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Characterization of Effect of Gamma Ray Induced Mutations on Morpho-Agronomic Traits of Dolichos Lablab (*Lablab purpureus l*.) Sweet

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Authors' contributions

This work was carried out in collaboration among all authors. Author SKK designed the study, wrote the protocol and the first draft of the manuscript. Author MGK provided the germplasms; Authors KCP and AKE reviewed the experimental design and all drafts of the manuscript. Author EC managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

Lablab purpureus (L.) Synonym Dolichos *lablab* (L.) Sweet; is a minor and an important multipurpose legume. Despite this it classified as an orphaned crop hence few studies on its improvement have been undertaken. Limited studies have been carried out on use of mutation on dolichos improvement. Four elite Lablab genotypes coded G1, B1, M5 and W7 were mutagenized with two doses of gamma radiation 300Gy and 400 Gy with objective to study the effect of mutation on various agronomical traits at M2 generation. Data on effect of irradiation on lablab was collected 10 randomly selected plants of on each plot .The traits evaluated were leaf length, leaf width, number of raceme per plant, raceme length, pod length, pod width, plant height, dry seed yield per plant and seed length and seed width. For these traits mean of mutant plants was significantly different from mean of control plants at $P \leq 0.05$. Mutant accessions of B1, M5 and W7 genotypes exhibited wide mutation spectra after mutagenesis of albino, leafiness, upright single stem, seedless pod, short dwarf pod, variegated leaf, variation in flower colour, variation in

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growth habit, leaf shape, seed colour. Gamma irradiation doses of 300 Gy and 400 Gy were potent in mutagenesis of the studied dolichos lablab. The agronomically diverse mutants are an important resource for dolichos improvement through breeding and genetic studies. Mutants with variegated leafs and flower colour can be used in the landscaping while those different seed colour could be used in the improvement of sensory and cooking qualities of other native dolichos lablab beans.

Keywords: Dolichos bean; novel mutations; genetic variation; mutation breeding; orphan crop; accessions.

1. INTRODUCTION

Dolichos lablab (*Lablab purpureus L.* Sweet*)* is one of the most native pulse crop in Asia and Africa [1]. According to [2] and [3] lablab *purpureus* is a species of tropical Asian origin. However based on the distribution of ancestral form sub species *uncinatus* [1] postulated an east African origin. It is referred to as an 'orphan legume crop' [4] due to their limited cultivation, production and utilization compared to other commercial cash crops. Dolichos lablab is a multipurpose crop rich in proximate nutritional values, other uses are as a fodder, forage, cover crop, green manure and as an ornamental plant [5,6]. It has been also used in various ethnobotanical and communal food functions and studies. Some genotypes are heat and drought tolerant [7]. The cultivated Dolichos lablab accessions are highly self-pollinated (cleistogamous) and the percentage of natural variability is low. The low genetic variability is further limited by probably few breeding programs, unavailability of breeding materials and cooking and non-taste preference of some genotypes. This challenges creates invaluable opportunities for dolichos breeders to improve the crop. Plant mutation technologies: chemical and physical mutagenesis were first identified by plant breeders through the analogy of spontaneous mutants. Mutations derived by both methodologies are proven to generate useful variation in both vegetative and seed propagated crops where crop genetic diversity is inadequate according to [8]. Plant breeders have over the years documented the potential of induced mutations through correlation the performance of new plant accessions derived from mutations [9,10]. Biotic resistance, altered stature, increased yield, and other quality or quantity traits fixed a good genetic background is a very attractive component and a looked for mutation in breeding programme. Applying this process is in breeding is simpler and quicker than crossing with exotic source, and is one of the foremost reasons for the extensive use of mutated alleles in breeding of various species [11]. The desired traits in mutant accessions can be selected from the second or third generation after mutagenic treatments and released as novel cultivars after rigorous agronomic evaluation [12]. Over three thousand significant cultivars from over 220 crop species have been released and utilized as cash crops and food crops globally the last decade [13,14]. Gamma irradiations produced by cobalt ^{60}(Co^{60}) facilities can also be negatively or positively potent in plants although currently there are no recorded significant impact of mutants on environment, flora and fauna. The optimum mutation doses as described by [15] can be determined by recording seed germination and emergence percentages and other plant growth parameters. However according [16] research studies on cowpea did not report an optimal dose of recommendation for cowpea due to differences in genotypic response to the treatment. The same has not been documented in dolichos lablab purpureus genotypes in Kenya. [17] reported that physical mutagens such as gamma irradiation is capable of creating structural changes in the chromosomes viz., deletions, duplication, inversions and translocations causing phenotypic changes in the morphology, anatomy, biochemistry and physiology of plants. The resultant chromosomal macro mutation can be easily selected in the M2 generation.

