have been found 38.02 and 38.13 respectively for Azam and Jalal variety. While the relationship within cultivars and gamma irradiation were revealed was organized between 36.16-39.2 for Azam and 37.13-39.4 for Jalal. The maximal percent reduction was revealed (7.75, 5.76%) respectively Azam and Jalal. The uppermost mean value for number grain row per was obtained at control. Similarly the smallest mean values were seen at 20 Krad dose (36.16, 37.13) correspondingly Azam and Jalal. Khan et al., (2003), Irfaq and Nawab (2003). Galal et al., (1975) Yildirum et al., (1989) Yousafzai et al., (2009) and Wali et al., (2010) observed that the number grains per row and per plant significantly reduces with the enhancing of ionization irradiation rate. However, in the current scenario, it could be determined that ionization irradiation failed to induce mutation, particularly in case of the number grains per row because of grains per row was significantly reduced as compare to into the control. The current phenomenon could be developed blatantly; polygenic mutation took place at random and would not adhere any specific design, this occurrences have also been stated by Brock, (1965) and Astveit, (1967).

Number of grains per cob.

Summary statistics for cob length (Appendix 8b) show that the effect of ionizing radiation dosage was highly significant and the varietal effect has been found insignificant and the interaction within the ionization radiation doses and varieties was significant. At table (8a) it

decided that the mean value for number of grains for each cob were significantly varied as raising the ionization radiation concentration the number of grain for each row constantly reduces. The influence of ionization irradiation of multiple dosage ranged from 401.45-536.48 And the cultivars effects have been found 498.4 and 496.44 respectively for Azam and Jalal variety. While the relationship within cultivars and gamma irradiation were revealed was organized between 396.7-549.23 for Azam and 406.2-523.73 for Jalal. The max percent reduction was exposed (27.77, 22.44%) respectively Azam and Jalal. The highest mean value for number grain per cob was found out at control. While the smallest mean values were seen at 20 Krad dose (396.7, 406.2) Inamullah et al., (2011) Khan et al., (2003), Irfaq and Nawab (2003). Galal et al., (1975) Yildirum et al., (1989) explore the significant decrease in munber of grain per cob and per plant with the raising of ioniozation radiation power. El-Hosary et al., (1994); Lee et al., (1995); Bolanos and Edmeades (1996); Flower et al., (1996); Singh and Mishra (1996); Balderrama et al., (1997) and Chapman et al., (1997) found additive kind of gene action for number of grains per cob with a few other yield associated parameters. Numerous genes were concerned to manage one characteristic. As before described, we are able to summarize that mutagenic elements induce damaging variation due to number of grains in cob had been minimized to an excellent level in most dosage as evaluate into the control treatment.