The objective of the present study was to determine the effect of gamma irradiation at M2 generation on different plant quantitative and qualitative characters in four elite Kenyan dolichos Lablab (*Lablab purpureus .L*) genotypes.

2. MATERIALS AND METHODS

2.1 Gamma Radiation

The study was carried out at university of Eldoret. Dolichos lablab bean seeds were provided by the biotechnology department dolichos research project. To determine the effects of gamma radiations on morpho-agronomic traits, 1000 seeds from Eldo-KT Maridadi, Eldo-KT Black 1, Eldo KT Black 2 and Eldo KT cream varieties coded as B1, W7, G1 and M5 respectively as indicated in Table 1 and figure 1were irradiated with 0 kGy, 300 kGy and 400 kGy doses of gamma radiations with a cobalt 60 (60Co) source Plant Genetics and Breeding Laboratories (PGBL) in Seibersdorf laboratories, Vienna, Austria in 2018. Irradiated seeds were grown as M1 in the long rains of April-November and bulk harvested per mutation dose per genotype in 2019. The M2 populations were screened in May through November 2020.

2.2 Field Trials

The M2 seed per genotype of M1 plants bulk harvested in 2019 were evaluated at University of Eldoret biotechnology field as indicated in Table 1. The site has an altitude of 2180 meters above sea level (masl), it consists primarily of an agro ecological zone LH3; latitude of 0°15' 31.64" S and longitude 35° 18' 17.96"E [1]. The average annual rainfall is 900 mm to 1000mm of a bimodal distribution. The mean air temperature ranges from 15 to 28 °C. The soil type is rhodic ferralsols non humic cambisols with impoverished acidic soils, low nutrient availability and moisture storage. The M2 seed per genotype per dose as indicated in Table 1 were grown during the rainy season of May to November 2020 in a spacing of 60cm by 40cm. The selection procedure was undertaken based on methods adapted from [11]. The mutants were grown with no fertilizer applications in all treatments and data collected from emergence to maturity with standard agronomic practices being implemented including crop protection measures. A total 17 characters were selected for evaluation of effect of mutation on dolichos bean. Quantitative data was collected from 10 randomly selected plants on Leaf length(LL) ,leaf let length (LLL),leaf width (LW), Flower bud length (FBL), Flower bud width (FBW), Number of flower buds per raceme, (NFB/R) Number of raceme per plant (NR/P), Number of buds per node(NB/N), Number of nodes per raceme (NN/R) , Raceme length in cm (RLC), days to 50% flowering (DTF), pod length (PL) , Pod width (PW) days to 50% maturity (DMT), Plant height in cm (PH), 100 seed weight (HSW) in gram and SYP in gram seed length (SL) in mm and seed width (SW) .The collected data were subjected to analysis of variance using SAS. Main effects were separated by least significant differences (LSD) at P = 0.05 level.

Fig. 1. Dolichos genotypes G1, B1, W7 and M5 irradiated at 300 gy and 400 gy at plant genetics and breeding laboratories (PGBL) at IAEA/FAO Seibersdorf, Vienna, Austria in 2018

Table1. Quantity of dolichos accessions screened in M2 at university of eldoret research field

Gamma irradiation doses (Gy)	Number of seeds planted per accession			
	B1	M5	G1	W7
0	900	900	900	900
300	900	980	900	900
400	900	900	950	800

3. RESULTS

In the present study effects of irradiation of gamma rays on dolichos lablab are summarized in Table 2 and presented in Figs. 1 and 2. Significant differences at P=0.05 and P =0.01 in leaf length between genotypes and irradiation doses were recorded. Gamma irradiation dose of 300gy significantly increased the leaf length in all the genotypes than dose 0 gy and dose 400 gy as presented on Fig. 2. The leaf length increased to 9.90 cm in M5, 10.00 cm in W7, 12.80cm in B1 and 12.30 cm in G1. Leaf width (LW) in cm was significant at 8.20cm in M5.There was no significant differences in leaf let length and number of flower buds per raceme in all the genotypes under the study. The number of raceme per plant reduced significantly in M5 to 13.90 while the other genotypes did not have any significant difference. All the genotypes recorded significant differences in raceme length in (cm) with significant increament from dose 0 Gy to 400 Gy.The average raceme length in M5 being 36.10 cm, 48.70 cm and 74.90 cm, W7 recorded 39.20, 63.00 and 93.20,B1 recorded 36.00, 58.30 and 74.30 and lastly genotype G1 had raceme length of 37.90 cm, 46.20 cm and 74.50 cm. The number of nodes per raceme were significantly different only in B1 genotype from 6.60 to 7.80 in 0 Gy and 400 Gy respectively. The number of buds per node (NBN) was significantly different between dose 0 Gy and 400 Gy in genotype B1 and G1. B1 recorded 3.50 and 2.70 while G1 had 2.90 and 2.20 number of buds respectively. There was a significant difference on pod length all the genotypes on irradiation dose 300 Gy. The highest significant difference was: 4.70cm in M5, 5.29 cm in W7, 5.04cm in B1 and 5.08 cm in G1. Only B1 genotype recorded significant decrease on width from 1.63cm to 1.37cm on dose 0 Gy and 400 Gy respectively. Days to maturity was significant in B1 and G1 with dose 300Gy recording 114 days compared to 120 days for dose 0 Gy, G1 dose 400 Gy recorded significantly more days maturity to126 while 0gy recorded 120.50 days that was not significantly different on days to maturity at dose 400Gy. Effect of radiation dose 300gy and 400gy significantly reduced plant height of M5 to 47.00cm and 48.50cm compared to 60.30 cm of 0 Gy, W7 also recorded significant reduction from 66cm in dose 0Gy to 58.50 cm in dose 300 Gy, G1 posted a reduced plant height significantly from 81.50cm in 0Gy to 66.50 cm and 60.0 in 300 Gy and 400Gy which was not significantly different. Seed width significantly differed between dose 0 Gy at 24.90mm and dose 400Gy having a width of 22.90 mm.Mutation dose of 300 Gy was significantly different in W7 with an increased mean of 32.10 mm compared to significant difference in irradiation dose of 0 Gy and 400 Gy that recorded 27.30 mm and 25.30 mm.Results of effect of irradiation dose on dry seed yield per plant indicate that dose of 300Gy produced the highest significant mean difference at 51.54grams in dry seed yield per plant at while 0 Gy and 400 Gy were 36.15 grams and 24.53 gram.Irradiation of W7 with doses 300 Gy and 400 Gy produced significantly the highest mean DSYPP of 85.46gms and 82.84gms against 53.11 gms in non-irradiated material 0 Gy.G1 genotype recorded the same trend to B1 on DSYPP at 76.41 gms, 62.86 gms and 36.69 gms in irradiation doses of 300 Gy ,400 Gy and 0 Gy. Genotype B1 at irradiation the dose of 400 Gy produced the highest significant DSYPP at 88.82 gms while 300 Gy and 0 Gy produced 79.02 gms and 57.07 gms respectively as indicated in Fig. 2 below. Genotypes M5, W7 and B1 recorded significant difference in seed length in millimeters dose 400 Gy caused significant different seed length increase of 5.46 mm compared to 0 Gy (3.92 mm) and 300 Gy (4.47 mm) in M5. There was significant increase in seed length on irradiation of W7 with mutation dose of 300 Gy at 8.86 mm and a significant decrease due to mutation dose of 400 Gy to 6.39 mm when compared to non-mutated material at 0 Gy. Mutation effect on B1 for seed length resulted in significant difference with mean seed length of 400 Gy being 9.54 mm, 300 Gy 6.57 mm and 0 Gy 4.37 mm. Genotype G1 did not significantly record mean changes in measurement of seed length in mm. Only genotype W7 recorded significant difference in seed width in (mm) in this study with irradiation dose recording 5.70 mm while 0 Gy and 400 Gy were not significantly different.

The traits that recorded significant differences in genotype M5 at P=0.05 and P = 0.01 were leaf length , leaf width, number of raceme per plant, raceme length (cm) ,pod length (cm), plant height (cm), dry seed yield per plant (grams (gms)) and seed length (mm) with recorded means of 7.96 cm, 7.16 cm, 16.73 cm, 53.23 cm,3.79 cm,51.93 cm,37.40 gms and 4.62cm.There was significant differences in mean of W7 genotype in leaf length (8.10 cm), raceme length (65.13 cm),seed width (28.26 mm),dry seed yield per plant (73.80 gms) and seed length (7.60 mm). Significant difference in B1 were recorded in leaf length (11.36 cm), raceme length (56.20

cm),number of nodes per raceme (6.80), number of buds per node (3.06), pod length (4.35 cm), pod width (1.52 cm), days to maturity (117.23), dry seed yield per plant (74.97) and seed length (6.83 mm).In G1 significant means were noted in leaf length at 10.33 cm, raceme length 74.50 cm, pod length 4.7cm , plant height 69.50 cm, and dry seed yield per plant 58.65 cm.