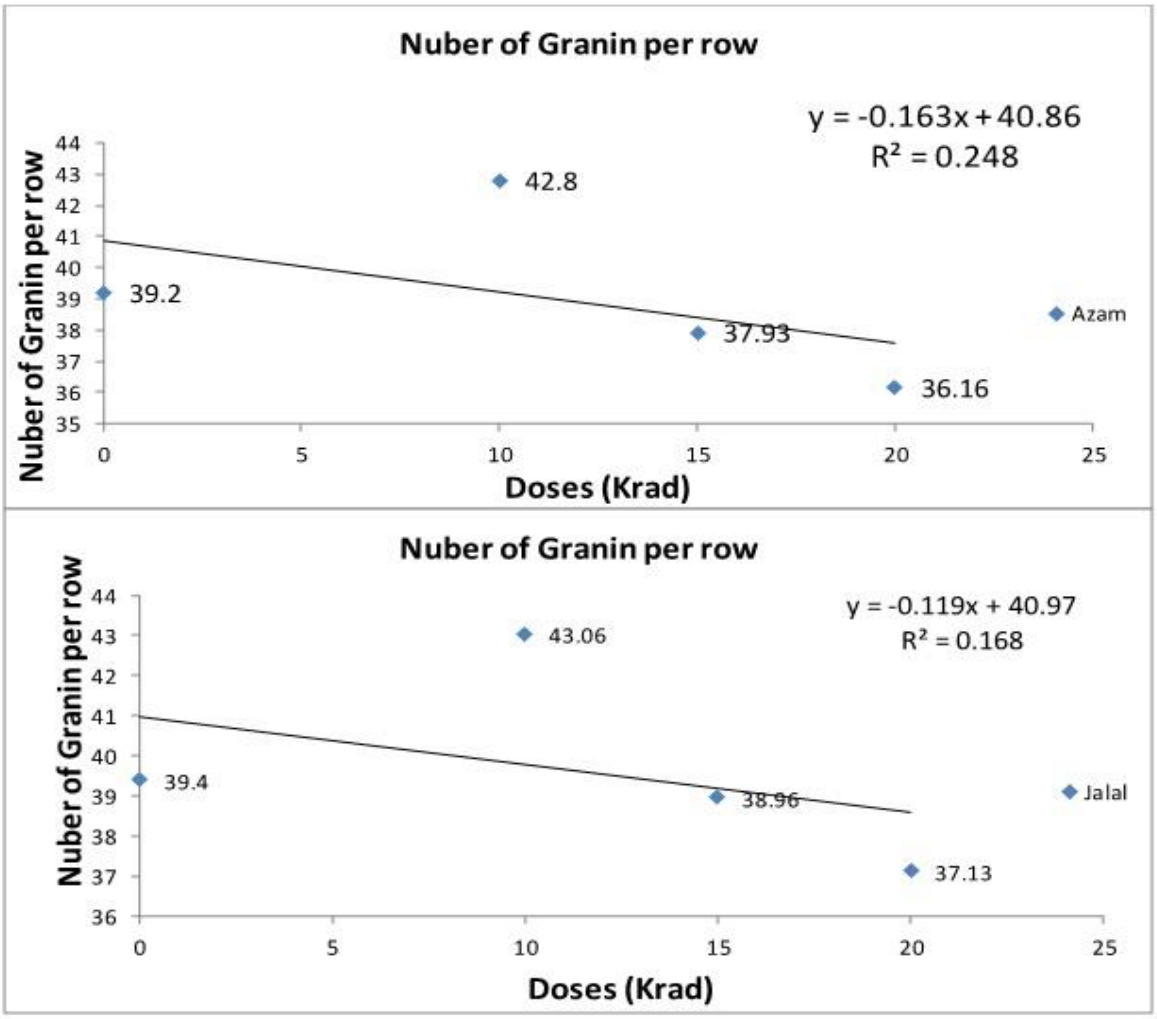

Figure 7: Impact of ionization irradiation on number of grain per row for Azam and Jalal varieties.

Table 7a: Effect of ionization irradiations on the number of grain row per cob for Azam and Jalal hybrids.

T0 Control	39.2 a	39.4 a
T1 10 Krad	42.8 ab	43.06 ab
T1 15 Krad	37.93 ab	38.96 ab
T1 20 Krad	36.16 b	37.13 ab
Mean	39.02	39.63

Mean using the the same alphabetic are not significantly various with respect to Tukey's Least significant difference at 5% probability level.

Table 7b: Summary of statistics for number of grain row per cob in maize hybrids due to ionization irradiation.

Source.	D.F	S.S	M.S	F value	Prob	Sig
Replication.	2	24.1233	12.0617			
Hybrids.	1	2.2204	2.2204	47.58	0.0204	*
Replication Error*Hybrids.	2	0.0933	0.0467			
Treatment.	3	21.9079	7.3026	1.87	0.1893	NS
Hybrids*Treatment.	3	0.9312	0.3104	0.08	0.97	NS
Erorr*Rep*Treatment.	12	46.9833	3.9153			
Total	23					

Abbreviations in tables symbolizing: DF "degree of freedom", SS "sum of square", MS "means square", F "fisher", P "probability value", Sig "significant via Tukey HSD test", ** "highly significant", * "significant"