Results of effect of mutation on qualitative data in M2 generations are presented in Table 3 and in Figs. 3 and 4. The germination percentage ranged of between 75 to 89% among the mutants. Mutants' accessions of M5, W7 and B1 genotypes on irradiation at 400 Gy reduced germination percentage below 80%. While germination for G1 genotype at irradiation dose of 300 was the least at 78% and 400 Gy 84% was the highest. There was a wide spectra of phenotypic abnormalities on mutant dolichos accessions due to gamma irradiation such as albinism, leaf deformity, single stem, seedless pods or short pod sizes were observed among 300 gy and 400 Gy doses. Albino plants were noted at M2 on M5 and B1 accessions on exposure to 300 Gy and 400 Gy, leafy type of mutants were found on 300 Gy and 400 Gy accessions of W7. Plants with upright stems were recorded in B1 accessions of 300 Gy and 400gy. Seedless pods were recovered in accessions 400 Gy in M5, W7 and B1. Short dwarf pods were also collected from M5 and B1 accessions of dose 400 Gy. Segregation of flower colour of white and cream were noted in both mutant accessions of M5. White, pink and purple flower buds were in W7 accessions of 300 Gy and 400 Gy .Flower bud colour in B1 300 Gy and 400 Gy ranged from pink and purple while genotype G1, on irradiation by 300 Gy and 400 Gy did not recorded segregation at the M2 on flower colour. Growth habit variations of determinate, semi determinate and indeterminate were observed in among M5, W7 and B1 the genotypes. Leaf shape ovate, ovate lanceolate, were common in dolichos mutants while lanceolate was noted to commonly occur in 400 Gy of B1 and W7. Seed shape segregated mostly to round, oval and flat among the genotypes B1 and W7. Dry seed colour varied in M5 between white, green, cream and brown and in B1 it ranged from cream, brown and black that were dotted, there was no variation on seed colour that was noted in G1.

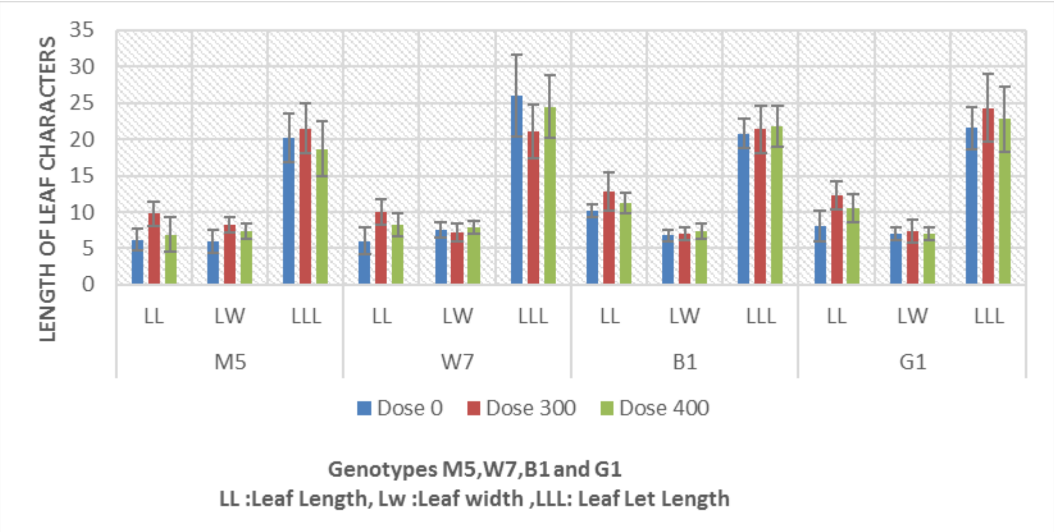

Fig. 2. Effect of different doses of gamma irradiation on parameters: Leaf Length in cm (LL), Leaf width in cm (LW) and Leaf Let Length (LLL) in cm in M2 accessions of M5, W7 B1 and G1 genotypes irradiated with 0Gy, 300Gy and 400Gy

Table 2. Results of effects of dosage rate on various quantitative morphological traits of dolichos lablab *lablab purpureus* (L.) in M2 generation

									TRAITS									
Genotypes	**Dose**	**LL**	**LW**	**LLL**	**NFBR**	**NRPP**	**RLC**	**NNR**	**NBN**	**DF**	**PL**	**PW**	**DTM**	**PH**	**SW**	**DSYP**	**SL**	**ST**
M5	0Gy	6.20B	6.00 B	20.20A	19.40A	16.50BA	36.10C	8.80A	2.80A	61.00A	3.04C	1.64A	118.00 A	60.30A	24.90A	36.15 B	3.92B	1.45A
	300Gy	9.90A	8.20A	21.50A	16.80A	19.80A	48.70B	7.70A	2.60A	60.30A	4.70A	1.64A	118.00 A	47.00B	23.60BA	51.54 A	4.47B	1.77A
	400G y	7.80B	7.30BA	18.70A	18.30A	13.90B	74.90A	9.30A	3.30A	60.90A	3.64B	1.57A	116.70 A	48.50B	22.90B	24.53 C	5.46A	1.83A
	Mean	7.96	7.16	20.13	18.16	16.73	53.23	8.6	2.90	60.73	3.79	1.61	117.86	51.93	23.80	37.40	4.62	1.68
	Pr >F	***	*	NS	NS	*	***	NS	NS	NS	***	NS	NS	*	NS	***	***	NS
	%CV	22.36	19.42	19.38	26.54	28.90	19.24	22.36	25.78	2.11	11.15	7.88	2.63	22.53	7.80	22.51	20.29	35.25
W7	0 Gy	6.00C	7.60 A	26.00A	15.60A	18.00A	39.20C	7.90A	2.50A	62.40A	4.80B	1.73A	139.30 A	66.00A	27.30B	53.11B	7.55B	5.03B
	300G y	10.00A	7.20 A	21.10A	17.40A	16.10A	63.00B	8.70A	2.40A	63.00A	5.29A	1.85A	138.90 A	58.50B	32.10A	85.46 A	8.86A	5.70A
	400G y	8.30B	7.90 A	24.50A	16.10A	18.90A	93.20A	8.90A	2.50A	63.30A	4.90BA	2.05A	143.40 A	63.50BA	25.30B	82.84 A	6.39 C	5.63BA
	Mean	8.10	7.56	23.86	16.36	17.66	65.13	8.50	2.46	62.90	5.01	1.87	140.53	62.66	28.26	73.80	7.60	5.45
	Pr >F	***	NS	NS	NS	NS	***	NS	NS	NS	NS	NS	NS	NS	***	***	***	NS
	CV	20.86	15.11	22.28	27.42	30.22	18.91	22.25	21.92	3.74	9.09	23.75	6.23	12.70	10.92	18.40	12.94	11.89
B1	0Gy	10.01B	6.80 A	19.00A	16.40A	18.50A	36.00C	6.00B	3.50A	63.40A	4.31 B	1.63A	120.40 A	65.50A	25.00A	57.07 C	4.37 C	4.04 A
	300G y	12.80A	7.10 A	21.40A	17.00A	19.50A	58.30B	6.60B	3.00BA	62.70A	5.04 A	1.56A	114.60 B	62.50A	25.68A	79.02 B	6.57 B	4.14 A
	400G y	11.20A	7.30 A	21.80A	14.40A	20.40A	74.30A	7.80A	2.70B	62.60A	3.72 C	1.37B	116.70BA	60.50A	26.20A	88.82 A	9.54 A	4.21 A
	Mean	11.36	7.06	20.73	15.93	19.46	56.20	6.80	3.06	62.90	4.35	1.52	117.23	62.83	25.62	74.97	6.83	4.13
	Pr >F	*	NS	NS	NS	NS	***	*	*	NS	***	***	*	NS	NS	***	***	NS
	CV	18.36	9.85	20.73	21.17	23047	7.89	18.29	22.71	2.87	9.68	9.01	4.20	15.79	6.07	11.84	28.42	22.54
G1	0Gy	8.10C	7.1A	21.60A	14.40A	20.40A	37.90C	7.70A	2.90A	64.30A	4.43B	1.79A	120.40 B	81.50A	25.40A	36.692B	9.32 A	5.77 A
	300G y	12.30A	7.30 A	24.30A	18.70A	17.90A	46.20B	8.90A	2.60BA	62.80A	5.08A	1.83	123.30BA	66.50B	25.30A	76.41 A	9.22 A	5.21 A
	400G y	10.60B	7.0A	22.80A	16.00A	17.20A	74.50A	7.70A	2.20B	62.50A	4.68BA	1.65A	126.50 A	60.50B	25.20A	62.86 A	9.02 A	5.36 A
	Mean	10.33	7.13	22.90	16.36	18.50	52.8	8.1	2.56	63.20	4.7	1.75	123.40	69.50	25.30	58.65	9.19	5.45
	Pr >F	***	NS	NS	NS	NS	***	NS	NS	NS	*	NS	NS	***	NS	***	NS	NS
	%CV	15.59	16.69	19.47	29.21	30.54	11.59	21.59	28.3	3.73	9.97	12.2	4.54	11.04	8.95	25.66	10.98	27.95