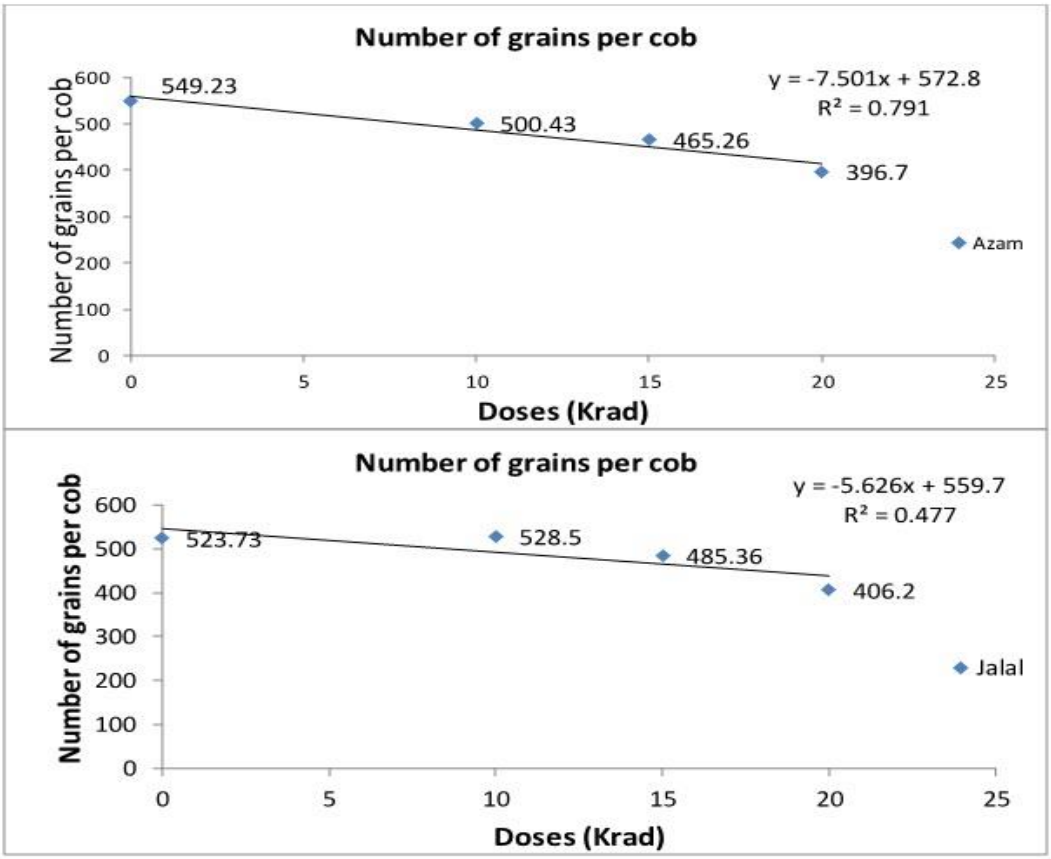

Figure 8: Impact of ionization irradiation on number of grain per cob for Azam and Jalal varieties.

Table 8a: Effect of ionizations irradiations on the number of grains per cob for Azam and Jalal hybrids.

T0 Control	549.23 a	523.73 a
T1 10 Krad	500.43 b	528.5 b
T1 15 Krad	465.26 c	485.36 c
T1 20 Krad	396.7 d	406.2 d
Mean	498.4	496.44

Mean using the the same alphabetic are not significantly various with respect to Tukey's Least significant difference at 5% probability level.

Table 8b: Summary of statistics for the number of grains per cob in maize hybrids due to ionization irradiation.

Source.	D.F	S.S	M.S	F value	Prob	Sig
Replication.	2	28021.9	14010.9			
Hybrids.	1	388	388	2.92	0.02295	*
Replication Error*Hybrids.	2	265.6	132.8			
Treatment.	3	39819.8	13273.3	12.15	0.0006	**
Hybrids*Treatment.	3	2510.4	836.8	0.77	0.05346	*
Erorr*Rep*Treatment.	12	13106.2	1092.2			
Total	23					

Abbreviations in tables symbolizing: DF "degree of freedom", SS "sum of square", MS "means square", F, "fisher", P, "probability value", Sig, "significant via Tukey HSD test", ** "highly significant", * "significant"

100 grains weight (gm).