and * significant at 5% and 1% Where: Leaf length (LL), Leaf width (LW), Leaflet length (LLL), Number of flower buds per raceme (NFBR), Number of raceme per plant (NRPP), Raceme length in cm (RLC), Number of nodes per raceme (NNR), Number of buds per node(NBN), Days to flowering (DF), Pod length (PL), Pod width (PW), Days to Maturity (DTM), Plant height (PH), Seed length in mm (SL), Seed thickness (ST), Dry seed yield per plant (DSYPP)*

Table 3. Results of qualitative efects of diferent dose rates of mutation on phenotypic characteristics observed in M2 accessions of dolichos in 2020

Dolichos M2 generation									
Variety	**Dose (Gy)**	**No of plants**	**EG%**	**ABN**	**FBC**	**GH**	**LS**	**SS**	**DSC**
M5	0	900	97	0	1	2	3	3	3
	300	980	89	0,1,	1,2	1,2,3	1,3,5	2,3	1,2,3
	400	900	78	0,1,4,5	1,2	1,2,3	3,5	3	1,2,3,5
W7	0	900	94	0	5	2	5	2	6
	300	900	84	0,2	1,2,5	2,3	3,5	1,2,3	3,6
	400	800	78	0,2,4	1,5	1,2,3	3,5,7	1,2,3	3,5,6
B1	0	900	96	0	5	2	3	2	5
	300	900	84	0,1,3	4,5	1,2	3,5	1,2	3,5,6
	400	900	75	0,1,3,4,5	4,5	1,2,3	3,5,7	1,2,3	3,5,6
G1	0	900	95	0	5	2	3	1	6
	300	900	78	0	5	2	3	1	6
	400	950	84	0	5	2	3	1	6

%G= percent germination, ABN= Abnormalities observed, where 0= normal, 1= Albino, 2= leafy type, 3 = upright single stem, 4=seedless pods and 5= short dwarf pods, FBC =flower bud colour, where 1=white, 2=cream, 3=light yellow,4=pink, 5=purple, GH =Growth habit where 1=determinate, 2=semidetermnate,3=indeterminate,4=others, LS=leaf shape where1=round, 3=ovate, 5=ovate lanceolate, 7=lanceolate ,9=linear lanceolate. SS= Seed shape where1=round, 2=oval, 3=flat, 4=others. DSC= dry seed colour where 1=white, 2=green, 3=cream, 4=purple, 5=brown and 6=black

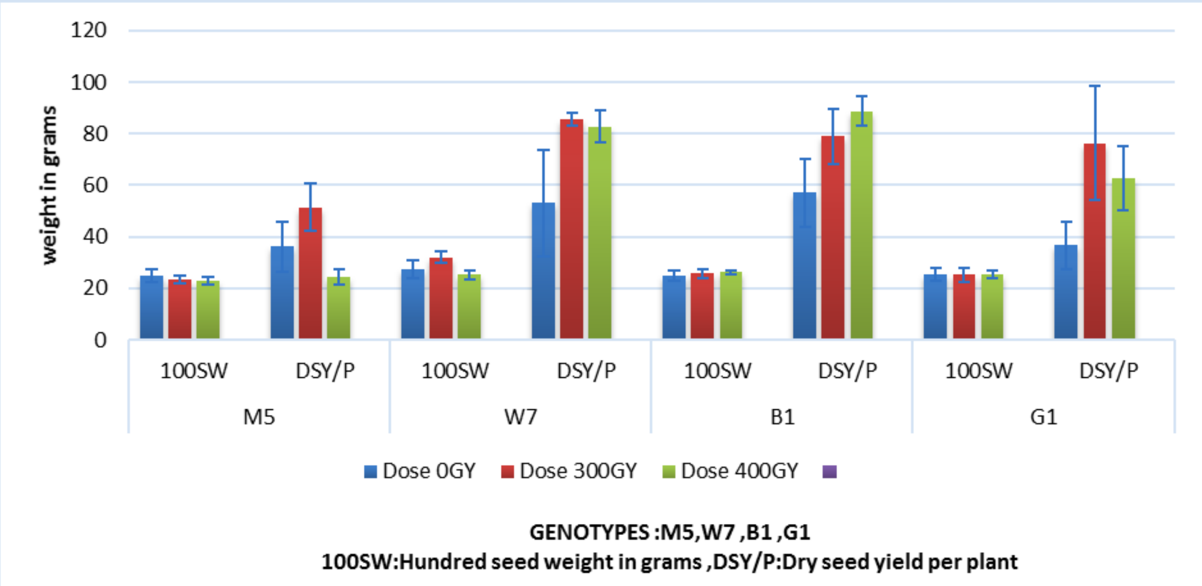

Fig. 3. Effect of mutation on seed Parameters: 100 SW (Seed weight) and DSY/P (dry seed yield per plant) in M2 accessions of M5, W7 B1 and G1 genotypes irradiated with 0Gy, 300Gy and 400Gy

4. DISCUSSION

The application gamma radiations on dolichos lablab resulted in a range of variations among the phenotypic traits in all the four dolichos genotypes. Segregation was evident among the M2 generation of the dolichos lablab for quantitative and qualitative traits in this study. This was in conformation that gamma ray produces high mutation frequency (MF), wide mutation spectrum and the frequent induction of large deletions and chromosomal rearrangements [18] The of effect of mutation in 13 out of 17 studied characters of dolichos indicates that gamma irradiation at 300gy and 400gy or higher can significantly cause genetic change in dolichos lablab. Ionizing radiation of gamma ray's has an impact on growth and morphological traits especially when the irradiated material is dry seed. The shoot meristem of the plants derived from irradiated dry seeds have been documented to take deleterious mutations, which lead to abnormal gametogenesis and embryonic lethality [19]. The reduction in plant height and other plant organs such as raceme length, leaf size observed in the current study may be attributed decreased mitotic activity of meristematic tissues among the dolichos mutants. It could also occur as a result of the effect on few genes or oligogenes yielding macro mutations [15]. Such kind of mutations have been reported on research of effect of mutation on cowpea [8], where by tall non branching mutant was recovered from 100Gy. [16] reported that there was substantial decrease on germination, epicotyl and hypocotyl lengths on cowpea on exposure to increasing doses of gamma radiation and that germination percent dropped from 100% (at 0 Gy, control treatment) to 0% when applying 300 and 400 Gy. Similar variations due to gamma mutations have also been reported in plant height, number of kernels per spike and spike length by [20] on barley.