Analysis of difference for 100 grain weight (Appendix 9b) reflects that the effect of ionizing radiation dosage and varietal effect found significant while the interaction within ionization radiation doses and varieties was observed insignificant. It finds out from the (Table 9a) that the fluctuation within the revealed mean values were various because of multiple ionization radiation dosage effect. The described mean values for 100 grain weight as a result of the ionization irradiation effect ranging from 14.76-22.54. The variation in the mean values because of cultivars ranged from effect 18.83 for Azam and 19.03 for Jalal. The interaction inside ionization irradiation and cultivars influence for 100 seed weight (gm) put from 14.45-22.4 and 15.07-22.68 for Azam and Jalal respectively. {In this analysis a coincident decline in the mean value of 1000-grain weight was seen because of raising multiple irradiation concentration. Maximal percent reduction documented (35.49, 33.55%) respectively Azam and Jalal. The highest mean value reported for 100 grain weight noticed at control (22.4) for Azam and (22.54) regarding Jalal. Although the smallest mean values were revealed at 20 Krad dose (14.45,15.07) respectively Azam and Jalal. Irfaq and Nwab (2001) explored the inversely proportional effect of various levels of ionization radiation on different variety there was an amazing reduction in 1000-seed weight as the ionization irradiation concentration raise the 1000 grain weight constantly reduce Sedhom (1994); Elhosary *et* al., (1994); Lee et al., (1995); Singh and Mishra (1996); Flower et al., (1996); Bolanos and Edmeades (1996); Chapman et al., (1997) and Balderrama et al., (1997) detected accumulative gene action was most prominent within the dominance gene action towards 100-seed weight.

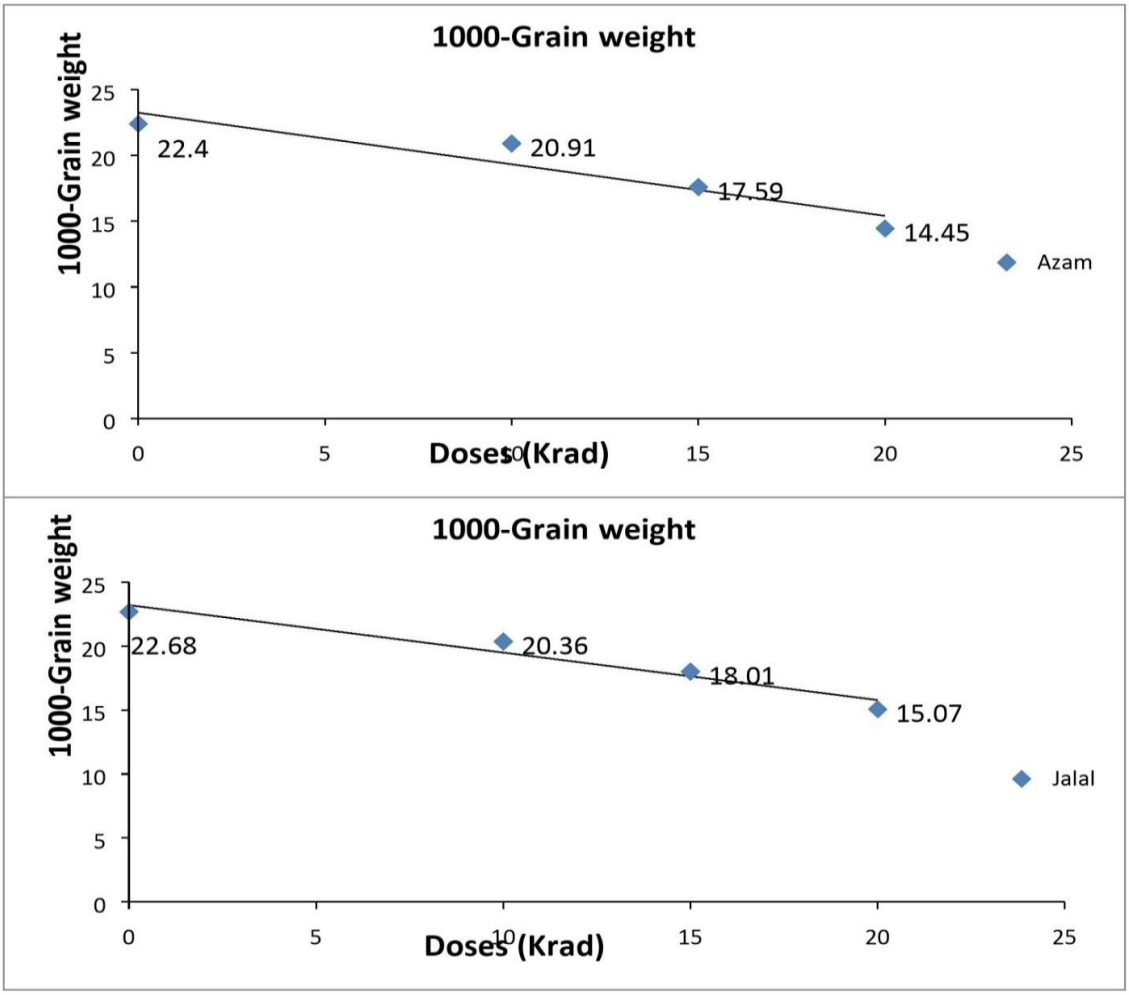

Figure 9: Impact of ionization irradiation on 100 grain weight for Azam and Jalal varieties

Table 9a: Effect of ionizations irradiations on the 100 grain weight for Azam and Jalal hybrids.

T0 Control	**22.4 ab**	**22.68 a**
T1 10 Krad	**20.91 ab**	**20.36 ab**
T1 15 Krad	**17.59 ab**	**18.01 ab**
T1 20 Krad	**14.45 c**	**15.07 c**
Mean	**18.83**	**19.03**

Mean using the same alphabetic are not significantly various with respect to Tukey's Least significant difference at 5% probability level**.**

Table 9b: Summary of statistics for 100 grain weight in maize hybrids due to ionization irradiation.

Source.	D.F	S.S	M.S	F value	Prob	Sig
Replication.	2	6.859	3.4295			
Hybrids.	1	0.9841	0.98415	20	0.0465	*
Replication Error*Hybrids.	2	0.0984	0.04921			
Treatment.	3	10.4799	3.4933	1.77	0.02054	*
Hybrids*Treatment.	3	0.1301	0.04336	0.02	0.9953	NS
Erorr*Rep*Treatment.	12	23.6198	1.96831			
Total	23					

Abbreviations in tables symbolizing: DF, "degree of freedom", SS, "sum of square", MS "means square", F, "fisher", P "probability value", Sig, "significant via Tukey HSD test", ** "highly significant", * "significant"

CONCLUSION

Each variables yield minimizes through the raising of ionizarion radiation extent while the harmful impact of higher doses of ionizing radiation dose caused by various other climatically state and environmental aspect particularly uppermost soil surface, moisture, soil chemistry, temperature, light extent especially as a result of substantial height. Both varieties calculated as fragile to increasing doses of ionization radiation, which causing to a reduce in the mean values of the most of the variables. Invaluable mutant can gained at 10 Krad dosage . In 10 Krad dose have the capacity to induce the optimum occurrence of mutation in maize variety of Azam and Jalal through revealing it to gamma radiation (10 Krad).

CONFLICT OF INTEREST

The authors declare that they have no ambitious pursuit.

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AUTHOR CONTRIBUTIONS

Ahamad hasan designed and performed the experiments.Sharifullah helped in seed irradiation and data collection. Amir Hasan Khan wrote the draft manuscript. Ateeur Rahman and khaleeq Ahmad compile and Analyzed the Data. Muhammad Abdul aziz and Muhammad Adnan gave technical suggestions on the draft and revealed the language and grammatical mistakes. Khan sheer and Ali Hazrat supervised. All the stages. All the authors consent and approved the Manuscript.

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