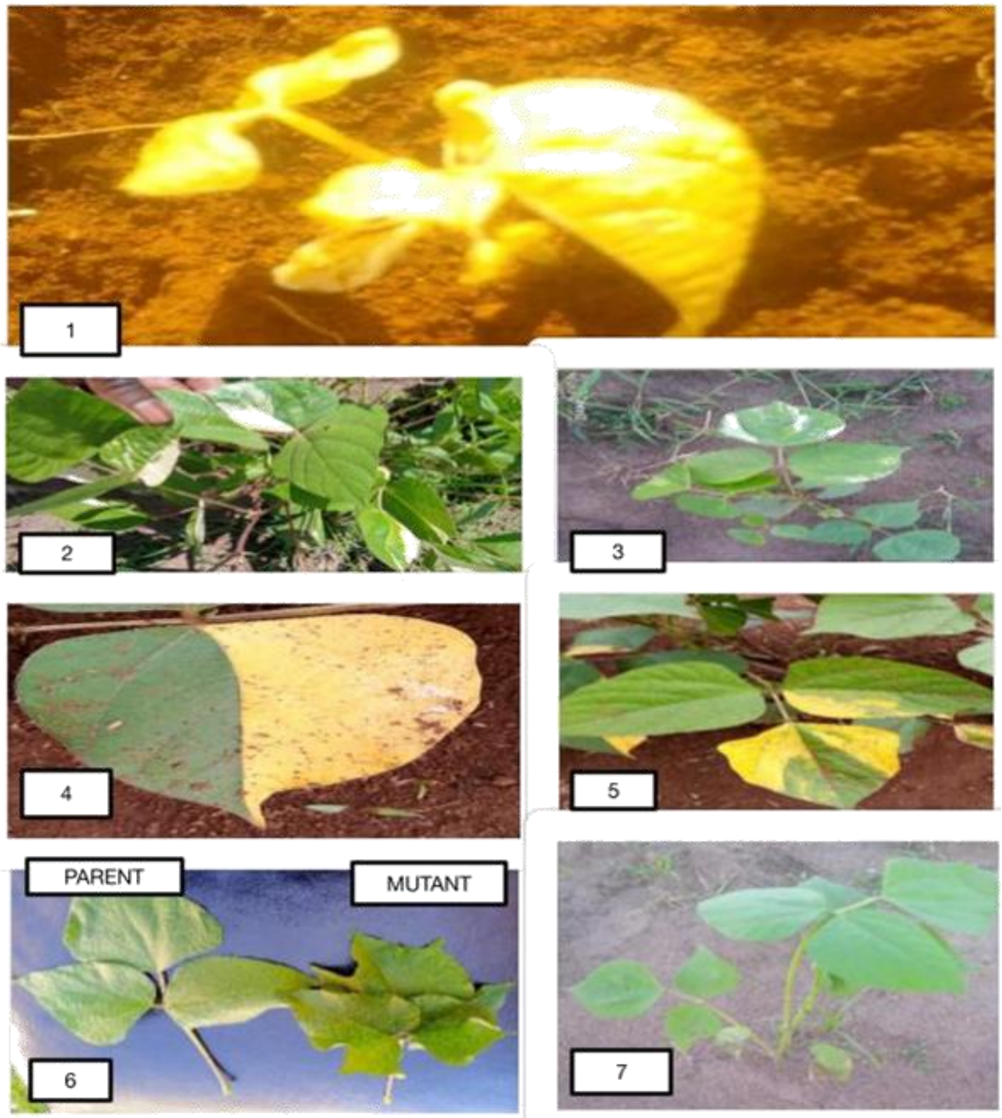

Fig. 4. Effect of gamma irradiation on dolichos lablab: 1 Albino seedling mutant; 2,3 white variegated mutant lablab; 4,5 yellow variegated leaf and leaflet; 6 Leaf of parent and mutant plant; 7 single stem plant

Fig. 5. (A-F): Variation in colour of seed in M2 mutant plants

The improved dry seed yield due to mutation at 300Gy in M5, W7 and G1 and at 400Gy in B1 within the dolichos lablab accessions is consistent with the findings of high yielding mutants that were isolated by in okra [21]. The frequencies leaf mutation resulting in variegated leaves of yellowing or white and lack of chlorophyll (albino) mutants also known as chlorophyll mutations were abundant in M5 and B1 irradiated genotypes at both doses of 300Gy and 400Gy. This chlorophyll mutations on this genotypes appeared on the first true leaves after seed germination can be used to monitor the effect of radiation on dolichos. Similar result of occurrence of chlorophyll mutations in Lentil and in Chickpea, Vicia beans [22]. It has aslo been documented on cowpeas varieties Konkan bhushan and Konkan Wal-2 varieties treated with various percent doses of chemical mutagen ethyl methane sulphonate (EMS) and SA and physical (Gamma rays- 5KR, 10KR, 15KR) [23,24,25,26]. It is cited that the *Lablab purpureus* is an all-around crop that would work impeccably in landscaping [5]. The variegated leaf, different flower bud colours, growth habit, leaf shape among the mutant accessions can serve beauty, edibility, functionality in the landscaping and other agroforestry services. Additionally, this study showed that there was change in seed shape and colour of the dry seed of the mutant accessions. This diversity is very important since such accessions can be used to further improve dolichos germplasm for food and sensory values. The creation of new phenotypes revealed the important roles of high doses of induced mutations in dolichos lablab breeding even among the same genotype of dolichos genotypes. The current study found that mutation treatment at 300 Gy and 400Gy on did not significantly affect G1 a part from germination percent [12,16] suggested the importance of carry out tests of radio sensitivity before actual research wok on mutation induction. Further radio sensitivity tests on G1 should be carried out to quantity mutation dose that can cause recognizable mutation effects on it. This will guide future researchers in the choice of optimal exposure dosage for the desired outcome.

The current study confirmed that doses 300 Gy and 400 Gy of gamma radiation applied on four different dolichos genotypes produced mutants with the new phenotypes that can be sources new perspective for breeding of dolichos lablab.

5. CONCLUSION

Dolichos lablab is an important multipurpose legume and induced mutation is a potential method for generating genetic diversity in it. From the results it was concluded that gamma irradiation by doses (300, 400 Gy) of were effective in improvement by increase of pod length, seed yield and reduction of plant height among other agronomic traits. These improvements in traits were accompanied with a marked phenotypic changes in leaf, flower colour and seed characteristics of the three out four dolichos genotypes under investigation. The dolichos mutants' accessions identified in this research are important for future work to plant breeders for further studies.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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